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Advancing Research in Uncertain Times

Can Canada break the glass ceiling in battling its productivity shortfall? Innovation experts are cautiously optimistic it can.

By Debbie Lawes

here's nothing like a pandemic and a looming recession to force governments to admit when they have a problem. That's what happened last April when Finance Minister Chrystia Freeland conceded in her 2022 Budget speech that Canada's chronic productivity shortage is "a well-known problem and an insidious one. It is time for Canada to tackle it."

It was the first time, perhaps ever, that a government has used such blunt and honest language to describe this country's poor innovation performance.

The numbers are stark. In 1996, Canada was ranked #1 compared to its peer countries in the United Nations Human Development Index which measures three dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. Today we sit at #16, despite being one of the top countries globally for K-12 and higher education.

"I was very optimistic after that budget because I thought we took the first important step which is to admit we have a problem," said Prof. Dan Breznitz, Co-Director of the Innovation Policy Lab at the University of Toronto.

That problem, according to Breznitz, is partly a policy one. While he credits Canada with doing well when it comes to national policies for science and technology, "where we have a complete failure is transferring any of this success into innovation or having a coherent, strategic, long-term innovation policy that is separate from research and development (R&D)"

"We're achieving that vision of a highly educated, democratic society and our science is world-class," said Breznitz.
"But we also want growth, productivity, higher wages and a greener economy which all depend on the business sector's utilization of that knowledge."

The 2022 budget included two big ticket measures to drive more investment in business R&D. The \$15-billion Canada Growth Fund is designed to attract \$45 billion in private capital to help Canadian businesses accelerate the adoption of green technologies.

Then there's the "operationally independent and market-oriented" \$1-billion Canadian Innovation and Investment Agency (CIIA). This yet-to-be-launched agency will reportedly have the flexibility to pilot new approaches to find out what works and what doesn't when it comes to incenting entrepreneurs to innovate.

Safeguarding Canadian IP

Breznitz's cautious optimism is shared by the Council of Canadian Innovators, which points to other promising signs of a shift to more innovation-friendly policies.

CCI President Benjamin Bergen said he's encouraged by the government's promise to review the scientific research and experimental development (SRED) tax credit, with an eye to streamlining and simplifying the program and helping Canadian companies generate and protect intellectual property (IP).

In particular, his business advocacy group wants an R&D tax credit that favours Canadian firms over foreign multinationals.

"About 50% of SRED goes to about 20 firms – the Ciscos and the IBMs here

Policy change is not enough if there is not a deep change in the ways Canadian businesses engage with knowledge and embrace innovation as their core global competitive strategy.

PROF. DAN BREZNITZ Co-Director, Innovation Policy Lab, University of Toronto

Breznitz, who advised Ottawa on the design of the CIIA, said there's "real promise" the new program will have the right personnel, budget and mission to experiment with new policies that can fix business innovation bottlenecks.

"It looks good on paper, but the real proof will be in the pudding and right now we're still waiting for the pudding."

But Breznitz cautioned that these new policies will have little effect unless companies change their behaviour.

"Policy change is not enough if there is not a deep change in the ways Canadian businesses engage with knowledge and embrace innovation as their core global competitive strategy. Innovation happens in the marketplace, which is where companies operate, not government." in Canada," he said. "That means the IP and wealth they generate ultimately flows out of the country." Instead, he said those tax credits should prioritize building homegrown companies that can compete globally and generate wealth and prosperity for Canada.

SRED's criteria were developed 37 years ago when companies invested in heavy machinery, not intangible assets like algorithms and software – the bedrocks of modern economies. As a result, Bergen said small companies are forced to hire expensive consultants to figure out how their R&D can qualify.

"It's estimated that about 20% of every SRED dollar goes to a consultant fee – 20% is a lot of money for a \$3.5-billion program," said Bergen.

The government did fulfill a key CCI

wish with the Global Skills Strategy which allows employers to process work permits for prospective international employees in as little as two weeks.

"About 40,000 highly skilled workers have moved to Canada under that program since 2018," said Bergen. "That's one good check mark for the government in fueling R&D."

Budget 2021 responded to another CCI recommendation with a \$90-million investment in ElevateIP, a national program to help Canadian companies – especially startups – generate, manage, protect and hold their IP. Canada still

Canada's Global Innovation Clusters program.

These trends include sustainability, disruptive technologies such as electrification, more personalized products, the shift from global to local supply chains, labour and skills shortages, and digitalization,

"It's no longer about getting a product out the door. It's about providing a solution for your customers, which means using data to create higher value products and services," he explained. "How you use that data is what's resulting in manufacturers becoming

About 40,000 highly skilled workers have moved to Canada under [the Global Skills Strategy] since 2018. That's one good check mark for the government in fueling R&D.

BENJAMIN BERGEN
President, Council of Canadian Innovators

isn't in the top 10 club for most innovative countries, but it shines in patent generation, ranking in the top five, according to the Bloomberg Innovation Index.

While ElevateIP is a good first step, Bergen said more needs to be done to ensure IP made in Canada stays in Canada, including a clear mandate for CIIA that treats data and IP as valuable strategic assets. He also wants our government to take a tougher stand in defending the IP of Canadian companies when they compete globally.

"A company like Samsung in South Korea is formidable because it has an entire state apparatus which helps protect that IP and defend it globally. You see the same thing in other countries," said Bergen.

Turning Manufacturers into Tech Companies

The shift from physical equipment to intangible assets such as data is driving transformations across many sectors. But the transition has been slow and difficult for a sector that generates 10% of Canada's GDP.

Manufacturers are operating in "volatile, uncertain, complex and ambitious times" driven by several megatrends affecting production, said Jayson Myers, CEO of Next Generation Manufacturing Canada (NGen), a not-for-profit organization funded under

more like tech companies and service companies."

NGen has recruited over 5,000 members to help build a national ecosystem that matches the needs of manufacturing companies with technologies being developed by universities, researchers, startups and other private sector organizations.

Myers said the sector's will to change is strong. Of the \$234 million NGen has invested in 167 projects, industry partners have contributed another \$371 million. One beneficiary of that support has

been Aspire Food Group, which has launched the world's largest, fully automated insect protein manufacturing plant. The London, ON company is a world leader in the commercial production and processing of crickets into nutritional ingredients for people, pets, and plants.

Aspire needed outside expertise to build its next-generation precision agricultural facility. To help, NGen approached DarwinAI, an innovative artificial intelligence (AI) company founded by four University of Waterloo engineering alumni.

That introduction led to NGen contributing \$17 million towards a \$73-million project that saw DarwinAI deploy its deep learning technology as an automated control system that analyzes data in real time from more than 5,000 sensors and

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Decoding the Cosmos

Building on our Nobel Prize-winning research in neutrino science, we're seeking to unlock the mysteries of the universe - from dark matter to anti-matter.

With experiments connecting experts across the globe, Queen's researchers are working in the world's most unique scientific facilities to investigate the biggest questions in astroparticle physics, cosmology, and astronomy.

Canada is leading galactic-sized science with global impact.



queensu.ca/impact2023



Neutrino detector at SNOLAB. Queen's Art of Research photo contest.

Leading research that addresses societal challenges

Top-Ranked



COVID-19 and mathematical modeling publications* (Canada)



Citation impact for health professions and nursing publications* (Canada)



Anxiety and mental health publications* (Canada)

*Based on recent Sci-Val metrics.

RIGHT

At York University we are conducting purposeful research to create positive change.

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PARTNER PERSPECTIVE



Amir Asif Vice-President Research & Innovation York University

he unexpected COVID-19 pandemic reminded us all that we live in uncertain times. Yet, despite challenges, York University persevered, not only delivering courses remotely but continuing to advance our research agenda by investing in innovative initiatives to drive positive change for our local and

global communities. The tenor of our times underscores the importance of making the world a better place to live. The University's current academic plan is centered around Building a Better Future. To work towards that goal, all of York's current endeavours are underpinned by our commitment to shared values, including the promotion of social justice, diversity, and the public good with an emphasis on contributing to the United Nations Sustainable Development Goals (SDGs). The SDGs help guide our research, connecting well with the university's reputation as a research leader that crosses disciplinary boundaries.

This January, York awarded \$4.05 million to 13 interdisciplinary research projects conducted by our Catalyzing Interdisciplinary Research Clusters (CIRCs). CIRC, now in its second year, fosters interdisciplinary collaboration, global research excellence and world-class training opportunities while supporting critical research to advance York's SDGs

The newly funded CIRCs

include projects that address

numerous SDGs, such as reduc-

ing inequality (Designing Sound

Advancing research in uncertain times

Futures: Inclusive Design and Transdisciplinary STEAM Learning); promoting good health and wellbeing (Overcoming Epidemics: Transnational Black Communities' Response, Recovery and Resilience); and sustaining clean water resources and security (Detection and Remediation of Water Contaminants).

Providing research opportunities for students is another way to advance York's research agenda. Students are our future, and we are committed to providing them with the knowledge and abilities that allow them to be impactful members of their communities and the world at large. For example, the Lassonde School of Engineering offers a summer research program that provides undergraduate students with experiential learning opportunities. Last summer, 90 students worked alongside Lassonde faculty on a variety of projects focusing on the SDGs. Raneem Ayoub contributed to Sustainable Cities and Communities by researching Dynamic Parking Pricing Using Real-Time Payment Data, while John Li Chen Hok explored Lead in Decentralized Drinking Water Systems to address clean water and sanitation.

Our undergraduate Liberal Arts & Professional Studies students can also engage in summer research as part of the DARE (Dean's Award for Research Excellence), which provides hands-on research opportunities and one-to-one mentoring. In 2022, 42 students were accepted into this competitive program. For instance, Kayla Saunders, a Gender & Women's Studies student, worked with Gail Vanstone,

an associate professor of humani-

ties, to produce an annotated

bibliography of Indigenous films

and writing created between 2000 and 2022.

In partnership with the Federation for the Humanities and Social Sciences, York University will host the 2023 Congress of the Humanities and Social Sciences, the largest academic gathering in Canada, and one of the largest in the world. Centered on the theme of Reckonings and Re-Imaginings, Congress brings together 8000 scholars, graduate students and practitioners representing 67 academic associations from humanities and social sciences disciplines.

As a research-intensive University, York is also committed to enhancing the health and well-being of the communities we serve. York's future vision includes a new medical school in the neighbouring City of Vaughan. Our outstanding health research currently spans all 11 Faculties and develops innovative approaches to solving pressing questions in health care, disease and injury prevention, and the digital delivery of health care.

The creation of a medical school will boost the University's strength in health research by providing real-world inspiration for cutting-edge new research and knowledge translation. Led by our 37 Research Chairs in Health, York has already seen strong growth in knowledge mobilization and technologytransfer in health-related areas with early and late-stage innovations in mobility technology; future opportunities beckon.

If we continue to invest in innovative research that addresses the problems of today and tomorrow. York will be able to lay claim to one of its catchphrases: Right the Future.





















































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Canada's **TOP 50 RESEARCH UNIVERSITIES 2022**

Ro	ınk		Sponsor	ed Research I	Researc	h Intensity			
			FY2021	FY2020	% Change 2020-	\$ per Faculty	\$ per Grad Student		
2021	2020	University	\$000	\$000	2021	\$000	\$000	Tier*	Prov
1	1	University of Toronto ⁺	\$1,461,571	\$1,234,278	18.4	\$531.1	\$71.0	М	ON
2	2	University of British Columbia	\$726,838	\$652,637	11.4	\$294.5	\$62.0	М	ВС
3	3	McGill University	\$687,413	\$628,642	9.3	\$372.8	\$69.4	М	QC
4	4	Université de Montréal	\$682,369	\$613,474	11.2	\$330.9	\$37.6	М	QC
5	6	University of Alberta	\$554,133	\$446,013	24.2	\$267.1	\$68.0	М	AB
6	7	Université Laval	\$515,077	\$426,628	20.7	\$322.9	\$43.0	М	QC
7	5	University of Calgary	\$504,480	\$457,296	10.3	\$333.2	\$74.1	М	AB
8	8	University of Ottawa	\$432,676	\$383,063	13.0	\$330.8	\$55.8	М	ON
9	9	McMaster University	\$374,609	\$353,530	6.0	\$419.0	\$74.2	М	ON
10	12	University of Saskatchewan	\$285,434	\$223,328	27.8	\$273.4	\$81.8	М	SK
11	10	Western University	\$264,426	\$230,407	14.8	\$174.5	\$39.2	М	ON
12	15	University of Manitoba	\$231,904	\$193,138	20.1	\$187.9	\$59.6	М	MB
13	11	Queen's University	\$227,337	\$228,092	-0.3	\$263.1	\$39.7	M	ON
14	13	University of Waterloo	\$221,029	\$211,213	4.6	\$179.8	\$35.3	С	ON
15	14	Université de Sherbrooke	\$207,332	\$205,176	1.1	\$166.3	\$20.6	М	QC
16	17	Dalhousie University	\$183,746	\$166,368	10.4	\$166.1	\$47.2	М	NS
17	18	University of Guelph	\$182,768	\$164,356	11.2	\$216.3	\$60.0	С	ON
18	19	Memorial University of Newfoundland	\$176,069	\$162,922	8.1	\$182.8	\$43.6	M	NL
19	16	Simon Fraser University	\$171,611	\$167,256	2.6	\$189.8	\$36.0	С	ВС
20	20	University of Victoria	\$123,708	\$124,972	-1.0	\$160.0	\$42.5	С	ВС
21	22	York University	\$105,541	\$100,416	5.1	\$75.2	\$16.8	С	ON
22	21	Toronto Metropolitan University	\$102,357	\$105,605	-3.1	\$111.5	\$33.8	С	ON
23	23	Carleton University	\$97,431	\$86,468	12.7	\$114.6	\$22.4	С	ON
24	24	Université du Québec à Montréal	\$88,212	\$83,567	5.6	\$79.5	\$10.5	С	QC
25	26	Concordia University	\$75,782	\$60,536	25.2	\$86.7	\$10.9	С	QC
26	25	Institut national de la recherche scientifique	\$69,829	\$66,280	5.4	\$453.4	\$102.7	S	QC
27	27	University of New Brunswick	\$55,666	\$50,609	10.0	\$122.1	\$35.2	C	NB
28	31	Université du Québec à Trois-Rivières	\$44,077	\$33,297	32.4	\$94.0	\$13.6	U	QC
29 30	29 30	École de technologie supérieure	\$37,733	\$35,570	6.1	\$186.8	\$16.6	S C	QC ON
31	32	University of Windsor Université du Québec à Rimouski	\$37,069 \$35,930	\$34,469 \$31,204	7.5 15.1	\$72.0 \$175.3	\$8.5 \$31.0	U	
32	33	University of Regina	\$33,930	\$28,027	11.5	\$72.2	\$14.9	U	QC SK
33	34	Université du Québec à Chicoutimi	\$29,054	\$26,745	8.6	\$115.3	\$15.3	U	QC
34	28	Laurentian University	\$25,238	\$37,794	-33.2	\$66.4	\$23.0	U	ON
35	35	Lakehead University	\$23,238	\$22,236	9.7	\$68.3	\$18.6	U	ON
36	36	Université du Québec en	Ψ2 1,373	\$22,230	7.7	\$00.5	\$10.0		011
	30	Abitibi-Témiscamingue	\$22,837	\$18,132	25.9	\$159.7	\$30.0	U	QC
37	38	Ontario Tech University	\$21,170	\$17,638	20.0	\$88.9	\$26.0	U	ON
38	39	Wilfrid Laurier University	\$20,813	\$16,926	23.0	\$38.8	\$8.6	U	ON
39	37	University of Lethbridge	\$18,184	\$17,911	1.5	\$52.0	\$26.2	U	AB
40	40	Brock University	\$16,561	\$15,592	6.2	\$29.8	\$8.8	U	ON
41	44	University of Winnipeg	\$15,419	\$13,169	17.1	\$52.6	\$59.5	U	МВ
42	41	University of Northern British Columbia	\$15,153	\$13,886	9.1	\$69.5	\$24.1	U	ВС
43	43	Trent University	\$13,838	\$13,532	2.3	\$52.2	\$19.8	U	ON
44	46	University of Prince Edward Island	\$12,875	\$10,987	17.2	\$46.0	\$26.8	U	PE
45	47	Saint Mary's University	\$12,340	\$10,103	22.1	\$48.6	\$21.2	U	NS
46	45	Université de Moncton	\$11,659	\$12,911	-9.7	\$34.9	\$18.9	U	NB
47	48	Université du Québec en Outaouais	\$11,434	\$9,411	21.5	\$46.7	\$8.1	U	QC
48	49	St. Francis Xavier University	\$8,031	\$6,727	19.4	\$31.4	\$13.7	U	NS
49	50	Acadia University	\$7,766	\$6,553	18.5	\$39.2	\$14.9	U	NS
50		Université TÉLUQ	\$6,757	\$4,538	48.9	\$75.1	\$6.0	U	QC

Ra

- 1. Sponsored research income includes all funds to support research received in the form
- of a grant, contribution or contract from all sources external to the institution.
- 2. Financial data were obtained from Statistics Canada. 3. Fiscal 2020 figures may have been adjusted as more accurate information became available.
- 4. Faculty headcounts for academic year 2020-2021 were used to calculate Research Intensity-\$ per Faculty. Includes full/part-time: full, associate and assistant ranks as provided/available. Data were obtained from Research Infosource's Canadian University R&D Database.
- 5. Graduate student enrollment headcounts for academic year 2020-2021 were used to calculate Research Intensity-\$ per Graduate Student. Includes full and part-time students enrolled in graduate level (master's and doctorate) programs and courses leading to degrees, certificates or diplomas. Excludes students enrolled in health-related internships/ residencies and first professional programs. Data were obtained from Maritime Provinces Higher Education Commission, Ministère de l'Éducation et de l'Enseignement supérieur,
- Ontario Ministry of Advanced Education and Skills Development, Manitoba Advanced Learning Division, Alberta Advanced Education, BC HEADSet and some individual universities.
- applicable. 7. All main institutions are members of the Canadian Association of University Business Officers (CAUBO)

6. All data are provided for the main university including its affiliated institutions, where

*Tier: M - Medical, C - Comprehensive, U - Undergraduate, S - Specialized (not full-service) ⁺Sponsored research income administered by affiliated hospitals was reported one fiscal year

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Research Universities of the Year 2022

Three universities gain Research Infosource's designation of Research University of the Year in their category for their performance on a balanced set of input and output measures. These full-service universities demonstrated superior performance on key measures of research success.

ank	Medical	Score*		lical Score* Rank Comprehensive		Comprehensive	Score*	Rank	Undergraduate	
1	University of Toronto	99.6	1	University of Waterloo	92.3	1	Université du Qu Rimouski			
2	McGill University	66.5	2	University of Guelph	84.9	2	Ontario Tech Unive			
3	McMaster University	64.5	3	Simon Fraser University	73.0	3	University of Regina			

1	Université du Québec à Rimouski	75.2
2	Ontario Tech University	74.4
3	University of Regina	72.9

Score*

*The score in each category is out of a possible 100 points based on the following measures and weighting: total sponsored research income (20%), research intensity per faculty (20%), research intensity per graduate student (10%), total number of publications in leading journals (20%), publication intensity (20%) and publication impact (10%). For each measure, the top ranking institution is assigned a score of 100 and the other institutions' scores are calculated as a percentage of the first ranked institution. To be eligible to be included in the Research Universities of the Year Tier rankings, full-service universities must have ranked in the top 50% in their respective tier for 5 out of 6 measures. See www.researchinfosource.com for details.

\$000

\$81.8

\$74.2

\$74.1

\$54.5

\$000

\$60.0

\$42.5

\$36.0

\$24.3

\$000

\$59.5

\$31.0

\$30.0

\$16.7

CANADA'S TOP 50

Research Universities

Research Income Soars

Research income at Canada's Top 50 Research Universities advanced by 12.4% to a combined \$9.29 billion in Fiscal 2021, quadrupling the 3.0% gain made in Fiscal 2020. Research income expanded at 45 universities and declined at only 5 others. Pandemic related research income started to flow through the universities in this fiscal year. In Fiscal 2021, average faculty research intensity - research income per faculty member - was \$226,200, a considerable increase of 11.1% over Fiscal 2020. Graduate student research intensity research income per graduate student – was \$42,800, increasing by 9.6% over the period.

The Fiscal 2021 result was mainly due to a substantial increase in Total Federal Government funding (\$4.77 billion, up 21.5%). Research funding expanded at SSHRC (\$461.8 million, up 40.0%), NSERC (\$1.05 billion, up 20.4%) and CIHR (\$1.17 billion, up 20.3%). However, funds received from CFI dropped over this period (down -4.9%). Research funding from Not-for-Profit sources increased overall by 5.8%, while Corporate funding was disappointing with a substantive decrease of -4.1% between Fiscal 2020 and Fiscal 2021.

\$100 Million Club

Research Infosource salutes 22 universities that gained membership in the prestigious \$100 Million Club - institutions that attracted \$100 million or more of research income in Fiscal 2021. Club members had a combined research income gain of 12.6%, slightly above the national level, and represented 91% of the total.

University Tiers

Sixteen Medical institutions posted a total of \$7.52 billion of combined research income which was

Top 50 – Leading Provinces				
Province	% of Total			
Ontario (17)	39			
Quebec (14)	27			
Alberta (3)	12			
British Columbia (4)	11			

Simon Fraser University

University of Waterloo

University of Guelph

Tier Average (11)

Undergraduate

Tier Average (19)

Lakehead University

Université de Moncton

Université du Québec à Trois-Rivières

Rank

81% of the Top 50 research income total, and a gain of 13.8% over Fiscal 2020. Eleven Comprehensive universities posted \$1.26 billion of research income, a rise of 6.0%, and accounted for 14% of all university research income. Twenty-one Undergraduate institutions reported a gain of 10.2% in research income, to \$404.8 million, which was 4% of the total.

The top universities in each tier as measured by research income were: University of Toronto (Medical tier, \$1.46 billion, 1st place overall), University of Waterloo (Comprehensive tier, \$221.0 million, 14th overall) and Université du Québec à Trois-Rivières (Undergraduate tier, \$44.1 million, 28th overall).

Research Income Growth

In Fiscal 2021 almost half the universities (21) exceed the national 12.4% research income growth. The Medical tier growth leader standout was University of Saskatchewan (27.8%). Concordia University led the Comprehensive tier (25.2%) and Université TÉLUQ was the Undergraduate tier and overall growth leader, (48.9%).

Faculty Research Intensity

Fiscal 2021 faculty research intensity - research income per faculty position - was \$226,200 overall, compared with \$203,600 in Fiscal 2020. The leading full-service university winners included: University of Toronto (Medical), which topped the ranking for faculty research intensity (\$531,100 of research income per faculty) and was joined by other tier leaders University of Guelph (Comprehensive, \$216,300) and Université du Québec à Rimouski (Undergraduate, \$175,300).

Graduate Student Research Intensity

Graduate student research intensity - research income per graduate student - averaged \$42,800 in Fiscal 2021, compared to \$39,000 over Fiscal 2020. Top winners by category were: University of Saskatchewan (Medical tier \$81,800 research income per graduate student), University of Guelph (Comprehensive tier, \$60,000) and University of Winnipeg (Undergraduate tier, \$59,500).

Provincial Performance

In Fiscal 2021, 17 Ontario universities attracted 39% (\$3.63 billion) of the national research income

Research Income Growth (% Change FY2020-FY2021) Research Income Medical \$000 **University of Saskatchewan** \$1,461,571 University of British Columbia University of Alberta 2 \$726,838 2 24.2 \$687,413 McGill University 3 Université Laval 20.7 Tier Average (16) Tier Average (16) \$469,713 13.8 Comprehensive \$000 Rank Comprehensive % **University of Waterloo** \$221,029 **Concordia University** 25.2 University of Guelph \$182,768 Carleton University 2 2 12.7 Simon Fraser University \$171,611 University of Guelph 11.2 Tier Average (11) Tier Average (11) \$114,652 Undergraduate \$000 Rank Undergraduate % Université du Québec à **Université TÉLUQ** 48.9 Université du Québec à Trois-Rivières Trois-Rivières \$44,077 32.4 Université du Ouébec à Rimouski \$35,930 Université du Québec en University of Regina \$31,259 Abitibi-Témiscamingue 25.9 Tier Average (21) \$19,276 Tier Average (21) 10.2 duate Student Research Intensity

Medical

University of Saskatchewan

McMaster University

University of Calgary

Tier Average (16)

Comprehensive

University of Guelph

Simon Fraser University

University of Winnipeg

Université du Québec en

Abitibi-Témiscamingue

Tier Average (21)

Université du Ouébec à Rimouski

University of Victoria

Tier Average (11)

Undergraduate

Top Universities by Tier FY2021

Faculty (\$ per Fa	y Research Intensity culty)		Gra (\$ per
Rank	Medical	\$000	Ran
1	University of Toronto	\$531.1	1
2	McMaster University	\$419.0	2
3	McGill University	\$372.8	3
	Tier Average (16)	\$306.9	
Rank	Comprehensive	\$000	Ran
1	University of Guelph	\$216.3	1
2	Simon Fraser University	\$189.8	2
3	University of Waterloo	\$179.8	3
	Tier Average (11)	\$127.7	
Rank	Undergraduate	\$000	Ran
1	Université du Québec à Rimouski	\$175.3	1
2	Université du Québec en		2
	Abitibi-Témiscamingue	\$159.7	3
3	Université du Québec à Chicoutimi	\$115.3	

Note: Based on full-service universities on the 2022 Top 50 Research Universities list.

\$63.7

25.2

16.7

15.0

-6.6

%

total. Quebec's 14 institutions garnered 27% (\$2.51 billion) of the Top 50 total, unchanged from Fiscal 2020. Three Alberta universities had 12% of research income (\$1.08 billion), up from 11% of the total in Fiscal 2020. British Columbia's 4 institutions attracted 11% of all research income (\$1.04 billion), down from 12% in Fiscal 2020.

Corporate and Not-for-Profit Research Income

Corporate Research Income Growth

University of Saskatchewan

Memorial University of Newfoundland

University of Manitoba

Tier Average (16)

(% Change FY2020-FY2021)

Medical

Rank

Tier Average (21)

In Fiscal 2021, Top 50 research income from Corporate sources totaled \$1.10 billion (down -4.1%), accounting for 12% of total university research income. University of Toronto reported the highest Corporate research income among its Medical peers (\$156.6 million), while University of Waterloo led the Comprehensive category (\$25.8 million) and Université du Québec en Abitibi-Témiscamingue (\$8.4 million) led the Undergraduate tier.

Not-for-Profit research income was \$1.63 billion in Fiscal 2021 (up 5.8%), accounting for 18% of the total. The top tier leaders for Not-for-Profit research income were: University of Toronto (Medical, \$464.8 million), Simon Fraser University (Comprehensive, \$24.9 million) and Lakehead University (Undergraduate, \$6.1 million).

Corporate and Not-for-Profit Research Income by Tier FY2021

Corpo	rate Research Income			rate Research Income as % of University Research Income
Rank	Medical	\$000	Rank	Medical
1	University of Toronto	\$156,597	1	Memorial University of Newfound
2	University of British Columbia	\$80,049	2	Queen's University
3	McMaster University	\$78,499	3	McMaster University
	Tier Average (16)	\$50,355		Tier Average (16)
Rank	Comprehensive	\$000	Rank	Comprehensive
1	University of Waterloo	\$25,776	1	University of Waterloo
2	University of Guelph	\$18,032	2	University of Guelph
3	University of Victoria	\$8,531	3	Université du Québec à Montréal
	Tier Average (11)	\$8,923		Tier Average (11)
Rank	Undergraduate	\$000	Rank	Undergraduate
1	Université du Québec en		1	Université du Québec en
	Abitibi-Témiscamingue	\$8,438		Abitibi-Témiscamingue
2	Université du Québec à Chicoutimi	\$6,875	2	Acadia University
3	Ontario Tech University	\$5,465	3	Ontario Tech University
	Tier Average (21)	\$1,925		Tier Average (21)
Not-fo	or-Profit Research Income		1	or-Profit Research Income as ^c University Research Income
Rank	Medical	\$000	Rank	Medical
1	University of Toronto	\$464,830	1	University of Manitoba
2	Université de Montréal	\$101,135	2	University of Toronto
3	McGill University	\$101,135	3	Université de Sherbrooke
3	Tier Average (16)	\$79,477		Tier Average (16)
Rank	Comprehensive	\$000	Rank	Comprehensive
			4	

\$24,867

\$19,795

\$13,122

\$9,985

\$000

\$6,092

\$5,242

\$3,255

\$1,897

% Comprehensive 11.7 **University of Victoria** 247.6 Toronto Metropolitan University 9.9 2 117.0 Carleton University 9.0 Tier Average (11) 7.8 % Rank Undergraduate Université du Québec en Outaouais 241.9 36.9 University of Lethbridge 237.5 29.8 Université de Moncton 196.1 25.8 10.5 Tier Average (20) 10.0

27.5

21.0

10.7

for-Profit Research Income as %	of	Not-fo	or-Profit
l University Research Income		(% Cha	nge FY2020
Medical	%	Rank	Medical
University of Manitoha	22 4	1	Universi

_	0	5
3	Université de Sherbrooke	18.6
	Tier Average (16)	16.9
Rank	Comprehensive	%
1	University of Windsor	14.5
2	Simon Fraser University	14.5
3	University of New Brunswick	14.5
	Tier Average (11)	8.7
Rank	Undergraduate	%
1	Université de Moncton	27.9
2	Lakehead University	25.0
3	University of Prince Edward Island	18.0
	Tier Average (19)	9.4

Based on full-service universities on the 2022 Top 50 Research Universities list, and reported research income from corporate and not-for-profit sources in the form of a grant or contract in Fiscal 2021.

Rank	Medical	%
1	University of Toronto	36.7
2	Queen's University	29.2
3	University of Manitoba	10.2
	Tier Average (16)	6.9
Rank	Comprehensive	%
1	University of Guelph	45.9
2	Carleton University	37.3
3	Toronto Metropolitan University	36.3
	Tier Average (11)	-0.2
Rank	Undergraduate	%
1	Saint Mary's University	68.0
2	Wilfrid Laurier University	41.1
3	Université du Québec en	
	Abitibi-Témiscamingue	37.9
	Tier Average (19)	1.8

Research Income Growth

Research Universities of the Year

Research Infosource has designated 3 institutions as Research Universities of the Year 2022 in their respective categories: University of Toronto (Medical), University of Waterloo (Comprehensive) and Université du Québec à Rimouski (Undergraduate). These institutions demonstrated superior performance on key measures of research success.

This Year and Next

Fiscal 2021 was an all-hands-on-deck period for university research. Governments around the world were scrambling for answers about the COVID-19 pandemic across all research domains - health, science, human behavior, etc. New funds were rapidly made available to fill knowledge gaps and the university research community responded.

Last year we said "One thing that COVID-19 has assuredly done is to reinforce the notion that a strong base of science - basic and applied - is absolutely critical for society to swiftly respond to emerging challenges". Fiscal 2021 proved the point.

Amidst the rapid growth of Federal government research funding (up 21.5%), Corporate support for university research was a discordant note, falling by -4.1%. We will have to see whether this is a temporary development or part of a longer term trend.

As for next year, a sense of COVID-19-fueled urgency has somewhat abated, but the need for additional knowledge that only science and research can supply remains. The research community is ready to respond. What direction will research funding take?





Making Canada a leader in RNA medicine

RNA research is rapidly making better treatments possible for a range of health challenges, including cancer and rare diseases.

Discover how McGill and its partners are leading the RNA revolution:



Made by collaboration





INVITED EDITORIAL

YOU+WATERLOO



Dave Tucker Assistant Vice-President, Research (Nuclear) McMaster University

s Canada looks toward a low-carbon future, there an urgent need for clean energy solutions that will help us achieve Net Zero. Experts at McMaster University are paving a path for a new class of nuclear reactor that has the potential to transform clean energy production in Canada and around the world.

McMaster is known for its excellence in nuclear research and innovation. Home to a unique by the McMaster Nuclear Reactor, the University has been pioneer-

ing advances in nuclear energy, medicine, materials and environmental science for over 60 years. And now, McMaster is ready to lead an exciting new chapter of nuclear research and innovation centred around the Small Modular Small modular reactors

(SMRs) are a fraction of the size of power reactors providing clean, safe and reliable energy powered by nuclear fission. They're ideal for installation in remote communities and on industrial sites; their components are pre-manufactured and then installed on-site and they are more cost- and time-effective than custom-building a nuclear reactor for a particular location.

Plan, which recognized the potential economic, geopolitical, social and environmental benefits of SMRs. Importantly, Canada's first SMR will be deployed at Chalk River Laboratories later this decade. However, if Canada is to realize the full benefits of this technology, we need to make a critical step from SMR demonstrations at large nuclear sites like Chalk River, to deployments that demonstrate how SMRs can power communities in transformative ways. That's where McMaster comes in.

McMaster's contribution to Canada's SMR Action Plan outlined our vision to explore the feasibility of hosting an SMR. Now, in partnership with Ultra Safe Nuclear Corporation and in-the-world project as a key resource and demonstration centre to showcase the transformative power of clean, reliable, abundant energy for small communities - and McMaster has everything required to make this vision a reality.

Powering a community of the future

at Canada's nuclear university

We have training and education programs for the next generation of nuclear professionals that will design, build, operate and regulate SMR technology in Canada. Engineering physics professor and nuclear safety expert, David Novog, is leading McMaster's Small Modular Advanced Reactor Training Program, designed to train future leaders in SMR design, safety and deployment.

We have specialized research programs and facilities and inter-

In 2020, the Canadian govern- Global First Power, we'll inves- nationally recognized experts in at the core of our SMR feasisuite of nuclear facilities anchored ment released its SMR Action tigate the potential of a first- nuclear safety, nuclear materi- bility study. We will work with als, health physics and nuclear waste management. Jim Cotton, mechanical engineering professor and energy systems expert is developing an Integrated Community Energy and Harvesting (ICE-Harvest) system that could be integrated with SMRs to create a truly carbon neutral energy pro-

Waterloo is on it.

uwaterloo.ca/on-it

duction and utilization system. Most importantly, McMaster has six decades of expertise in safely operating a 5 MW research reactor at the heart of our campus community. We've harnessed its energy to drive knowledge creation, nuclear outreach and education, medical isotope production and tremendous economic benefits for our region, province and country.

Canadian communities are

our partners in Indigenous and remote northern communities to guide our research as we collectively consider how SMRs might power remote communities and improve access to energyintensive technologies like water purification and desalination.

As Canada's Nuclear University, McMaster has a responsibility to contribute our expertise to support the country's clean energy needs. Our vision will facilitate unique educational programs and the creation of high-quality jobs in nuclear science and engineering. We have the potential to be the go-to site for communities across Canada - and around the world - to explore, first-hand, the potential of SMRs for Canada's sustainable future.



LEADERS' CORNER



After three years in a row at the top of the rankings, we can affirm that Cégep de Trois-Rivières has reached a sustainable position of leadership in applied research. This consecration is the result of the remarkable work of our three CCTT's and their teams. Their dedication, passion and expertise provide concrete solutions to the challenges of our time.

Louis Gendron Directeur général Cégep de Trois-Rivières



eCampusOntario is thrilled to support collaborative innovation partnerships between Ontario businesses and the province's colleges, universities and Indigenous Institutes.

The Ontario Collaborative Innovation Platform (OCIP) helps businesses remain at the forefront of their sector while giving students valuable work experiences, ensuring Ontario's innovation capacity is stronger for tomorrow.

Dr. Robert Luke
Chief Executive Officer
eCampusOntario



The University of Alberta is a place where ideas collide. From advancing solutions in energy, climate transition and food sustainability to forging new paths in artificial intelligence, health and Indigenous leadership, our expertise is being brought to bear on today's most pressing global issues. United with partners in industry, academia and government, we are looking to the future – and leading with purpose.

Aminah Robinson Fayek

Vice-President, Research and Innovation

University of Alberta



By building on our research expertise and strategic priorities, universities continue to demonstrate their ability to be innovative as we adapt to changing conditions.

Toronto Metropolitan University researchers are committed to identifying and accelerating research to meet pressing societal challenges. Together with our partners, we are driving innovation in critical areas such as health, community engagement and biomedical advances.

Dr. Steven N. Liss Vice-President, Research and Innovation Toronto Metropolitan University



Thanks to the innovative spirit of McMaster's research community, our work continues to have significant influence and impact at home and around the world. We're mobilizing our knowledge to inform public policies and decision-making and creating spin-off companies to ensure Canada's competitiveness and stature on the global stage.

Karen Mossman

Vice-President, Research



A world-leading university, McGill continues to set audacious goals and accelerate discovery through investments in fundamental research and innovation. A revolution in RNA medicine is on the horizon. Together with community and industry partners, McGill aspires to create an inclusive and healthier future for all.

Martha Crago

Vice-Principal, Research and Innovation

McGill University



University of Manitoba researchers are addressing critical issues facing our society and world today. From food and water insecurity, climate action, and Indigenous Reconciliation, to health as a human right – our impacts multiply when research creates opportunities for us all to reach our full potential.

B. Mario Pinto, PhD, FRSC

Vice-President (Research & International)

University of Manitoba



Innovative. Dedicated. Resilient. This is Queen's research. Our community is fueled by a passion to find solutions for the world's greatest challenges – from understanding the building blocks of the universe, to advancing a low-carbon future, and improving health outcomes. We're working to build a sustainable, healthy, and technologically advanced Canada.

Dr. Nancy Ross

Vice-Principal Research
Queen's University



Since its outset, the University of Waterloo has fostered an ecosystem of curiosity and discovery across our disciplines that has led to innovation that is helping shape a better world. We continue to seek out solutions to the challenges facing humanity, today and into the future.

Vivek Goel, CM

President and Vice-Chancellor

University of Waterloo



Good health is our single most important asset. Canada urgently needs cutting-edge research and innovation infrastructure. The new Advanced Medical Research Centre at the University of Ottawa will connect government, academia, industry, and hospitals. It will attract new talent and fuel long-term economic growth by facilitating the commercialization of discoveries in a rapidly growing sector.

Sylvain Charbonneau Vice-President, Research and Innovation University of Ottawa



Accelerating the transition path from research to commercialization is a core contributor to Canada's competitiveness and colleges are well positioned to help with this critical path. As a top ranked research college, Lambton is supporting industry with this transition in the areas of Materials, Energy, Water, IT, Manufacturing and Biotechnology.

Dr. Mehdi Sheikhzadeh

Vice-President, Research & Innovation



INRS is the university of choice for partnerships and the training of scientific leaders. Over the years, our ranking confirms the relevance of INRS' unique model: an institution dedicated to research and training, taking on strategic challenges, while contributing to the economic, social, and cultural development of our society.

Claude Guertin

Scientific Director

Scientific Director Institut national de la recherche scientifique (INRS)



Research, innovation, and entrepreneurship continue to thrive at Sheridan, as we further our commitment to drive meaningful impact for our partners and the communities we serve. Sheridan's number one ranking in research partnerships and industry research income reflects our researchers' unmatched capacity to contribute to Canadian innovation through purposeful collaboration.

Andrea England

Vice Provost, Research

Vice Provost, Researd Sheridan College



As one of Canada's fastest-growing researchintensive universities, we are extremely proud of Carleton's continuing rise in research funding. Carleton's proven leadership in research areas such as sustainability and health and wellness are providing impacts that promise lasting, societal benefits to all Canadians for years to come. Rafik Goubran

Vice-President (Research and International)
Carleton University



Ontario Tech University is delighted to be again designated one of Canada's Research Universities of the Year. We have built world class core research facilities and a dynamic research community over the past two decades. New research milestones in 2022 include Project Arrow, the establishment of Canada's UN International Atomic Energy Agency Collaborating Centre, and the Brilliant Energy Institute Sion Laboratories.

Prof. Les Jacobs, PhD, FRSC Vice-President, Research & Innovation Ontario Tech University



York University is a leading international teaching and research university, and a driving force for positive change. York's 11 Faculties and Professional Schools conduct ambitious and groundbreaking interdisciplinary research that cuts across traditional academic boundaries, including areas such as global health, vision science, disaster risk management, liberal arts and social justice, and space exploration.

Vice-President Research & Innovation York University

transition.

COVER STORY

Advancing Research in Uncertain Times

McMaster University

Continued from page 1

other industrial Internet of IOT (Internet of Things) devices. The system provides around-the-clock, high-throughput agricultural production that would not be possible with human operators.

"That project was later recognized by the United Nations as one of the top 10 AI applications in the world to advance the UN's Sustainable Development Goals," said Myers.

Decarbonizing Heavy Industry

There is no one solution to decarbonizing heavy emitting industries such as cement, steel aluminum, and mining. Yet that's what is needed for Canada to meet its ambitious commitment to cut greenhouse gas (GHG) emissions by at least 40-45% below 2005 levels by 2030,

and achieve net-zero emissions by 2050.

The intergovernmental International Energy Agency has made clear that these net-zero goals will become virtually impossible to meet without carbon capture, utilization and storage (CCUS).

The federal government and the Cement Association of Canada recently released a roadmap detailing how Canada can eliminate 15 megatonnes of CO₂ by 2030 by adopting CCUS technologies.

CarbonCure Technologies is one of the companies helping Canada meet that target. The Dartmouth, NS firm received support from the National Research Council of Canada's Industrial Research Assistance Program more than a decade ago to scale up a technology capable of mineralizing and storing carbon dioxide in ready mixed or manufactured concrete. Its technologies are being used in hundreds of concrete production plants across 30 countries, generating over 230,000 tons of CO₂ savings to date.

"They are able to reduce emissions in the cement sector, capture the CO₂ and put it back into the cement itself to make it stronger," said Catherine Stewart, Canada's Ambassador for Climate Change.

The government has also developed a Federal GHG Offset System, which includes measures to make it easier for Indigenous communities to develop nature-based offset projects that reduce or remove GHGs from the atmosphere.

Lambton College

ing Indigenous communities in transitioning to a clean energy future.

The program provided \$4.5 million toward building an Indigenous-owned 2.2-megawatt solar energy and energy storage project in Fort Chipewyan, northern Alberta. It will produce 20% of the

community's electricity.

Indigenous Natural Resource Partner-

ships is another federal program support-

emissions, as well as a new investment

tax credit for CCUS projects announced

in the Fall 2022 Economic Statement.

Our first applied research centres were created 40 years ago because there was a need for research close to where

[small- and medium-sized enterprises] were located.

MARIE GAGNÉ

CEO, Synchronex College Centres for the Transfer of Technology (CCTT) Network, Quebec

Similar advances are happening to eliminate GHGs from aluminum production.

"Alcoa and Rio Tinto Alcan, for example, are working hard on that, supported by the governments of Canada and Quebec. Those are sectors where low carbon innovation is already happening and it's just giving some funding to help support that," she said.

The public side of that funding is from programs such as the \$2-billion Low Carbon Economy Fund, and the \$8-billion Net-Zero Accelerator which aims to help large emitters reduce their

"It's the largest solar off-grid project in Canada," said Stewart, "and an example of a project which directly has the participation of the Indigenous communities and organizations."

The Innovation-Boosting Power Of Colleges

Power Of Colleges
Many companies, especially small ones, don't have the time, resources and money to conduct R&D that helps them improve their processes, products or practices. It's why a growing number of firms are partnering with local

colleges, including the College Centres

for the Transfer of Technology (CCTT) in Quebec, the innovation centres of

CÉGEPs and colleges.

Micro Thermo Technologies was one of the first. It partnered with the Centre for Innovation in Microelectronics of Quebec (CIMEQ) more than 30 years ago when it was just a three employee microbusiness specializing in energy control systems for supermarket freezers.

CIMEQ worked with the company to establish a network of distributed intelligence that served not only the freezer sensors, but electrical equipment of any kind. Micro Thermo eventually grew to have a full R&D department, helping large clients like Costco be more efficient with their energy management.

"Quebec was the first province to use colleges to work with companies, mainly small- and medium-sized enterprises (SMEs). Our first applied research centres were created 40 years ago because there was a need for research close to where the SMEs were located," said Marie Gagné, CEO of the Synchronex CCTT Network.

The 59 CCTTs draw on a provincewide network of some 2,400 experts in innovation and applied research to collaborate with about 6,000 companies, mostly SMEs, on more than 11,000 projects each year.

"They may want to increase productivity or develop a new product or have a problem with a manufacturing process, so they call the CCTT. That's usually how a relationship between a CCTT and a company starts, and in many cases those relationships become long-term,"

said Gagné.

Companies often work with multiple centres that specialize in a certain field, such as energy management and

agriculture. In September, Synchronex unveiled a new platform – Mon succès numérique (My Digital Success) – which brings together experts from AI, cybersecurity, data science, robotics and other fields from 14 CCTTs to guide companies through a successful digital

The new service, which Gagné describes as "easily accessible and very fast", matches company needs with the right technology centre or centres.

Another 11 CCTTs specialize in the

transfer of innovative social practices.

"This includes looking at how we can better integrate immigrants or people who have disabilities into our workforce," she added, "or how we address the social side of agriculture or the social side of sustainable development."

Matching Companies with Academic Expertise

Too few small companies do the R&D that's essential to their survival and growth. An Ontario-funded consortium of 53 colleges, universities and Indigenous institutes is working to change that by helping SMEs become more productive and competitive through the adoption of new technologies like AI, machine learning and automation.

eCampusOntario was created in 2015 as a portal for learners, including entrepreneurs, with a mandate to support innovation, collaboration and education excellence. Access is provided to thousands of online courses and programs offered by anybody in Ontario in the publicly funded postsecondary sector.

"We provide the largest open library of educational resources for people to

Continued on page 8



Welcome to transformative research

At the University of Ottawa, we're reimagining a better world and daring to make it a reality.

Fuelling innovation and improving patient care by bringing scientists, government and business under one roof.

Developing responsible artificial intelligence applications by better understanding their societal, educational, ethical and legal implications.

Tackling cyber-threats by developing technology, legal frameworks and training strategies.

This is optimism at work.



Explore our impact and discoveries

PARTNER PERSPECTIVE



Dr. Kathy Lewis Interim Vice-President, Research and Innovation University of Northern British Columbia

a research-intensive institution with a focus on innovation and community connections, the University of Northern British Columbia is uniquely positioned to address some of the most pressing challenges facing society.

Located in the spectacular landscape of northern B.C., our proximity to natural resources and distance from large, urban centres

The real-world impact of research at UNBC

communities, sustainable resource development, energy production and export, climate change, the availability of fresh water and

support this, UNBC researchers have formed partnerships with community groups, industry leaders and government agencies with the goal of transforming the quality of life in northern B.C. and beyond. These partnerships ensure this new knowledge is mobilized and the positive impacts of our research extend beyond our campus to the global community.

For the third year in a row, the University of Northern British Columbia increased its research funding to ensure the crucial work of examining these pressing issues

provide unique opportunities to continues. UNBC's total research research programs focus on test- \$1.9 million in funding to support est overall total since 2010. In table access to technology for addition, UNBC is first among universities in its tier for the percentage of funding from the Canadian Institutes of Health Research (CIHR).

And the results of research and partnerships at UNBC inform real-world change – for example:

• UNBC is the host institution for the Centre for Technology Adoption for Aging in the North (CTAAN), an AGE-WELL National Innovation Hub. CTAAN supports aging in northern and rural communities by making technologies more available to older adults, caregivers and the healthcare systems that support them. The Centre's

nology solutions to provide equiquality aging.

• The National Collaborating Centre for Indigenous Health and the Health Arts Research Centre, both housed at UNBC, have received \$1 million in federal funding to collaborate on a project focused on promoting cultural safety and Indigenous knowledge in health care. The Hearts-based Education and Anticolonial Learning (HEAL) initiative is anchored in training and educating healthcare students and professionals to create better outcomes for Indigenous people.

• The Pacific Economic Development Agency of Canada provided

research issues surrounding health income rose to \$15.2 million in ing, piloting, implementing and the establishment of the new Envicare, Indigenous peoples and 2022, a 9.1 per cent increase from promoting new and existing tech-ronmental Solutions Innovation turbances on streamflow and river Hub at UNBC. The hub, housed in the Northern Analytical Laboratory Services lab, has facilitated the procurement of personnel and the advanced analytical equipment needed to meet an ever-expanding demand from local and regional natural resource-based firms to perform chemical and analytical work leading to environmental

> · An international team of scientists used a supercomputer at UNBC to calibrate their findings in their ongoing efforts to study the impact of climate change on glaciers in Western Canada and around the world. The computer, jointly funded by UNBC and the Tula Foundation, allowed researchers to analyze more than

440,000 satellite images and construct digital elevation models to calibrate their projections.

 New research underway at UNBC looks to advance the development of hydrological forecast systems and quantify the impact of climate change and forest diswater temperatures across several watersheds in northern British Columbia. An Environmental Science research team has received Discovery Grant funding from the Natural Sciences and Engineering Research Council of Canada to fund five interrelated projects with the overarching goal of designing an improved hydrological prediction system hoped to increase Canada's capacity in reliable river streamflow forecasts.

At UNBC, we are proud of the positive impact our research has the region we serve, and we will continue to push the boundaries of knowledge and innovation to make meaningful differences in our Province, Canada, and the





Improving survival rates for mothers and infants will transform the lives of millions

University of Manitoba's researchers are improving health outcomes here at home and around the world.

As part of a strategic program in population and global health, Dr. Meghan Azad is reimagining breast milk research in Manitoba and breaking the barriers of social inequity new moms and infants can face that lead to chronic disease.

Dr. James Blanchard is transforming health education, care and systems to dramatically increase maternal and newborn survival rates in Uttar Pradesh, India.

Their groundbreaking work, supported by the Bill & Melinda Gates Foundation, propels us closer to ensuring each new life can reach its full potential.

University of Manitoba

WHAT INSPIRES YOU CAN CHANGE EVERYTHING.

COVER STORY

Advancing Research in Uncertain Times

Continued from page 6

use. Reusing open educational resources is one way to reduce costs for learners to engage in collaborative creation of content," said Robert Luke, CEO, eCampus Ontario.

The consortium is also responding to a growing demand for micro-credentials, which are available online "to anybody who wants to take them, any learner, any company, anyone," he added. "Companies, for example, can get access to justin-time workforce training their employees might need."

eCampusOntario's newest initiative launched in December. The Ontario Collaborative Innovation Platform (OCIP) received \$4 million in provincial funding to scale up an online portal that matches industry professionals with a research expert, facilities and funding.

USherbrooke.ca/research

Initiatives supported through the pilot stage focused on urgent needs related to the pandemic, including the development of a low-cost decontamination n for disposable N95 masks and studying the impacts of telework on both the environment and employee performance.

"OCIP is a matchmaking platform," said Luke. "It uses AI machine learning to make it easier and faster to find the right match for the right company at the right stage of a project."

The goal is to encourage more companies to do R&D. "We de-risk those opportunities by exposing them to the potential for partnerships in the public sector which will fast-track them into R&D."

For example, OCIP connected Cheelcare a Richmond Hill medical device startup with OCAD University to learn how to access funding, stickhandle logistics around user testing, and secure affordable industrial real-estate in the Greater Toronto Area for its production of assistive mobility devices, including a robotic power wheelchair.

"Cheelcare also wanted help navigating regulatory compliance and certification which enabled them to begin production and marketing. They wer then referred to Loyalist College to do the prototyping," said Luke.

Students also benefit from these R&D collaborations. "They gain innovation literacy and valuable work-integrated learning experience," he added. "In many cases, they even get hired by the company they're working with, which builds that company's capacity to do even more innovation."

Making New Drugs Available Faster

Governments and companies have demonstrated that they can come up with innovative solutions in times of crisis and faster than thought possible.

Université de Sherbrooke

It took top scientists less than a year to develop a COVID-19 vaccine that is safe and effective, and just another three months to move that vaccine from lab to jab.

The federal government is now exploring how the temporary expedited approval process for COVID-19 products, known as 'agile licensing', could apply to other drugs and therap

us what we can accomplish when we all work together towards a common goal. The collaboration between governments, industry, health stakeholders, and patients during the COVID-19 pandemic was unprecedented and, as a result, we were able to collectively come up with solutions to get Canadians fast access to COVID-19 vaccines and treatments"

The COVID-19 pandemic underscored the value of timely access to vaccines and treatments for Canadians, but also exposed vulnerability in our biomanufacturing capabilities.

> PAMELA FRALICK President, Innovative Medicines Canada

"While there are many details to discuss, this is an encouraging signal that the government is open to looking at ways to quickly and safely adopt new treatments for the benefit of Canadians," said Pamela Fralick, President of Innovative Medicines Canada, the advocacy group for Canada's research-based pharmaceutical companies.

IMC is pushing on several fronts to ensure faster access to new drugs. Currently, just 18% of new medicines launched globally are available to Canadians served by public drug plans. Of the medicines that are available through those plans, patients wait an average of two years to get access.

"The COVID-19 pandemic underscored the value of timely access to vaccines and treatments for Canadians, but also exposed vulnerability in our biomanufacturing capabilities and the need to grow and foster Canada's pharmaceutical sector," said Fralick.

The Biomanufacturing and Life Sciences Strategy and the National Strategy for Drugs for Rare Diseases are good first steps towards improving that capacity and agility, she added, as long as a whole-of-government approach is taken to ensure that well-intentioned initiatives "aren't undermined by decisions made elsewhere in the regulatory or policy environment".

The world was able to fast-track the development of COVID-19 vaccines by building on years of previous research on related viruses, including SARS-CoV-2. That's why continued public investments in talent, academic institutions and leading research organizations are essential,

Harnessing the **World's Top Minds**

How successful countries are at advancing research in times of uncertainty largely depends on investments in fundamental research that have taken place over decades.

That's the case with CIFAR, a research organization based in Canada that supports some 20 Nobel laureates and more than 400 top scientists from over 20 countries. Founded 40 years ago, CIFAR takes the long view when it comes to investing in collaborative and interdisciplinary research to better understand the physical, biological and social world around us.

For example, CIFAR began investing in AI four decades ago, well before AI was cool. In recognition of that expertise, the federal government tasked CIFAR to deliver its \$125-million Pan-Canadian AI Strategy.

"AI was our very first program, but we didn't know at the time how important AI would become," said CIFAR President Dr. Stephen Toope.

Though still firmly rooted in discovery science, a new and younger generation of CIFAR researchers are looking for ways to have an even greater impact.

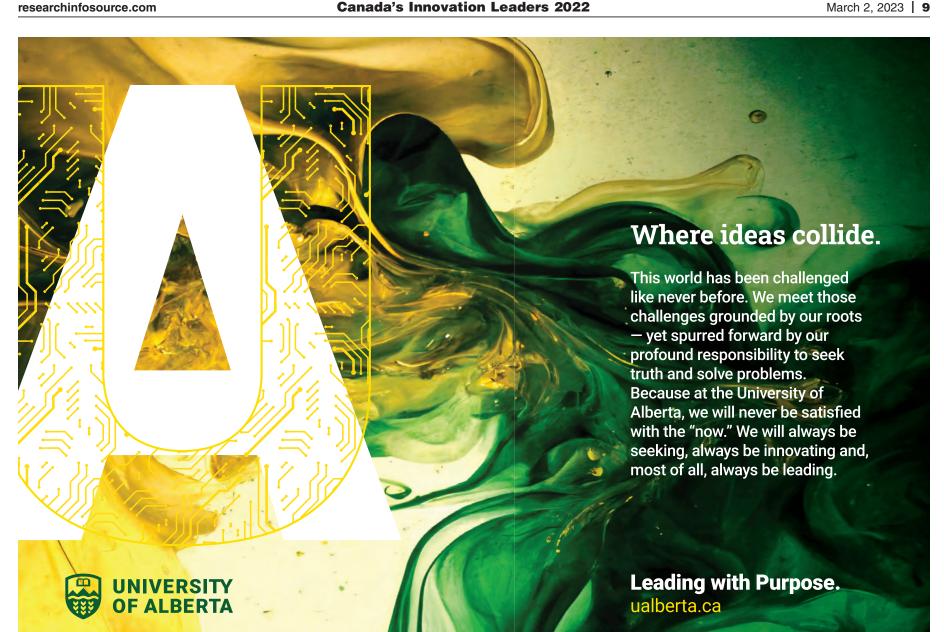
"People often talk about the next couple of generations being even more purpose-driven than previous generations and we're seeing that play out in the research community as well," said Toope. One project with real-world impacts

is being led by Dr. Leah Cowen. The University of Toronto molecular biologist is studying often overlooked fungi,



added Fralick. "The COVID-19 pandemic showed

Continued on page 16



PARTNER PERSPECTIVE



Dr. Steven N. Liss Vice-President, Research and Toronto Metropolitan University

he numerous pressures faced by Canadians, from societal challenges to health crises, have placed a strain as our mental wellbeing and the bonds that connect us.

Transforming the future of healthcare

At Toronto Metropolitan University (TMU) our researchers are driving positive change by developing tangible and accessible solutions that address these social and community health issues

The exceptional work and expertise of our faculty provides a solid foundation of innovation and research excellence across many dimensions of health and health care. Their work is characterized by a long history of collaborations and community engagement with the common goal of improving the health and wellness of Canadians.

Mental health is a global issue, and TMU researchers are leading essential research and piloting on our physical health as well treatments that are having a signifi-

require the highest standards of care, and psychology professor Dr. Candice Monson is recognized as a world leader in setting those standards. She leads the advancement, development and adoption of clinical tools used in the treatment of veterans diagnosed with PTSD as well as their family members, both in clinical settings and through self-directed tools such as the mobile app Couple HOPES.

Anxiety and related disorders impact the mental health of thousands of people from all walks of life. Psychology professor **Dr. Martin Antony** is developing highly effective, evidence-based treatments for social anxiety, cognitive behaviour disorders and other psychological conditions. He has cultivated collaborations with

the mental wellbeing of Canadians to ensure that his sought-after programs and tools are accessible to patients directly through frontline

Health training struggles to meet the needs of underserviced groups such as the LGBTQ2S community. This was found by the research of nursing professor Dr. Erin Ziegler, who is also working to fill these gaps. Her online Sexual Orientation and Gender Identity (SOGI) Nursing Toolkit has been used by more than 2.5 million individuals worldwide, including health-care practitioners and educators as part of their curricula, and by organizations as part of their professional development and staff training.

Advances at the intersection of nedicine and technology are aug-

fronts. A prime example is the biomedical research of engineering professors Dr. Bo Tan and Dr. Krishnan Venkatakrishnan in collaboration with research partners and trainees at the Institute of Biomedical Engineering, Science and Technology (iBEST). Together, they are using AIpowered nanosensors to detect brain cancer in extremely smallvolume blood samples with incredible accuracy. This novel "liquid biopsy" technology could enable the early detection of cancer though non-invasive screening.

The next generation of healthcare professionals will face unprecedented challenges, and TMU's Daphne Cockwell School of Nursing is embracing technological advancements in its training programs to meet those Those who have endured trauma premier institutions specializing in menting health care on multiple challenges. The School's state-of-leaders and practitioners.

the-art simulation lab is designed to replicate many real-life scenarios and interactions with patients. They also plan to expand their suite of award-winning virtual game training simulations to feature multi-perspective scenarios.

Expanding our capacity to train future generations, planning for TMU's School of Medicine is well underway, and at this new school, we will approach health care differently. We will cultivate a new model of inclusive, community-focused, collaborative healthcare. As a health system that serves one of the most diverse communities in Ontario, TMU's primary clinical partner, William Osler Health System, is an ideal partner. Together, we will address evolving health and health-care needs through research, delivery and practice, collaborating closely every step of the way.

TMU's research community is committed to ensuring that Canada is leading the way in medical, societal and technological advancements to future-ready the next generation of health













































FOCUS ON

Mental Health Research

Scientists and community partners work hand-in-hand to develop evidence-based solutions to treat and prevent mental illness.



By Debbie Lawes

staggering 970 million people struggled with mental illness in 2019 – including more than nine million in Canada – making it the leading cause of disability worldwide. This public health crisis is only getting worse, compounded by the effects of the COVID-19 pandemic and overburdened and underfunded healthcare systems that are ill-equipped to meet an unprecedented demand for diagnosis and treatment.

Universities, colleges, and research hospitals across the country are working with community partners, as well as those with lived experience, their families and caregivers, to develop grassroots solutions that are firmly rooted in evidence. This includes solutions that promote mental health and wellbeing and interventions to tackle mental illness before it starts.

Research Infosource interviewed several scientists and academic leaders to learn what the country's top research institutions are doing to improve the mental health of Canadians.

Saskatchewan Polytechnic

The suicide rate among Canadian farmers is woefully under-estimated.

"The suicide rate amongst farmers is not well documented," said Dr. Michelle Pavloff, the Rural Health Research Chair at Saskatchewan Polytechnic who is leading a project that recently launched the SaskAgMatters Network, a farm-culture friendly support system led by two patient and family partners.

Patient partners play key roles in all aspects of the Farmer and Rancher Mental Health (FARMh) project, directing its design, advising on how data should be collected, and how the research findings are put into practice.

"They're really running the show," said Pavloff.

Over 100 farmers and ranchers shared their experiences and recommendations for effective mental health supports and how to access them. That data are being used to create a mental wellness toolbox, a one-stop online resource for mental health tools and resources. The toolbox will include a peer support network, addiction resources and free counselling with a psychologist or social worker with a background in farm culture who understands the unique

with a psychologist or social worker with a background in farm culture who understands the unique stresses faced by agricultural producers.

A similar community-based project is underway in the northern community of La Loche where local youth are exploring the use of virtual reality to

rural, remote and northern communities.

The goal is to create a culturally based, secure platform grounded in safety, identity and belonging. It would use VR to make mental health resources more easily available and reduce the sense of stigma.

enhance the wellbeing of Indigenous youth living in

"It may be scary to talk to an adult face-to-face if they are struggling, but with this platform youth will be able to immerse themselves in resources, or connect with other youth, to address a mental health issue. All of our ideas are really being driven by the youth," said Lindsey Boechler, Research Manager at Sask Polytech.

Dr. Madeline Press, Director of Sask Polytech's Centre for Health Research, Innovation and Scholarship (CHRIS), said the amount of research being done at the centre is growing, particularly in the area of mental health.

"Most of our projects at CHRIS relate in some way to mental health because that's where the need is," said Press.

Université du Québec à Trois-Rivières

Dr. Georgia Vrakas worries that patient voices are underrepresented when it comes to expanding the eligibility for Medical Assistance in Dying (MAiD) to include mental illness as the sole underlying condition.

consultation. She wants to find out whose views carried the most weight with politicians – those of people living with a mental illness or the psychiatrists and other professionals who speak for them. She's still crunching the data but initial findings suggest the voices of those with a mental illness were woefully underrepresented.

Vrakas also appeared last May before a federal committee studying MAiD. Rather than taking "an easy and cheaper solution to a complex problem" with MAID, she urged parliamentarians to invest in promotion and prevention programs, mental health services, psychiatric research, mental health education programs and fighting stigma.

"The results of my case study could be useful for politicians and policymakers when considering future legislation," she said. "We need to find ways to offer people hope, not make it easier for them to die."

University of Waterloo

Dr. John Hirdes is part of an international effort to standardize how people with a mental illness

The results of my case study on
Medical Assistance in Dying could be useful for
politicians and policymakers when considering future legislation.
We need to find ways to offer people hope, not make it easier for them to die.

DR. GEORGIA VRAKAS Professor, Department of Psychoeducation, Université du Québec à Trois-Rivières

The clinical psychologist at Université du Québec à Trois-Rivières (UQTR) and member of the Expert Advisory Group on MAiD launched a research project studying the Quebec National Assembly's recent focus on this issue. Just three days prior to her appearance before the committee in May 2021, she was diagnosed with bipolar disorder.

"It took me 23 years to find out that my recurring depression is bipolar disorder."

Vrakas said she's concerned that people will opt for MAiD because the health system has failed to provide appropriate, free and timely mental health

"The lack of access and the lack of psychiatric research in this area means it can take a very long time to get a correct diagnosis and some never do," she said. "That doesn't mean we throw up our hands and see mental illness as irremediable [incurable],

and see mental illness as irremediable [incurable], which is one of the criteria for getting MAiD."

Politicians, she added, need to consider the social determinants of mental health that contribute to

employment, housing and social marginalization.

Her study is looking at how many people with a mental illness provided input to the Quebec special committee, both in person and through an online

people's suffering - factors like income, education,

are assessed – a critical first step to ensuring they receive the right care, at the right time and in the

The University of Waterloo public health professor has led the development of several tools for mental health screening through his involvement with interRAI, an international consortium of researchers and clinicians from 40+ countries that develops evidence-based assessment tools for comprehensive care and service planning. He also chairs interRAI's Network for Mental Health and the interRAI Network of Canada.

InterRAI instruments cover all sectors of the health system for people with complex care needs, from newborns to centenarians.

"They're used for nursing homes, home care, mental health, acute care, palliative care, physical rehabilitation, and persons with intellectual disabilities to develop care plans and track outcomes over time," he said. "Over 21 million interRAI assessments have been done so far on over six million Canadians."

Despite the move towards standardization, Hirdes' research found that the services and supports for persons living with mental illness are often fragmented, uncoordinated, and inadequately responsive. The study included recommendations for identifying and responding to mental illness throughout a person's life as they move through the various parts of the health system.

"We showed how we could measure depressive

symptoms in exactly the same way in 10 different care settings, from community-based primary care to palliative care," he said. "It provides a holistic Canadian picture of how well depressed mood is managed in different settings."

The end goal, he added, is for countries to prioritize mental health as much as physical health.

"I feel very strongly about the need for us to treat mental health with equal importance to physical health problems in our society. We are doing better at prioritizing it, but we haven't done a great job at quantifying it and understanding it across settings because everybody uses different tools. Standardized assessment tools across the health care continuum would help address that problem."

The Royal's Institute of Mental Health Research

Shortening wait times and improving access to care is a priority for governments across Canada. One way to tackle this challenge is by investing more in research, said Dr. Florence Dzierszinski, Vice-President Research at The Royal, and President of the Institute of Mental Health Research. The IMHR is home to 19 scientists who work closely with about 70 clinician scientists at The Royal.

"When I tell people that research is care, they don't always see the connection. But we can increase access to care through research by bringing cutting-edge research and technology to the point of care. This includes research to find new treatments for mental illness, effective prevention and personalized

treatment choices," said Dzierszinski.

Towards this end, Dzierszinski said The Royal is transforming its Brain Imaging Centre into the Clinical Brain Research Centre, with research and clinical care co-existing seamlessly in a patient-centred manner. It will include various hubs of expertise, including treatment, diagnosis and prevention.

Two pilot clinics have already launched, one that uses repetitive magnetic pulses to stimulate nerve cells in the brain to improve symptoms of depression, and one offering a nasal spray form of esketamine (a more potent version of the psychedelic ketamine) for treatment-resistant depression.

"Our esketamine clinic has a research component embedded which helps us take a more personalized approach with our clients. This may include additional treatment options like psychotherapy for people who receive an esketamine infusion."

Engaging patients and their families in bench-to-bedside-to-society research is another priority at The Royal. For example, the past chair of The Royal's Family Advisory Council, Cynthia Clark, was the principal investigator on a Canadian Institutes of Health Research-funded project that explored the current state of caregiver advisor engagement in health organizations. Insights from that project are shared on engagecaregivers.ca, a new platform that provides practical tools for supporting more meaningful engagement of caregiver advisors by health organizations across Canada.

"The secret sauce is really about building interprofessional teams comprising patients and families, clinicians, program leaders and scientists," said Dzierszinski. "When clients are engaged in care and research we see consistently better outcomes. We are redefining how lived expertise can inform and shape care, education and research that advance our understanding of mental health and substance use health."

The secret sauce is really about building inter-professional teams comprised of patients and families, clinicians, program leaders and scientists. When clients are engaged in care and research we see consistently better outcomes.

DR. FLORENCE DZIERSZINSKI Vice-President Research, The Royal

Researchers across Canada are collaborating with community and healthcare partners, as well as those with lived experience, their families and caregivers to address the country's mental health crisis.

Together, they are mobilizing their knowledge to develop evidence-based solutions that focus not only on diagnoses and treatment, but also preventing mental illness before it starts.

> **RON FREEDMAN** CEO, Research Infosource Inc.

RESEARCHERS' CORNER





Melody Morton Ninomiya was recently named the Canada Research Chair in Community-Driven Knowledge Mobilization and Pathways to Wellness. An assistant professor at Wilfrid Laurier University, Morton Ninomiya works with First Nations, communities and organizations to co-develop research projects centred around local knowledge systems, protocols and priorities. Her research is largely focused on health and wellness in Indigenous communities throughout Canada, and her collaborations have contributed to community-identified needs such as strategic wellness plans and fetal alcohol spectrum disorder prevention.

Melody Morton Ninomiya Canada Research Chair in Community-Driven Knowledge Mobilization and Pathways to Wellness Wilfrid Laurier University

In order to counteract the negative impacts of psychological trauma, particularly childhood abuse and neglect, Dr. Nicolas Berthelot has developed a unique prenatal intervention: the STEP program. This program aims at intercepting the intergenerational transmission of childhood maltreatment. The concept of mentalization of trauma, an innovative approach in developmental and clinical psychology, also stems from his work and permitted to shed new lights on resilience processes in survivors of childhood trauma.



Dr. Nicolas Berthelot Canada Research Chair in Developmental Trauma Professor, Department of Nursing Université du Québec à Trois-Rivières



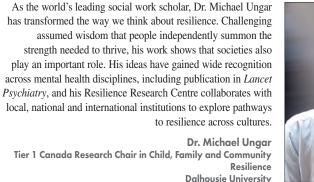
L-R: Dr. Sara Tremblay, Scientist Dr. Lisa McMurray, Psychiatrist The Royal

Hope for people living with difficult-to-treat depression

At The Royal, Scientist Sara Tremblay uses repetitive transcranial magnetic stimulation (rTMS) to stimulate specific brain circuits known to be dysfunctional in people with major depression. This non-drug therapy is safe, non-invasive, has few side effects. What's

> even more exciting is rTMS has shown positive outcomes for people who have difficult-to-treat depression.

Dr. Tremblay's research is leading to better care for patients for whom traditional treatments haven't worked.

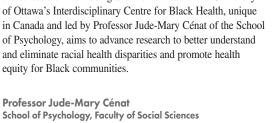






Black communities in Canada – which represent over one million people - face a host of social and economic inequities that affect their well-being and mental health. The University of Ottawa's Interdisciplinary Centre for Black Health, unique of Psychology, aims to advance research to better understand and eliminate racial health disparities and promote health equity for Black communities.

Professor Jude-Mary Cénat University of Ottawa



An international expert on the complex intersections between immigration, aging and health, Dr. Sepali Guruge is developing strategies to ensure older people make social connections and receive necessary care and supports to improve their short- and long-term health. Through her research projects, such as *Inclusive* Communities for Older Immigrants and Examining Relational Care in Long-term Care Settings, Dr. Guruge reaches across disciplines and leverages collaborations to improve the lives of older people in Canada.



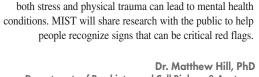
Dr. Sepali Guruge **Daphne Cockwell School of Nursing Toronto Metropolitan University**



Using leading-edge virtual reality (VR) technologies, Assistant Professor Michelle Rutty explores the impacts of environmental change on the global tourism economy. Through immersion in a destination before or after being impacted by natural disasters (e.g., hurricanes, wildfires), 'overtourism' (i.e., destinations exceeding their carrying capacity), and climate-induced environmental change (e.g., coastal inundation, glacier retreat), she is advancing our understanding of tourism's coupled humanenvironment relationship and contributing to policies that sustain natural resources while enhancing destination well-being.

Assistant Professor, Geography and Environmental Management Canada Research Chair – Tourism, Environment & Sustainability **University of Waterloo**

Dr. Matthew Hill, PhD is the inaugural chair of the Mental Health Initiative for Stress and Trauma (MIST) at the Hotchkiss Brain Institute at UCalgary. MIST, created through philanthropic and community support, explores how both stress and physical trauma can lead to mental health



Marisa Young knows it takes a holistic approach to better

understand mental health and its impact on families. It's that

McMaster's Centre for Advanced Research for Mental Health and Society. With a focus on work-family conflict – a more

modern mental health issue, exacerbated by the pandemic -

deal with competing demands and working to eliminate the social inequalities of mental health for parents and children.

Young is driving community-based initiatives to help families

rationale that positioned her to be the inaugural director of



Professor, Departments of Psychiatry and Cell Biology & Anatomy **Cumming School of Medicine University of Calgary**



Niagara College (NC) research teams are recognized for responding to industry needs at the speed of business.

For example, Allan Spence, PhD, brings a technical background in computer-aided design, product design and development, and dimensional metrology to his work mentoring students and tackling the innovation challenges of businesses who seek solutions from NC's Walker Advanced Manufacturing Innovation Centre (WAMIC). Spence recently contributed to successful grant applications for critical tools, including a co-ordinate measuring machine and a medical-grade 3D printer.

Allan Spence, PhD Research Scientist, WAMIC Niagara College



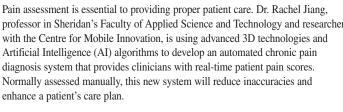
Lindsey Boechler is a Research Manager with Saskatchewan Polytechnic's Centre for Health Research, Innovation, and Scholarship (CHRIS). Lindsey's current research is being done in collaboration with northern high school students to explore how virtual reality (VR) technology can be used to promote the mental health and wellbeing of Indigenous youth living in rural and remote communities. This project holds the potential to increase access to care and meet individualized community needs in a culturally responsive way.

Lindsey Boechler, MA Research Manager Centre for Health Research, Innovation and Scholarship (CHRIS) Saskatchewan Polytechnic



Chronic Pain Assessment

professor in Sheridan's Faculty of Applied Science and Technology and researcher with the Centre for Mobile Innovation, is using advanced 3D technologies and Artificial Intelligence (AI) algorithms to develop an automated chronic pain diagnosis system that provides clinicians with real-time patient pain scores. Normally assessed manually, this new system will reduce inaccuracies and enhance a patient's care plan.



If increasing rates of antimicrobial resistance (AMR) worldwide become the next pandemic, how can we combat it? The new AMR Policy Accelerator at York's Global Strategy Lab, directed by Professor Steven Hoffman, will be a critical antidote to this threat by combining scientific research and evidence-based policy to urge governments to act. An \$8.7-million grant from the charitable Wellcome Trust has enabled the lab to provide customized, research-based and advisory services to governments and other organizations worldwide.



Marisa Young

McMaster University

Associate Professor, Sociology

Canada Research Chair in Mental Health and Work-Life Transitions

Steven Hoffman **Professor at York University Dahdaleh Distinguished Chair** Director, Global Strategy Lab

Dr. Rachel Jiana Professor

Faculty of Applied Science and Technology, School of Applied Computing Researcher, Centre for Mobile Innovation, Generator at Sheridan Sheridan College

CANADA'S Innovation

Canada's innovation community continues to be at the forefront of research and discovery

Through entrepreneurship, commercialization and social innovation, researchers in our universities, hospitals, colleges and companies are turning their leading-edge research into products, technologies and services that advance our economy and improve the lives of citizens the world over. Take a look at how their work is transforming society.

Ontario Tech University was the build partner for Project Arrow, Canada's pioneering full-build, zero-emission concept vehicle revealed at the Consumer Electronics Show on January 6, 2023, in Las Vegas.

The Automotive Parts Manufacturers' Association (APMA) of Canada launched Project Arrow in 2019, with funding from the Government of Ontario and the Government of Canada. The vehicle was built in partnership with Canada's automotive supply sector at Ontario Tech University by faculty researchers, technical staff, and students, utilizing its world class core research facilities including ACE,



A team of faculty researchers, led by Dr. Ahmad Barari, Faculty of Engineering and Applied Science, worked with students and the ACE engineering team to create significant efficiencies in smart advanced manufacturing using emerging technologies such a digitalization in design, manufacturing, and inspection, multi-physics simulations, and additive manufacturing.

Project Arrow showcased Ontario Tech's unique experiential learning opportunities for students to make a once-in-their-lifetime contribution to Canada's technology future.

ntariotechu.ca



Carleton University's Black **Entrepreneurship Knowledge Hub**

The Black Entrepreneurship Knowledge Hub (BEKH) is led by Carleton University's Sprott School of Business and Dream Legacy Foundation. We facilitate national communityled intersectional research through our national network of regional hubs to foster sustainable research, on-going convening of community engagements, and research capacity building within the Black community. Advancing this research in uncertain economic times will unlock economic value for Canada and Black entrepreneurs.

Our key mandates are to conduct data collection, perform quantitative and qualitative research to gain a broad understanding of the people and enterprises of Black entrepreneurs in Canada, and create a network mapping of the Black entrepreneurial ecosystem in Canada.

The results will provide insights and a detailed digital map of Black business ecosystems across the country to help identify critical gaps where Black entrepreneurs are facing the greatest challenges.

This research will be available to stakeholders within the Black community, Canadian policymakers, and others.

f sprott.carleton.ca/bekh

When experiencing a mental health crisis, individuals rely on emergency services such as 9-1-1 dispatchers, paramedic services, police services and hospital emergency department services. It is increasingly understood that emergency response to mental health calls may have substantial, potentially life and death consequences.



Humber College ITAL and TAIBU Community Health Centre & Middlesex-London Paramedic Service are collaborating on "Developing a best practice model for mental health crisis care: A community-engaged approach" social innovation research project. This will bring together community-based service and emergency care providers to develop a model for responding to mental health crisis care and supporting all members of the community requiring emergency mental health support. Particular attention is also given to those of lower socioeconomic status, Black and Indigenous communities, People of Colour, and LGBT2SQ+ and immigrant communities. The project aims to co-develop workshops and training for practitioners working in these fields.

humber.ca/research

Polly Ford-Jones AEMCA, MA, PhD Sheryl Thompson MSW, RSW, PhD(c) Danielle Pomeroy MSW, RSW

Researchers:

Sheridan's Screen Industries Research and Training (SIRT) Centre is at the forefront of the next frontier of the human-digital experience - lifelike virtual humans called Dynamic Digital Humans (DDH) that are changing the way content is created and how people engage and interact across all media platforms. SIRT is an integral part of Generator at Sheridan, which fosters collaboration to drive innovation and impact in industry and communities.



Performing perfect lip-synch with expression and

In 2022, SIRT helped create a patented standardized, efficient workflow to enable the creation of more realistic and less resource-intensive digital characters. The Centre also contributed to the development of a new department for industry partner Cream Productions, which helped bring them into the interaction market. Building on this accomplishment, SIRT will continue to enhance DDH innovation and enable the adoption of digital humans into people's daily lives.

i sirtcentre.com

Canada Foundation for Innovation

The ambitions of Canadian researchers encompass every social, environmental, medical and economic sector. Whether they advance healthcare, develop solutions to business challenges or create clean technologies, their work provides a wide range of benefits to Canada. Stateof-the art research infrastructure enables them to realize their ambitions, allows talented researchers and their students to open up new avenues of inquiry, forge partnerships and think creatively to find concrete solutions to the problems we face as a nation - and as a planet. The labs and facilities across the country are gathering places where brilliant ideas converge, strengthening our economy and building vibrant communities.



Roseann O'Reilly Runte President and CEO Canada Foundation for Innovation

innovation.ca



Professor Dept. of Aerospace Engineering, Toronto Metropolitan University Institute for Biomedical Engineering, Science and Technology (iBEST)



Dr. Krishnan Venkatakrishnan Dept. of Mechanical & Industrial Engineering, Toronto Metropolitan University Institute for Biomedical Engineering, Science and Technology (iBEST)

Effectively detecting brain tumours with blood samples and AI

An innovative cancer screening practice, developed by Toronto Metropolitan University researchers Dr. Bo Tan and Dr. Krishnan Venkatakrishnan along with research partners at St. Michael's Hospital at iBEST, can detect brain cancer earlier and more easily through a blood sample instead of surgery. In a practice called liquid biopsy diagnosis, researchers use a highly sensitive nanosensor and machine learning to detect cancer biomarkers in blood samples as small as five microlitres. Recently published research found this innovation can detect brain tumours with 100 per cent accuracy and tumour location with 96 per cent accuracy.

Liquid biopsy could play an important role in managing patient care while relieving pressure on healthcare systems. The practice can effectively detect cancer before conventional screening practices like MRIs and tissue biopsy, leading to more early-stage diagnoses. The researchers are currently testing for tumour content accuracy for common cancers like breast, lung and colon at stages I and II.

torontomu.ca/research



Ontario Tech University

More than 600,000 Canadians are living with dementia. The Alzheimer's Society of Canada forecasts that number to reach one million by 2030, and 1.7 million by 2050.

Ontario Tech University and Ontario Shores Centre for Mental Health Sciences are breaking new ground in addressing this crisis with the launch last November of the Advancement for Dementia Care Centre (ADCC), a new community-based

"There's been a real concerted effort that started about a decade ago to look at creating a centre of excellence in Ontario's Durham Region focusing on

dementia care," said Jennifer Freeman, Executive Director, Research Services at Ontario Tech.

The ADCC, co-chaired by Dr. Winnie Sun (Ontario Tech) and Dr. Amer Burhan (Ontario Shores), builds off the work of a Clinical Demonstration Unit the two institutions created in 2019 which explored how technologies being developed at the university - such as conversational robots their caregivers.

and virtual reality - could be transferred to clinical care to help individuals with dementia as well as "What makes this collaboration unique is we're

really embedded in Ontario Shores, and embedded in the community," said Freeman. "We have faculty

is important, she said it's equally important to technology.

other avenues."

Technology with a conscience is one of our key priorities. It's about advancing the use of technologies in ethical and applied ways to help with resiliency, health care, mental health and other avenues.

JENNIFER FREEMAN

members and students that are housed there, including two new research chairs."

Not all interventions need to be expensive. One collaboration between the university (Dr. Wally Bartfay) and Ontario Shores (Sheri Hosbourgh) found that personalized music can provide a safe, low-cost and drug-free way to help manage behavioural and psychological symptoms of dementia.

Another study co-led by Ontario Tech researchers Dr. Meghann Lloyd and Dr. Robert Balogh, showed that young adults with intellectual and developmental disabilities who participated in the Special Olympics were 49% less likely to be diagnosed with depression than their peers.

"This was a ground-breaking study in a traditionally under-researched population," said Freeman, "and it illustrates the breadth of research we do in the area of mental health, which people may find surpris-

ing for a university with 'technology' in its name." While developing the next tech breakthrough

understand the social and ethical implications of "Technology with a conscience is one of our key priorities," added Freeman. "It's about advancing the

use of technologies in ethical and applied ways to

help with resiliency, health care, mental health and

Baycrest

Research has already proven that depression and anxiety can nearly double a person's risk of developing dementia later in life. But who exactly is at highest risk?

Scientists at Baycrest's Rotman Research Institute (RRI) are working to find out.

"Not everyone with depression or anxiety will develop dementia but a subset will," said Dr. Linda Mah, Senior Clinician Scientist at RRI, which leads critical research to advance prevention and treatment of dementia. "If we can develop objective indicators that tell us which individuals who have experienced depression are likely to develop Alzheimer's disease or dementia, the hope is we could introduce earlier interventions to prevent dementia."

One potential indicator is heart rate variability (HRV), the time interval between successive heartbeats which predicts cardiac health. Mah is leading a new study looking at how variations in these intervals - by even just a few milliseconds - is linked to better cognitive health.

Armed with this new evidence, she said it would only take a few minutes for any hospital or clinic to measure HRV using an electrocardiogram monitor.

"If we can detect differences in HRV in older

Achievements



Located in Hamilton, Ontario, **McMaster University** is one of Canada's most research-intensive universities and the nation's preeminent nuclear research institution. McMaster has maintained active research and educational programs in nuclear science and engineering for nearly 65 years and is home to a unique suite of world-class nuclear research facilities – anchored by the McMaster Nuclear Reactor – that enable discoveries in medicine, clean energy, nuclear safety, advanced materials and environmental science.

McMaster is a global leader in medical isotope research, development, and production, providing personalized cancer treatments for more than 70,000 patients every year. And we're a key resource for Canada's nuclear energy sector. Our experts perform testing and analysis on nuclear power plant components to ensure their safe continued use and are studying next-generation clean energy technologies, like Small Modular Reactors (SMRs). Our research and training are advancing the country's clean energy needs and will play a critical role in achieving Net Zero.

i nuclear.mcmaster.ca

Supporting Business Growth Through Collaborative Innovation

The Ontario Collaborative Innovation Platform (OCIP), launched by **eCampusOntario**, supports research partnership between companies and Ontario's public postsecondary institutions (PSIs). OCIP is a matchmaking service, connecting companies to PSIs to form collaborative innovation partnerships.

We know that companies that do R&D are more likely to survive and grow, hire more people, export more goods and services, and have a bigger economic impact in their communities. We also know that companies need help navigating the R&D landscape. OCIP helps Ontario businesses find R&D support, workforce training and IP support with Ontario's 56 colleges, universities and Indigenous Institutes. It is one way we are filling a gap in the innovation pipeline.

ocip.ecampusontario.ca





Canada's Innovation Leaders 2022

Despite increased awareness about the prevalence of mental health concerns, many racial, ethnic and gender-diverse groups remain at risk for poor mental health outcomes. Professor Rebecca Pillai Riddell, Faculty of Health, is working to change that through a revolutionary new research and training initiative, **DIVERT**, or the Digital, Inclusive, Virtual and Equitable Research Training in Mental Health platform. Pillai Riddell and a leadership team of eight principal investigators from six Canadian institutions have received \$5.45 million over six years to create the platform.

DIVERT's ultimate aim is to lead to a mental health system that better serves all Canadians. DIVERT will synergize expertise across Canada to create a more diverse pool of mental health practitioners and more digital and virtual mental health interventions that are grounded in inclusive and equitable knowledges. The platform will embed cultural affirmation into the mental health system by starting at the beginning of the pipeline: academic training programs that involve mental health.

i yorku.ca/research

Scientists at **The Royal** are using Artificial Intelligence to bring precision diagnosis and personalized treatments to mental health care.

Neuroscientist Georg Northoff is using Artificial Neural Networks in combination with brain imaging to analyse the neuronal activity that defines how our brains interact with the world around us.

Examining the deeper layers of the brain in this non-invasive way takes us beyond understanding what changes occur during mental illness to understanding why and how those changes are taking place. This opens to the door for highly effective personalized treatments – not just medication but non-drug treatments like music therapy - based on a patient's neural activity.

Zachary Kaminsky, DIFD-Mach-Gaensslen Chair in Suicide Prevention Research, is employing Artificial Intelligence to identify people who are at heightened risk for suicide and enable life-saving intervention. He has developed the Suicide Artificial Intelligence Prediction Heuristic (SAIPH), an algorithm that can assess an individual's risk based on publicly available data in Twitter posts.

theroyal.ca/ResearchAI



Dr. Georg Northoff



Future Advanced Medical Research of Ottawa, University of Ottawa

The COVID-19 pandemic has sharpened our focus on both individual and collective health, and on the need for a robust, effective Canadian health-care system. The **University of Ottawa**'s excellence in academic and clinical research is recognized around the world. High-tech innovations currently present tremendous opportunities to advance precision medicine and smart health. uOttawa is seizing these opportunities through its new Advanced Medical Research Centre (AMRC), which will transform health and patient care, develop new treatments and therapies for devastating diseases, and advance new health technologies. In the fall of 2025, uOttawa will open this new, 350,000 sq. ft. state-of-the-art research centre. The goal is to nurture a diverse health research and life sciences ecosystem, where collaboration drives innovation, develops talent, and accelerates the discovery and commercialization of transformative "made in Canada" solutions that improve and save lives.

1 uottawa.ca/giving/advanced-medical-research-centre

A community partnership between RRC Polytech's Technology Access Centre for Aerospace and Manufacturing (TACAM) and Cascade Manufacturing, a local agricultural irrigation production company, reinvented the wheel. You'll soon be able to purchase a low-maintenance, all-steel bolted wheel for agricultural irrigation systems later this year.

After working on a prototype bolted wheel since 2018, Cascade reached out to TACAM to collaborate on a redesign. With in-house expertise on 3D modelling and finite element analysis to identify and address high mechanical stress areas and potential points of failure, TACAM was able to provide recommendations for workability and cost reductions. Cascade is beginning to market the redesigned wheel and expects to have 150 made and sold in 2023.

As Manitoba's largest institute for applied learning and research, RRC Polytech finds innovative solutions to real-world challenges alongside industry, while also providing students with the applied knowledge to succeed in their future careers.

i rrc.ca/research



Continued from page 12

adults who have been depressed, compared to non-depressed individuals, and then link these HRV metrics to cognition, these indices could potentially serve as an objective biomarker of risk for future cognitive decline or dementia," said Mah, who is also a geriatric neuropsychiatrist at Baycrest in Toronto.

Not surprisingly, depression is very common among people with Alzheimer's disease and other dementias. Unfortunately, first-line approaches such as antidepressants and psychotherapy are ineffective in people with dementia.

Mah is studying the effects of a non-invasive procedure, called transcranial magnetic stimulation, to stimulate nerve cells in the brains of older people to improve symptoms of depression. Her lab is investigating a type of TMS, called deep TMS, which penetrates deeper into the brain.

"TMS is an established treatment for depression, but hasn't been studied in older people with depression who also have some cognitive impairment such as mild cognitive impairment or dementia," she

explained.
"By stimulating neurons [or brain cells], we hope to increase neuroplasticity and connections

between brain cells, which we think may not only help depression but could potentially improve cognition, ultimately improving quality of life for these individuals by allowing them to live independently."

University of Northern British Columbia

Supporting persons living with dementia to age in place and remain active in their community often depends on where they live.

Dr. Shannon Freeman, an Associate Professor of Nursing at the University of Northern British Columbia (UNBC) who specializes in social gerontology, aims to support older persons to age with grace and dignity in rural and northern BC through collaborative, community-based research. Freeman highlighted the importance of collaborating with and learning from persons with lived experience in northern and rural communities.

"The Dementia-inclusive Streets and Community Access, Participation and Engagement (Dem-SCAPE) project focuses on how persons living with dementia navigate their neighbourhood environments," said Freeman. "It's not just the physical infrastructure and built environment but also the level of cognitive stimulation. How noisy is it? How busy is the traffic? These are important

considerations in supporting the independence and

autonomy of persons living with dementia."

Together with researchers from Simon Fraser University and the University of British Columbia, the DemSCAPE team is developing guidelines for dementia-inclusive communities and an environmental audit tool for municipalities to support safety, mobility, engagement, and social participation of persons living with dementia. The project is being funded by the Public Health Agency of Canada which oversees Canada's national dementia strategy.

Canada which oversees Canada's national dementia strategy.

The UNBC DemSCAPE team engaged in conversations and outdoor walks with people living with dementia and their caregivers to understand how they are using and pavigating their neighbourhood

they are using and navigating their neighbourhood environments in Prince George BC. "Understanding how persons with dementia navigate their neighbourhoods means municipalities will

individuals who have experienced depression are likely to develop Alzheimer's disease or dementia, the hope is we could introduce earlier intervention to prevent dementia.

DR. LINDA MAH
Senior Clinician Scientist, Rotman Research Institute, Baycrest

Senior Clinician Scientist, Rotman Research Institute, Baycrest

If we can develop objective indicators that tell us which

be better equipped to support residents to age in place," said Freeman, who co-leads the northern arm of DemSCAPE with Dr. Mark Groulx in UNBC's School of Planning and Sustainability.

A partnered and collaborative research approach is key, said Freeman, who is also part of a collaboration with kinesiologist Dr. Laura Middleton to create evidence-based training modules to help people living with dementia and their families learn more about inclusion, physical activity, and healthy eating, and increase their confidence to manage wellbeing.

These resources, co-developed with persons with dementia and their care partners are freely available at dementiaexercise.com and dementiawellnesscanada.com.

Granting Council Research Income Performance FY2017-FY2021

Research Infosource shines the spotlight on the granting councils research income performance – as measured by research income received by full-service universities from each national granting council between FY2017-FY2021.

Nati	Natural Sciences and Engineering Research Council of Canada (NSERC)								
NSERC	Research Income			Research Income of Total University Researc	h Income				
Rank	Medical	\$000	Rank	Medical	%				
1	University of Toronto	\$399,879	1	Dalhousie University	19.1				
2	University of British Columbia	\$355,206	2	University of Saskatchewan	17.0				
3	University of Alberta	\$308,334	3	Université de Sherbrooke	13.2				
4	Université de Montréal	\$278,684	4	Queen's University	12.5				
5	McGill University	\$276,833	5	University of Alberta	12.3				
	Tier Average (16)	\$197,148		Tier Average (16)	9.7				
Rank	Comprehensive	\$000	Rank	Comprehensive	%				
1	University of Waterloo	\$271,075	1	University of Windsor	25.8				
2	Simon Fraser University	\$114,826	2	University of Waterloo	25.2				
3	University of Guelph	\$114,765	3	Carleton University	22.3				
4	University of Victoria	\$90,493	4	Concordia University	21.6				
5	Carleton University	\$86,871	5	York University	16.0				
	Tier Average (11)	\$89,721		Tier Average (11)	17.5				
Rank	Undergraduate	\$000	Rank	Undergraduate	%				
1	Ontario Tech University	\$20,230	1	Ontario Tech University	25.8				
2	University of Regina	\$19,645	2	Trent University	22.3				
3	Université du Québec à		3	Brock University	21.8				
	Trois-Rivières	\$18,613	4	University of Lethbridge	21.3				
4	University of Lethbridge	\$17,960	5	Saint Mary's University	17.6				
5	Brock University	\$17,184		Tier Average (19)	14.2				
	Tier Average (19)	\$12,642		- '					

CIHR I	Research Income			Research Income of Total University Research I	ncome
Rank	Medical	\$000	Rank	Medical	0/
1	University of Toronto \$	1,026,918	1	McGill University	18.4
2	McGill University	\$552,698	2	University of British Columbia	17.0
3	University of British Columbia	\$544,642	3	University of Toronto	17.0
4	Université de Montréal	\$374,535	4	Université Laval	16.0
5	Université Laval	\$337,316	5	University of Ottawa	15.4
	Tier Average (16)	\$280,074		Tier Average (16)	13.
Rank	Comprehensive	\$000	Rank	Comprehensive	0,
1	Simon Fraser University	\$55,952	1	York University	7.
2	York University	\$38,044	2	Simon Fraser University	7.
3	University of Waterloo	\$31,991	3	University of Victoria	4.
4	University of Victoria	\$29,150	4	Toronto Metropolitan University	3.
5	University of Guelph	\$19,407	5	Concordia University	3.
	Tier Average (11)	\$20,755		Tier Average (11)	4.
Rank	Undergraduate	\$000	Rank	Undergraduate	q
1	University of Regina	\$11,576	1	University of Northern	
2	Laurentian University	\$10,760		British Columbia	12.
3	University of Northern British Columb	ia \$7,711	2	University of Regina	9.
4	University of Lethbridge	\$4,124	3	Laurentian University	6.
5	Brock University	\$4,021	4	Brock University	5.
	Tier Average (16)	\$3,607	5	University of Lethbridge	4.
				Tier Average (16)	4.

SSHRC	Research Income			Research Income of Total University Research In-	come
Rank	Medical	\$000	Rank	Medical	%
1	University of Toronto	\$154,573	1	Dalhousie University	5.6
2	University of British Columbia	\$136,287	2	Queen's University	4.9
3	McGill University	\$104,494	3	University of British Columbia	4.3
4	Université de Montréal	\$102,404	4	University of Ottawa	3.8
5	University of Alberta	\$76,972	5	Western University	3.8
	Tier Average (16)	\$65,486		Tier Average (16)	3.2
Rank	Comprehensive	\$000	Rank	Comprehensive	%
1	York University	\$76,166	1	York University	15.0
2	Université du Québec à Montréal	\$53,887	2	Université du Québec à Montréal	13.9
3	Simon Fraser University	\$49,196	3	Carleton University	12.1
4	Carleton University	\$47,366	4	Concordia University	11.3
5	University of Waterloo	\$41,858	5	Toronto Metropolitan University	7.5
	Tier Average (11)	\$38,319		Tier Average (11)	7.5
Rank	Undergraduate	\$000	Rank	Undergraduate	%
1	Wilfrid Laurier University	\$24,156	1	Wilfrid Laurier University	26 .1
2	Brock University	\$14,468	2	Université du Québec en Outaouais	19.3
3	Université du Québec à		3	Brock University	18.4
	Trois-Rivières	\$13,353	4	University of Winnipeg	14.8
4	Université du Québec en Outaouais	\$9,065	5	Saint Mary's University	10.2
5	University of Winnipeg	\$8,874		Tier Average (19)	7.7
	Tier Average (19)	\$6,827			

			CEL Do	search Income			
CFI Re	search Income		as % of Total University Research Income				
Rank	Medical	\$000	Rank	Medical	%		
1	University of Toronto	\$310,891	1	University of Saskatchewan	13.6		
2	University of British Columbia	\$176,168	2	Queen's University	7.5		
3	McGill University	\$161,905	3	University of British Columbia	5.		
4	University of Saskatchewan	\$150,954	4	McGill University	5.		
5	Université Laval	\$100,741	5	Dalhousie University	5.		
	Tier Average (16)	\$92,389		Tier Average (16)	4.		
Rank	Comprehensive	\$000	Rank	Comprehensive	9		
1	University of Victoria	\$89,933	1	University of Victoria	15.		
2	Simon Fraser University	\$84,390	2	Simon Fraser University	10.		
3	University of Waterloo	\$64,852	3	University of Windsor	6.		
4	University of Guelph	\$17,546	4	University of Waterloo	6.		
5	York University	\$16,931	5	York University	3.		
	Tier Average (10)	\$32,012		Tier Average (10)	6.		
Rank	Undergraduate	\$000	Rank	Undergraduate	9		
1	Wilfrid Laurier University	\$6,380	1	University of Winnipeg	8.		
2	University of Winnipeg	\$4,987	2	St. Francis Xavier University	7.		
3	Université du Québec à Rimouski	\$4,814	3	Wilfrid Laurier University	6.		
4	Laurentian University	\$4,784	4	Saint Mary's University	5.		
5	Université du Québec à Trois-Rivières	\$3,326	5	Trent University	4.		
	Tier Average (18)	\$2,846		Tier Average (18)	3.		

- Based on full-service universities on the Top 50 Research Universities list for all 5 years; and reported \$20,000 or more for each granting council per year between FY2017-FY2021
- Apparent ties due to rounding





University of Manitoba

A growing number of Manitoba residents now have access to an evidence-based treatment that has become the gold standard in psychotherapy, thanks to research led by the University of Manitoba.

The Government of Manitoba invested \$300,000 in 2021 to establish the mindfulnessbased cognitive behavioural therapy (CBTm) hub for adults. The five-week online class covers areas such as mindfulness, goal setting and realistic thinking - practical skills that make people more aware of how their thoughts and behaviours can impact how they are feeling, and how they can

change it. "These are skills that anyone can use in their everyday life, with the added benefit that it can also improve mental health," said Dr. Jintender Sareen, Professor and Head of Psychiatry at the University

of Manitoba. "There is evidence that CBTm can

improve even low-level mental health symptoms

among people that are doing well."

More jurisdictions are turning to online CBT classes to meet a growing demand for mental health services. What differentiates CBTm from similar programs is it can be offered online to large classes, as opposed to small groups or one-on-one.

"These are large classes, up to about 50 people, where you learn simple principles and techniques for managing depression and anxiety," said Sareen. "You also have access to self-help tools. It provides immediate help to people who might otherwise have to wait a year in the public system for therapy."

CBTm is available to all Manitobans, free of charge with no wait time. The program currently operates at 40 sites across the province, including crisis response centres, hospitals and community health centres. An additional \$700,000 from the province will expand access and adapt it for adolescents.

CBTm has also been adapted to provide targeted services to specific groups including the 50-plus population, public safety personnel, Indigenous communities, military veterans, cancer patients, new moms and women who are pregnant.

"The evidence shows that CBTm not only reduces wait times, but also reduces people's symptoms," said Sareen. "They actually start to feel better after learning how to do CBT."

The evidence shows that mindfulness-based cognitive behavioural therapy not only reduces wait times, but also reduces people's symptoms.

DR. JINTENDER SAREEN

Professor and Head of Psychiatry, University of Manitoba

McMaster University A new research centre at McMaster University in Hamilton ON is bridging the gap between health sciences and social sciences to prevent mental illness before it starts.

The Centre for Advanced Research on Mental Health and Society (ARMS) is looking beyond the genetic, biological and physiological contributors to mental illness to understand how social and cultural factors such as inequality and employment contrib-

ute to mental illness. "We hope that by bringing these two camps together in a more holistic way we can take a more preventative approach to addressing mental health problems," said Dr. Marisa Young, Academic Director of ARMS and Canada Research Chair in Mental

Health and Work-Life Transitions. ARMS provides a physical space and financial and other resources to facilitate partnerships between researchers and students from multiple disciplines and community practitioners. It draws on the Faculty of Social Sciences' Community Research Platform, which has fostered relationships

Canada's

HOSPITALS

TOP 40 RESEARCH HOSPITALS 2022

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CANA INNOV LEAD	AT	ON











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Rank			Research Research Spending Intensity			earch			
Ra	nk		Rese	arch Spen	ding %	Intensity Researcher Hospital			
2021	2020	Hospital/Hospital Network/ Health Authority	FY2021 \$000	FY2020 \$000	Change 2020- 2021	\$ per Researcher \$000	\$ as % of Total Hospital Spending	Prov	Main Affiliated Research Centre(s)/Institute(s)
1	1	University Health Network (UHN)	\$452,954	\$489,966	-7.6	\$555.1	17.2	ON	PM Cancer Centre, Krembil, TGHRI, McEwen Institute, Techna, KITE@UHN,
		,							TIER@UHN
2	2 3	Hospital for Sick Children McGill University Health	\$278,139 \$196,780	\$281,939 \$206,101	-1.3 -4.5	\$681.7 \$393.6	22.9 13.4	ON QC	SickKids Research Institute Research Institute of the MUHC
4	6	Centre (MUHC) Provincial Health Services	\$188,828	\$155,246	21.6	\$198.3	4.4	BC	BC Cancer Agency/Research Centre.
_	_	Authority							BC Children's Hospital Research Institute, BC Centre for Disease Control
5	5	Vancouver Coastal Health Authority	\$174,510	\$164,736	5.9	\$416.5	3.8	BC	Vancouver Coastal Health Research Institute, Providence Research
6	7	Ottawa Hospital	\$149,560	\$144,848	3.3	\$401.0	8.8	ON	Ottawa Hospital Research Institute, Ottawa Heart Institute Research Corp
7	4	Hamilton Health Sciences	\$138,423	\$171,115	-19.1	\$249.0	8.8	ON	Population Health Research Institute, Thrombosis and Atheroscelerosis Research Institute, Escarpment Cancer Research Institute
8	9	CHU de Québec - Université Laval	\$136,807	\$112,855	21.2	\$419.7	9.5	QC	Centre de recherche du CHU de Québec - Université Laval
9	8	London Health Sciences Centre/St. Joseph's Health Care London ^(a)	\$129,832	\$121,888	6.5	\$746.2	7.1	ON	Lawson Health Research Institute
10	10	Sunnybrook Health Sciences Centre	\$102,896	\$107,616	-4.4	\$283.5	8.1	ON	Sunnybrook Research Institute
11	12	Unity Health Toronto	\$94,618	\$88,948	6.4	\$852.4	7.2	ON	Li Ka Shing Knowledge Institute, Keenan Research Centre for Biomedical Science
12	11	Sinai Health	\$92,528	\$93,376	-0.9	\$706.3	12.9	ON	Lunenfeld-Tanenbaum Research Institute, Bridgepoint Collaboratory for Research and Innovation
13	13	Centre hospitalier de l'Université de Montréal (CHUM)	\$84,887	\$83,216	2.0	\$230.0	5.5	QC	Centre de recherche du CHUM
14	14	Centre for Addiction and Mental Health	\$79,669	\$75,615	5.4	\$491.8	16.0	ON	Campbell Family Mental Health Research Institute, Krembil Centre for Neuroinformatics, Azrieli Centre for Neuro-Radiochemistry
15	15	CIUSSS de la Capitale-Nationale	\$76,899	\$74,817	2.8	\$251.3	4.1	QC	CERVO, VITAM, CRUJEF, CIRRIS
16	17	CIUSSS de l'Estrie - Centre Hospitalier Universitaire de Sherbrooke (CHUS)	\$61,874	\$56,659	9.2	\$126.8	3.5	QC	Centre de recherche du CHUS, Centre de recherche sur le vieillissement, Institut universitaire de première ligne en santé et services sociaux
17	18	CIUSSS du Centre-Ouest-de- l´île de Montréal	\$56,119	\$51,536	8.9	\$256.3	4.2	QC	Lady Davis Institute
18	19	CHU Sainte-Justine	\$53,246	\$50,551	5.3	\$201.7	8.9	QC	Centre de recherche du CHU Sainte-Justine
19	16	Alberta Health Services - Edmonton Zone	\$51,921	\$57,002	-8.9	\$147.1	na	AB	
20	20	Montreal Heart Institute	\$46,793	\$43,636	7.2	\$458.8	18.5	QC	Montreal Heart Institute Research Center
21	22	CIUSSS de l'Est-de- l'Île-de-Montréal	\$33,117	\$33,915	-2.4	\$144.6	1.9	QC	Centre de recherche de l'Hôpital Maisonneuve-Rosemont, Centre de recherche de l'Institut universitaire de santé mentale de Montréal
22	21	Institut universitaire de cardiologie et de pneumologie de Québec - Université Laval	\$32,865	\$34,458	-4.6	\$426.8	10.1	QC	Centre de recherche de l'Institut universitaire de cardiologie et de pneumologie de Québec - Université Laval
23	30	Kingston Health Sciences Centre	\$29,056	\$25,266	15.0	\$90.5	4.4	ON	Kingston General Health Research Institute
24	26	St. Joseph's Healthcare Hamilton	\$27,676	\$26,870	3.0	\$136.3	4.0	ON	Research Institute of St. Joe's Hamilton, Firestone Institute for Respiratory Health, Michael G. DeGroote Centre for Medicinal Cannabis Research
25	24	CIUSSS de l'Ouest-de- l'Île-de-Montréal	\$26,565	\$30,295	-12.3	\$442.8	2.4	QC	Douglas Hospital Research Centre
26	25	Baycrest	\$26,332	\$26,920	-2.2	\$975.3	13.4	ON	Rotman Research Institute
27 28	27	Children's Hospital of Eastern Ontario Alberta Health Services -	\$26,278 \$25,282	\$26,783 \$33,070	-1.9 -23.6	\$230.5 \$308.3	7.1 na	ON AB	Children's Hospital of Eastern Ontario Research Institute
29	31	Calgary Zone Health Sciences Centre	\$23,282	\$20,210	20.8	\$121.5	3.9	MB	
30	29	Winnipeg	\$24,318		-5.4	\$77.2	1.0	NS	
31	29	Nova Scotia Health Authority CIUSSS du Centre-Sud-de-		\$25,700					
		l'Île-de-Montréal	\$23,419	\$26,497	-11.6	\$86.7	1.1	QC	Centre de recherche de l'Institut universitaire de gériatrie de Montréal, Institut universitaire sur la rédaptation en déficience physique de Montréal, Institut universitaire sur les dépendances
32	32	Women's College Hospital	\$17,394	\$17,606	-1.2	\$334.5	9.6	ON	Women's College Research Institute, Women's College Hospital Institute for Health System Solutions and Virtual Care
33	33	The Royal	\$15,253	\$15,336	-0.5	\$231.1	7.8	ON	University of Ottawa Institute of Mental Health Research
34	34	Holland Bloorview Kids Rehabilitation Hospital	\$13,094	\$14,000	-6.5	\$654.7	12.9	ON	Bloorview Research Institute
35	35	St. Boniface Hospital	\$12,971	\$13,475	-3.7	\$341.3	3.6	МВ	Institute of Cardiovascular Sciences, Canadian Centre for Agri-Food Research in Health & Medicine, Div. of Neurodegenerative Disorders
36	36	IWK Health Centre	\$12,220	\$12,374	-1.2	\$111.1	4.1	NS	Centre for Pediatric Pain Research

37

38

39

40

37

38

39

Research spending includes all funds (direct and indirect) spent on all sources (internal and external) to support research.

\$11,382

\$10,348

\$10,275

\$9,454

\$10,011

\$11,626

\$10,401

\$9,732

13.7

-11.0

-1.2

-2.9

Trillium Health Partners

Vitalité Health Network

Hôpital Montfort

Bruyère

Data were obtained through a survey and from financial statements. FY2020 figures may have been adjusted as more accurate information became available. Researcher headcounts include full and part-time researchers, scientists, investigators and

clinician-researchers with a faculty appointment who actively conducted research in Fiscal 2021.

 $5. \ \, \text{Data are provided for the main hospital/health network/health authority including their}$ affiliated hospitals and research centres/institutes, where applicable

ON

NB

ON

ON

Institute for Better Health

Bruyère Research Institute

Institut du Savoir Montfort

\$180.7

\$106.7

\$244.6

\$85.9

0.9

1.4

5.1

3.7

na = Not available $^{(a)}$ Research spending amounts were combined as these hospitals have one research institute.

CANADA'S TOP 40

Research Hospitals

Hospital Research Spending Growth Flatlines

In Fiscal 2021, Canada's Top 40 Research Hospitals posted a flat 0.1% gain of over Fiscal 2020. The combined research spending of the Top 40 was \$3.06 billion, no change from Fiscal 2020. Research spending increased at 17 Hospitals, Hospital Networks and Health Authorities and declined at just over half (23) of the others. The number of health researchers was 9.889, a 3.9% increase over Fiscal 2020.

University Health Network (UHN) led the national ranking, with outlays of \$453.0 million down -7.6% from Fiscal 2020. Hospital for Sick Children ranked in second spot (\$278.1 million, down -1.3%), followed by McGill University Health Centre (MUHC) in third (\$196.8 million, down -4.5%). Provincial Health Services Authority moved into fourth spot (\$188.8 million, up 21.6%) and Vancouver Coastal Health Authority maintained fifth position (\$174.5 million, up 5.9%). Ottawa Hospital moved up into sixth place (\$149.6 million, up 3.3%). With a drop of -19.1% in their research spending in Fiscal 2021 to \$138.4 million, Hamilton Health Sciences fell to seventh place, down from fourth last year. New to the Top 40 this year is Trillium Health Partners, which debuted in the 37th position.

\$100 Million Club

In Fiscal 2021, 10 institutions – the same group as in Fiscal 2020 – each recorded research spending in

\$100	Million Club	
2021 Rank	Hospital	Research Spending \$000
1	University Health Network (UHN)	\$452,954
2	Hospital for Sick Children	\$278,139
3	McGill University Health	
	Centre (MUHC)	\$196,780
4	Provincial Health Services Authority	\$188,828
5	Vancouver Coastal Health Authority	\$174,510
6	Ottawa Hospital	\$149,560
7	Hamilton Health Sciences	\$138,423
8	CHU de Québec - Université Laval	\$136,807
9	London Health Sciences Centre St. Joseph's Health Care London	·
10	Sunnybrook Health Sciences Centre	\$102,896

excess of \$100 million. This elite group in the \$100 Million Club recorded a combined research spending of \$1.95 billion and accounted for 64% of total national research spending.

Provincial Performance

In Fiscal 2021, 19 Ontario health research organizations on the Top 40, accounted for \$1.70 billion of total national research spending, or 56% of the total (down -3.0%). Quebec's 12 institutions accounted for \$829.4 million, representing 27% of the national total (up 3.1%). Two health organizations from British Columbia posted \$363.3 million of research spending, or 12% of the national total (up 13.5%).

Top 40 – Leading Provinces						
Province	% of Total					
Ontario (19)	56					
Quebec (12)	27					
British Columbia (2)	12					

Research Spending Growth

Compared with a flat growth rate (0.1%) in national research spending, 10 organizations recorded increases of more than 6% in their research activity in Fiscal 2021. Five of note reported double digit research spending increases: Provincial Health Services Authority (up 21.6%), CHU de Québec -Université Laval (up 21.2%), Health Sciences Centre Winnipeg (up 20.8%), Kingston Health Sciences Centre (up 15.0%) and Trillium Health Partners (up 13.7%). Other organizations that also reported larger research spending gains in Fiscal 2021 were CIUSSS de l'Estrie - Centre Hospitalier Universitaire de Sherbrooke (CHUS) (up 9.2%), CIUSSS du Centre-Ouest-de-l'île de Montréal (up 8.9%) and Montreal Heart Institute (up 7.2%).

Researcher Intensity

Research Infosource measures research intensity in two ways: by researcher (research spending per researcher), and by hospital (hospital research spending as a percent of total hospital spending). In Fiscal 2021, at the national level, researcher intensity dropped by -3.6% to an average of \$309,300 of spending per researcher, and the national hospital intensity was 6.5%, a decrease of -8.7% between Fiscal 2020 and Fiscal 2021.

At \$852,400 of spending per researcher, Unity Health Toronto led its Large hospital peers,

Top Researcher-Intensive Organizations (Research Spending per Researcher) \$000 Rank Medium \$000 Rank Large \$000 Rank Small Unity Health Toronto \$852.4 Sinai Health \$706.3 **Baycrest** \$975.3 Holland Bloorview 2 London Health Sciences Hospital for Sick \$681.7 Kids Rehabilitation Centre/St. Joseph's Children \$654.7 Health Care London \$746.2 Centre for Addiction Hospital University Health and Mental Health \$491.8 Montreal Heart \$555.1 \$458.8 Network (UHN) Institute Top Hospital-Intensive Organizations (Research Spending as % of Total Hospital Spending) Rank Medium % Rank Small **University Health Montreal Heart Hospital for Sick** Network (UHN) 17.2 Children 22.9 Institute 18.5 McGill University Health Centre for Addiction Baycrest 13.4 Centre (MUHC) and Mental Health 16.0 Holland Bloorview CHU de Québec -Sinai Health 12.9 Kids Rehabilitation 12.9

Spotlight on Hospital Research Activity FY2021

followed by London Health Sciences Centre/ St. Joseph's Health Care London (\$746,200 per researcher) and University Health Network (\$555,100 per researcher). In the Medium hospital category, Sinai Health (\$706,300 spending per researcher) was the most researcher-intensive institution, followed by Hospital for Sick Children (\$681,700 spending per researcher) and in third spot, Centre for Addiction and Mental Health (\$491,800 per researcher). In the Small category Baycrest (\$975,300 spending per researcher) was the most researcher-intensive and also led the national results. In second place in the Small category was Holland Bloorview Kids Rehabilitation Hospital (\$654,700 spending per researcher), followed in third by Montreal Heart Institute (\$458,800 spending per researcher).

Note: Hospital size is based on Fiscal 2021 total hospital spending: Large = more than \$1 billion; Medium = \$400 million to \$1 billion; Small = less than \$400 million

Measured by hospital intensity (proportion of total hospital spending accounted for by research), University Health Network led the Large hospital category, devoting 17.2% of its total hospital spending to research. Hospital for Sick Children (22.9%), the leader for the Medium category also posted the highest portion of research spending nationally. Montreal Heart Institute topped the Small category

This Year and Next

The Fiscal 2021 Top 40 Research Hospitals results are puzzling. A majority of hospitals/hospital networks/health authorities reported research spending declines. In contrast, their combined total institutional spending did increase by 10.1%, which presumably reflects the effect of new COVID-19 funding on hospital resources. Is it possible that institutions were forced to divert research resources

Top 10 Research Hospitals by Research Spending Growth 2021 % Change Rank Hospital 2020-2021 Provincial Health Services Authority 21.6 CHU de Ouébec - Université Laval 21.2 Health Sciences Centre Winnipeg Kingston Health Sciences Centre 15.0 Trillium Health Partners 13.7 CIUSSS de l'Estrie - Centre Hospitalier Universitaire de Sherbrooke (CHUS) 9.2 CIUSSS du Centre-Ouest-de-l'île de Montréal 8.9 Montreal Heart Institute 7.2 London Health Sciences Centre/ St. Joseph's Health Care London 6.5 Unity Health Toronto 6.4

away from research and to an all-hands-on-deck response to COVID-19 treatment?

Admittedly, the Fiscal 2021 results reflect the early effects of COVID-19 on the health system, and it is possible that the Fiscal 2022 data will shed additional light on the situation. Stay tuned.



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PARTNER PERSPECTIVE



Dr. Allison Sekuler Sandra A. Rotman Chair in Cognitive Neuroscience,

Baycrest's Rotman Research Institute and the University of

President & Chief Scientist, Baycrest Academy for Research and Education at Baycrest Centre for Geriatric Care

President & Chief Scientist, Centre for Aging + Brain Health Innovation (CABHI)

Leading research in difficult times to transform the journey of aging

Tt is predicted that nearly treat dementia, regardless of the economic challenges and uncertainty we are presently facing.

Maximizing impact through interdisciplinary research and key partnerships

To optimize aging and tackle the dementia crisis, scientists, staff, and trainees at Baycrest's Rotman Research Institute (RRI) are paving the way toward the new, interdisciplinary field of predictive neuroscience for precision aging. This field brings together artificial intelligence (AI), neuroinformatics, biomarkers, and sensory and cognitive neuroscience together with information about individuals' lifestyles and environments to model and predict how people will age in the future.

Living with dementia by the and these experts are forming and related neurodegenerative year 2030. As such, it is criti- partnerships with key players disorders. cal that we continue to invest in in the field and opening doors research to prevent, detect, and for funding from a broad variety Harnessing and driving of sources, from federal agencies to diverse foundations and community-based organizations. In addition, Baycrest houses the scientific headquarters of the Canadian Consortium on Neurodegeneration in Aging (CCNA), Canada's largest national dementia research initiative.

With neuroscience at its core, predictive neuroscience for precision aging is a holistic approach that considers the brain in connection with the rest of the body. as well as the environment and society. Through this interdisciplinary approach, we are bringing the world of precision medicine into the field of aging and brain health. This will allow us to create personalized longevity and brain health prescriptions for

technological innovations

in research and care No matter the economic climate, the technology available to us is constantly evolving, and it is crucial that we adapt and use it to its full potential to make research as efficient and impactful as possible. This is precisely what we are doing at Baycrest's Pamela & Paul Austin Centre for Neurology and Behavioural Support, which is home to a transformational AI-supported platform that offers precision medicine and personalized care. Staffed by researchers and an interprofessional clinical team integrating neurology subspecialties, the Austin Centre coordinates assessment, diagnosis, and care for patients experiencing

cognitive decline, dementia, and

Baycrest is home to lead-the prevention, early detection, behavioural challenges, as well toward building a better future Parkinson's disease and multiple

> and Baycrest's Sam and Ida Ross Memory Clinic, the Austin AI platform will help clinicians quickly prioritize patients based on their needs; establish a therapeutic relationship; and provide timely access to memory health resources. The platform will also help clinicians understand each individual's path for optimal aging, and develop predictive models to ensure personalized strategies are implemented for the prevention, early detection, treatment, and care of age-related neurodegeneration.

Creating a better future for all Canadians

In the face of economic challenge and uncertainty, we must remain optimistic and oriented

1 million Canadians will be ing experts in all of these areas, treatment, and care of dementia as movement disorders, including for all. At Baycrest, this includes driving technological and research innovations, advancing Using a novel AI approach basic science in the area of brain initially developed by the RRI health and aging, supporting the next generation of scientific leaders, and adopting open science principles.

We are grateful to all our generous donors. However, government support of research and innovation in aging, brain health, and dementia remains imperative. Canada needs significant investment both in foundational research to further our understanding of aging and the human brain, and in translation and innovation programs to turn ideas into impact: developing, spreading, and scaling novel approaches that prevent, detect, and treat dementia.

Together, we can accelerate research, discovery, and innovation to benefit older adults everywhere, and to create a world where we can all age fearlessly.

COVER STORY

Advancing Research in Uncertain Times

Continued from page 8

from new opportunities for environmental remediation, to future risks to global health, agriculture and biodiversity. Her new startup, Bright Angel Therapeutics, is developing novel therapeutics for the treatment of drug-resistant and lifethreatening fungal infections.

"Many people think the next global pandemic could be a fungal pandemic," said Toope, "so the work Leah is doing with this startup could prove to be essential if we confront a fungal pandemic in the next few years."

Solving complex and immediate global problems like climate change, biodiversity and food security have become bigger priorities for CIFAR, where the translation of science into practical solutions is more on their radar.

"We're not going to be commercializers of research or a public policy think tank," said Toope, "but I think it's important to engage more with government, industry and civil society to understand the big challenges going forward."

CIFAR research also extends into policy, with four CIFAR researchers working on secondment with their home governments in Canada, Israel, the U.S. and South Korea, to develop national science and tech policies. CIFAR Fellow Dan Breznitz just wrapped up his term as the Clifford Clark Visiting Economist at Finance Canada.

Making Government More Science-Savvy

Building better science advice capacity within government was one of the first priorities Dr. Mona Nemer embarked on when she was appointed Canada's inaugural Chief Science Advisor in

She has worked with federal depart-

ments and agencies to establish a network of departmental science advisors, usually university researchers, who assist bureaucrats in integrating scientific considerations into federal policies and programs. Eight have been appointed to date.

"Scientific research can help policymakers understand the potential environmental impacts of a proposed policy, the likely economic outcomes, and the possible health effects," said Nemer. "In addition, scientists can help policymakers identify potential solutions to complex problems." The need for credible, rapid and up-to-

the-minute scientific information became critical during the COVID-19 outbreak. Nemer's office moved quickly to establish the COVID-19 Expert Panel, one of several such groups her office has convened. The panel held its first meeting on March 10, 2020, one day before the World Health Organization declared COVID-19 a global pandemic.

"Experts across the country and from many fields of research responded with overwhelming commitment, and throughScientific research can help policymakers understand the potential environmental impacts of a proposed policy, the likely economic outcomes, and the possible health effects ... [and] identify potential solutions to complex problems.

DR. MONA NEMER Chief Science Advisor of Canada

out the pandemic, they provided me with multidisciplinary advice that I was able to convey to government and release publicly through six formal reports," said Nemer. "Having these established networks helped us immensely and will continue to ensure better emergency preparedness and better communication of

Of course, even the best scientific advice will have little impact if it's not seen as credible by politicians or the public. Mis- and disinformation can have devastating consequences when it comes to making good decisions that affect people's lives and livelihoods.

An important step to building that

trust is allowing scientists to communicate their work with the public, she said. "One of the first major projects my

office undertook was to establish a model policy on scientific integrity for federal departments and agencies. It provides guidelines for ensuring that government scientists are free to share their work publicly and provides guidance on best practices for the ethical conduct of research." Her office also worked with gov-

ernment and international colleagues to establish a framework for making publicly funded research open and accessible

Continued on page 23





























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Canada's **TOP 50 RESEARCH** I FGFS 2022

Dec	le		Do	Sponsored		Daramahana	Research		
Ra	nK		Kes	search Inco	% Change	Researchers 2020-	Intensity \$ per		
2021	2020	College	FY2021 \$000	FY2020 \$000	2020- 2021	2020- 2021 #	Researcher \$000	Prov	Main Affiliated Research Centre(s)/Institute(s)
1	1	Cégep de Trois-Rivières	\$19,864	\$19,521	1.8	131	\$151.6	QC	Centre de Métallurgie du Québec, Innofibre, C2T3
2	3	Niagara College	\$18,116	\$13,917	30.2	61	\$297.0	ON	Walker Advanced Manufacturing Innovation Centre
3	4	Lambton College	\$14,210	\$12,527	13.4	174	\$81.7	ON	Centre of Excellence in Energy & Bio-Industrial Technologies
4	17	British Columbia Institute of Technology	\$13,317	\$6,171	115.8	110	\$121.1	ВС	Centre for Applied Research and Innovation (CARI)
5	6	Southern Alberta Institute of Technology (SAIT)	\$12,964	\$11,726	10.6	119	\$108.9	AB	Green Building Technologies (GBT)
6	11	Sheridan College	\$10,340	\$8,237	25.5	214	\$48.3	ON	Centre for Elder Research
7	5	NAIT - Northern Alberta Institute of Technology	\$9,696	\$12,252	-20.9	74	\$131.0	AB	
9	8	Cégep de la Gaspésie et des Îles George Brown College	\$8,609 \$8,425	\$9,761 \$9,199	-11.8 -8.4	131 79	\$65.7 \$106.6	QC ON	CIRADD, Merinov, Nergica Food Innovation and Research Studio (FIRSt)
10	42	Olds College	\$7,564	\$2,364	220.0	55	\$137.5	AB	Olds College Centre for Innovation
11	14	RRC Polytech	\$7,426	\$6,874	8.0	101	\$73.5	MB	Technology Access Centre for Aerospace & Manufacturing (TACAM)
12 13	10 19	Mohawk College Collège de Maisonneuve	\$7,414 \$7,402	\$8,493 \$5,527	-12.7 33.9	127 68	\$58.4 \$108.9	ON QC	IDEAWORKS Centre d'études des procédés
14	13	Cégep de La Pocatière	\$7,351	\$6,939	5.9	161	\$45.7	QC	chimiques du Québec (CÉPROCQ) Solutions Novika - Biopterre et Optech
15	16	Conestoga College	\$7,083	\$6,348	11.6	221	\$32.0	ON	SMART Centre; Canadian Institute for Safety, Wellness & Performance; Conestoga Food Research & Innovation Lab
16	29	Lethbridge College	\$7,078	\$3,479	103.4	65	\$108.9	AB	Integrated Agriculture Technology Centre, Spatial Technologies Applied Research and Training Centre, Centre for Public Safety Applied Research
17	12	Saskatchewan Polytechnic	\$5,890	\$7,023	-16.1	145	\$40.6	SK	Digital Integration Centre of Excellence (DICE), Sustainability-Led Integrated Centres of Excellence (SLICE)
18	15	Cégep de Shawinigan	\$5,756	\$6,513	-11.6	42	\$137.0	QC	Centre National en Électrochimie et en Technologies Environnementales (CNETI
19 20	20	Cégep Édouard-Montpetit Centennial College	\$5,680 \$5,563	\$7,364 \$4,959	-22.9 12.2	54 101	\$105.2 \$55.1	QC ON	CTA, CEFIR Wearable Interactive Mobile Technologies Access Centre / Aerospace Innovation
21	21	Seneca College	\$5,384	\$4,494	19.8	121	\$44.5	ON	Seneca Centre for Innovation in Life Sciences (SCILS)
22	2	Humber College	\$5,074	\$15,034	-66.2	469	\$10.8	ON	Barrett Centre for Technology Innovation
23 24	32 22	Cégep de Saint-Jérôme College of the North Atlantic	\$4,948 \$4,400	\$2,957 \$4,264	67.3 3.2	65 48	\$76.1 \$91.7	QC NL	Institut du véhicule innovant (IVI) Centre for Innovative Mining Solution (CIMS), Newfoundland and Labrador Workforce Innovation Centre
25	9	Cégep de Thetford	\$4,153	\$8,639	-51.9	68	\$61.1	QC	COALIA, Kemitek
26 27	40	Cégep de Rimouski Cégep de Lévis	\$4,060 \$3,800	\$2,532 \$3,003	60.3	49 43	\$82.9 \$88.4	QC QC	SEREX, Innovation maritime Centre de robotique et de vision
28	30	Cégep de l'Abitibi- Témiscaminque	\$3,717	\$3,325	11.8	38	\$97.8	QC	industrielles (CRVI), TransBIOTech Centre technologique des résidus industriels (CTRI)
29	33	Selkirk College	\$3,715	\$2,799	32.7	25	\$148.6	ВС	Selkirk College Technology Access Centre
30	26	Cégep André-Laurendeau	\$3,537	\$3,569	-0.9	66	\$53.6	QC	OPTECH, InnovLOG
31 32	25 50	Collège d'Alma Camosun College	\$3,324 \$3,073	\$3,813 \$1,695	-12.8 81.3	22 20	\$151.1 \$153.7	QC BC	Agrinova Camosun Technology Access Centre
33		Lakeland College	\$3,047	\$866	251.8	34	\$89.6	AB	G.N. Sweet Livestock Research Facility
34	46	Cégep de Saint-Laurent	\$2,917	\$1,981	47.2	37	\$78.8	QC	Cteau, Artenso
35	38	Fleming College	\$2,914	\$2,601	12.0	44	\$66.2	ON	CAWT, CAMIIT, CIAP
36 37	39	Cambrian College Durham College	\$2,763 \$2,688	\$5,561 \$2,562	-50.3 4.9	90 60	\$30.7 \$44.8	ON	Glencore Centre for Innovation & Centre for Smart Mining Hub for Applied Research in Artificial Intelligence for Business Solutions (The Al Hub)
38		Red Deer Polytechnic	\$2,593	\$421	515.9	68	\$38.1	AB	CIM-TAC, EIC
39 40	37 28	Holland College Collège communautaire du	\$2,558 \$2,527	\$2,622 \$3,507	-2.4 -27.9	28 29	\$91.4 \$87.1	PE NB	Canada's Smartest Kitchen CCNB-INNOV
41	36	Nouveau-Brunswick Nova Scotia Community College	\$2,220	\$2,661	-16.6	52	\$42.7	NS	SEATAC
42	34	Aurora College	\$2,077	\$2,789	-25.5	30	\$69.2	NT	Aurora Research Institute
43	23	La Cité	\$2,025	\$4,001	-49.4	29	\$69.8	ON	Centre d'accès à la technologie en Bio-innovation (CAT-B)
44	35	Loyalist College	\$2,023	\$2,735	-26.0	14	\$144.5	ON	Centre for Natural Products and Medical Cannabis
45 46	27	Collège Boréal Algonquin College	\$1,814 \$1,746	\$1,256 \$3,552	-50.8	28 59	\$64.8 \$29.6	ON ON	Data Analytics Centre, Social Innovation Lab, Victimology Research Centre
47		New Brunswick Community College	\$1,500	\$1,308	14.7	43	\$34.9	NB	Centre for Applied Research and Ubiquitous Computing
48		Justice Institute of British Columbia	\$1,346	\$777	73.2	36	\$37.4	ВС	obiquitous Computing
49		Dawson College	\$1,268	\$976	29.9	28	\$45.3	QC	CRISPESH
50	41	Fanshawe College	\$1,245	\$2,468	-49.6	55	\$22.6	ON	Centre for Applied Research in Biotechnology (CARIB)

Notes:

- 1. Sponsored research income includes all funds to support research received in the form of a grant, contribution or contract from all sources external to the institution. Excludes funds from
- technical service agreements and entrepreneurship operations/activities. Data were obtained through a survey of publicly-funded colleges and from financial statements. 3. Fiscal 2020 figures may have been adjusted as more accurate information became available.
- 5. Data are provided for the main college including affiliated research centres/institutes, where applicable.

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technicians who conducted research in Fiscal 2021.

4. Researcher headcounts include full and part-time faculty, teachers, researchers and

Rank Small

260

178

134

Cégep de Trois-Rivières

Selkirk College

et des Îles

3 Cégep de la Gaspésie

103

60

CANADA'S TOP 50

Research Colleges

College Research Income Growth **Maintains Pace**

The combined sponsored research income of the colleges and cégeps on Canada's Top 50 Research Colleges List reached \$278.2 million in Fiscal 2021, a modest gain of 3.8% over Fiscal 2020. Research income was in the form of research grants, contracts and contributions (cash and in-kind) from third parties. In Fiscal 2021, Total Government funding accounted for \$176.3 million or 63% of the total. Federal government sources accounted for 41% of total funding (\$115.3 million), while Provincial governments contributed 21% (\$59.6 million) to the Government total. Industry funding was responsible for 27% (\$75.4 million) of all funding, while Non-Industry sources provided 6%.

Cégep de Trois-Rivières led the national Top 50 Research Colleges ranking, reporting sponsored research income in Fiscal 2021 of \$19.9 million, a 1.8% increase over Fiscal 2020. Niagara College moved into second place with a large increase of 30.2%, posting research income of \$18.1 million. Lambton College took 3rd spot with \$14.2 million, a gain of 13.4%. Overall, 30 institutions posted research income increases against 20 where research income declined.

Provincial Performance

In Fiscal 2021, 17 Ontario colleges accounted for 36% of the Top 50 total (\$98.8 million) and 15 Quebec cégeps accounted for 31% (\$86.4 million). Alberta's six colleges were responsible for 15% of the national total (\$42.9 million) and British Columbia's four institutions contributed 8%

Top 50 – Leading Pr	ovinces
Province	% of Total
Ontario (17)	36
Quebec (15)	31
Alberta (6)	15
British Columbia (4)	8

Top 10 Research Colleges by

8

Resea	rch Income Growth	
2021 Rank		% Change 2020-2021
1	Red Deer Polytechnic	515.9
2	Lakeland College	251.8
3	Olds College	220.0
4	British Columbia Institute of	
	Technology	115.8
5	Lethbridge College	103.4
6	Camosun College	81.3
7	Justice Institute of British Colu	ımbia 73.2

Cégep de Saint-Jérôme

Cégep de Saint-Laurent

Cégep de Rimouski

Average per-college provincial research income was highest in Manitoba, where RRC Polytech reported \$7.4 million of sponsored research income. Among larger provinces, Alberta averaged \$7.2 million of sponsored research income per institution. Both Ontario and Quebec colleges garnered an average of \$5.8 million and British Columbia colleges attracted \$5.4 million per institution on average.

Research Income Growth

In Fiscal 2021, five of the institutions on the Top 50 reported triple-digit growth in sponsored research income. Among the top gainers were Red Deer Polytechnic (515.9%), Lakeland College (251.8%), Olds College (220.0%), British Columbia Institute of Technology (115.8%) and Lethbridge College (103.4%).

Research Intensity

A number of colleges stood out in terms of research intensity - research income per researcher. The top three were Niagara College (\$297,000 per researcher), Camosun College (\$153,700 per researcher) and Cégep de Trois-Rivières (\$151,600 per researcher). The national average research intensity in Fiscal 2021 was \$69,000 per researcher.

Research Partnerships and Projects

Measuring a college's or cégep's volume of research partnerships and completed research projects provides a good indication of its levels of activity and output. In Fiscal 2021, the Top 50 Research Colleges engaged in a total of 4,822 research partnerships and completed 2,950 research projects. A number of institutions stood out on these measures. Among Large institutions, Sheridan College led reporting with 257 research partnerships in Fiscal 2021. Lambton College (287) was the leader in the Medium category, while Cégep de Trois-Rivières headed the Small tier with 490 partnerships.

In terms of completed research projects the leaders by tier were: Saskatchewan Polytechnic in the Large tier completed 350 projects, Niagara College in the Medium tier completed 228 projects and Cégep de Trois-Rivières in the Small tier completed 497 projects.

Students provide a large element of the college research workforce and receive experience and payment in return. A total of 3,436 students engaged in some kind of paid applied research projects. The top institutions by tier were: Centennial College in the Large tier employed a total of 515 students on its research projects, while Lambton College in the Medium tier employed 260 and Cégep de Trois-Rivières in the Small category hired 103 students.

Industry Research Income

67.3

60.3

In Fiscal 2021, total research income provided by industry via grants, contracts and contributions – a combination of cash and in-kind - was \$70.6 million. A number of institutions stood out in terms of the research income they received from industry

Spotlight on College Research Activity FY2021 Research Partnerships* Rank Large # Rank Medium # Rank Small Sheridan College Lambton College Cégep de Trois-Rivières 490 Niagara College Saskatchewan 190 Cégep de la Gaspésie Polytechnic 208 RRC Polytech et des Îles 258 Algonquin College 168 Collège d'Alma 181 Completed Research Projects* # Rank Medium **Rank Small** Rank Large Niagara College 228 1 Cégep de Trois-Rivières 497 1 Saskatchewan RRC Polytech Cégep de La Pocatière 107 Polytechnic 350 3 Selkirk College Lambton College 69 Algonquin College 155 George Brown College

Industry	Research	Income+

515

339

194

Paid Student Researchers**

Rank Large

Centennial College

Sheridan College

Humber College

	, , , , , , , , , , , , , , , , , , , ,							
Rank	Large	\$000	Rank	Medium	\$000	Rank	Small	\$000
1	Sheridan College	\$3,399	1	Niagara College	\$14,214	1	Cégep de	
2	Southern Alberta Institu	ıte	2	Lambton College	\$2,586		Trois-Rivières	\$5,973
	of Technology (SAIT)	\$3,051	3	Mohawk College	\$1,928	2	Cégep de La Pocatière	\$5,230
3	British Columbia Institu	te				3	Cégep de Shawinigan	\$1,650
l	of Toologic	42 000						

Rank Medium

3

1 Lambton College

2 Durham College

Mohawk College

Industry Research Income+ as % of Total College Research Income

	_							
ank	Large	%	Rank	Medium	%	Rank	Small	%
1	Centennial College	48.9	1	Niagara College	78.5	1	Cégep de La Pocatière	71.1
2	Saskatchewan		2	Loyalist College	47.5	2	Cégep de Trois-Rivières	30.1
	Polytechnic	37.6	3	Durham College	34.7	3	Cégep de Shawinigan	28.7
3	Seneca College	33.9						

- res. College size tiers were based on Fiscal 2021 total college income: Large = \$250 million or more; Medium = \$75 million to less than \$250 million; Small = less than \$75 million.
- Research partnerships and completed research projects with external organizations governed by formal written agreements
- *Students that were involved in applied research projects that were paid for their work.

Includes research income reported from industry sources in the form of a grant, contract and contribution (cash and in-kind). Excludes all funds from technical service agreements and entrepreneurship operations/activities.

sources to work on research projects. In Fiscal 2021, leaders in each category included Sheridan College (Large tier, \$3.4 million of industry research income), Niagara College (Medium tier, \$14.2 million) and Cégep de Trois-Rivières (Small tier, \$6.0 million).

Industry research income comprised a high proportion of total sponsored research income at a number of institutions. Industry research income was highest at Centennial College (Large tier, 48.9% of the total), Niagara College (Medium tier, 78.5%) and Cégep de La Pocatière (Small tier, 71.1%).

This Year and Next

Colleges' and cégeps' posted a respectable Fiscal 2021 research income increase of 3.8%. However, their ongoing challenge is to increase their involvement with the corporate sector, especially local and regional firms that need research assistance. To a large extent success will depend on the willingness and ability of companies to contribute in-kind and financially to joint projects. The in-kind element is of less concern in the upcoming year than the financial element; whether economic conditions will give firms

Top 10 Research Colleges by **Research Intensity** \$ per Researcher College Rank \$000 Niagara College \$297.0 Camosun College \$153.7 Cégep de Trois-Rivières \$151.6 Collège d'Alma \$151.1 Selkirk College \$148.6 Loyalist College \$144.5 Olds College \$137.5 Cégep de Shawinigan \$137.0 NAIT - Northern Alberta Institute \$131.0 of Technology British Columbia Institute of Technology \$121.1

the financial wherewithal and the confidence to plan for their future. At this writing economic conditions are in flux. Colleges and cégeps stand ready to help. Let's hope that firms will pursue the opportunity.





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#1 CANADA'S TOP 50 RESEARCH COLLEGE

- > Applied research in metallurgy, bio-based products and telecommunications
- > Innovation support and technical assistance services
- > Specialized equipments, laboratories and pilot facilities that are unique in Canada
- > Multidisciplinary teams composed of researchers, technicians and teachers
- Training of skilled workers
- > Integration of college and university students in research projects







for 3 years



PARTNER PERSPECTIVE

SHERIDAN COLLEGE:

Driving innovation and impact in industry and communities

Andrea England

Vice Provost, Research Sheridan College

a breakneck speed, the need for bold Land collaborative ways of bringing about meaningful and sustainable impact grows stronger. Generator at Sheridan researchers, innovators, entrepreneurs and changemakers - brings people together Innovation Supports to spark ideas and advance solutions to for Business issues that really matter.

"Engaging and empowering community and industry partners is key to our approach, so that we continue to deliver partner CleanAir.AI on the development social and economic benefits through our work," says Andrea England, Sheridan's Vice Provost, Research. "Our futurefocused view ensures that our faculty, staff and students keep pace with the changing informed about the air they're breathing.

needs of our external partners and of the The applied research out of CAMDT world's evolving landscape."

At Sheridan, purpose and passion unite the extraordinary research, innovation and n a complex world that is changing at entrepreneurship undertaken across its Faculties and Centres. Here are a few examples from the last year that showcase Generator at Sheridan's powerful

Sheridan's Centre for Advanced Manufacturing and Design Technologies (CAMDT) collaborated with industry of an advanced air filter for commercial and residential HVAC systems, called ALVI. ALVI provides its users with cleaner air, while keeping them connected and

addressed the demonstration of ALVI in commercial buildings to offer enhanced air quality and has since contributed to the commercialization of a CleanAIR ServiceTM solution for the hotel industry.

Tackling COVID-19 Misinformation

Professors Dr. Nathaniel Barr and Dr. Michael McNamara from the Sheridan Faculty of Humanities and Social Sciences, in collaboration with BEworks, MediaSmarts, and leading researchers in misinformation, designed, tested and disseminated evidence-based communication and education tools meant to change online behaviour and promote digital literacy. They began by looking at behavioural insights from scientific literature about why people think and act the way they do and then lever-

aged the creativity of Sheridan alumni from the Faculty of Animation, Arts & Design to visualize the findings in a compelling way. The interventions they developed were disseminated widely on social media, garnering over 1.3 million Twitter impressions. The research generated critical knowledge around interventions that can effectively minimize the spread of misinformation.

Support for Under-Represented Communities

A Sheridan research team led by professor Dr. Ferzana Chaze, in collaboration

with the Alzheimer Society of Peel, have created a Hindi-language toolkit (Interacting with Persons with Dementia in South Asian Communities) to help support those in the South Asian community living with dementia. Also available in Punjabi, the toolkit addresses an important gap for the South Asian community by using language and situations that are culturally relevant to demonstrate the ideal ways to relate to those living with dementia and their caregivers.

Generating Socially Conscious Founders

As an accelerator of social ventures, Sheridan's EDGE Entrepreneurship Hub provides critical supports to impact entrepreneurs who seek to balance the triple bottom line of people, planet and profit. EDGE helps changemakers and socially responsible entrepreneurs through mentorship, connections, and enriching programs. For example, Social Impact Catalyst powered by RBC Future Launch provides resources, networks, knowledge and encouragement for young changemakers to turn their impact ideas into reality. The program has recently announced their winter cohort of 33 ventures which will tackle issues of climate change and environmental sustainability.

Through purposeful collaboration, Generator at Sheridan drives innovation and impact in industry and communities. Be a part of it.

Visit sheridancollege.ca/generator



Why innovate without impact?

Together, we spark ideas and advance solutions to the issues that matter.

Research, Innovation & Entrepreneurship Happen.

Where

Be a part of it.

sheridancollege.ca/generator





FOCUS ON MENTAL HEALTH RESEARCH

Continued from page 14

with five community organizations: Hamilton Public Library, Canadian Mental Health Association of Hamilton (CMHA Hamilton), John Howard Society of Ontario, YWCA Hamilton and the Centre for Artistic and Social Practice.

"As a researcher it can be hard to get your foot in the door of these organizations, so one of the goals of ARMS is to create a foundation for those networking opportunities," said Young.

For example, ARMS Executive Director Dr. Diana Singh partnered with CMHA Hamilton to develop a resilience-building workshop and peer support program for librarians, a frontline profession that suffered from high rates of stress and burnout even before the pandemic began. The study sought to evaluate the effects of "emotional labour", which refers to how service employees must often hide or suppress their emotions to do their jobs.

Through ARMS, psychiatrists and social scientists are also contributing to a World Health Organization-led study examining mental, substance and behavioural disorders among college students worldwide. Findings will be shared with the Wellness Centre and Student Success Centre at McMaster to connect students with resources and supports.

"We think that will have an impact overall on the university community," said Young, "and hopefully it can be adopted by universities across the country." Most academic units focus on research or training while hospitals focus on clinical services. We're trying to bring all this into one hub within the centre. It's a new model.

DR. LENA PALANIYAPPAN
Researcher, Douglas Research Centre, McGill University Douglas Research Centre

"The centre will primarily focus on intentional development of mental health services that support young people, aged zero to 25, as well as the informed discovery of treatments that are developmentally appropriate, not just treatments transposed from older people," said Palaniyappan.

Philanthropic support from the Graham Boeckh Foundation provided core funding for the new centre.

"Most academic units focus on research or training while hospitals focus on clinical services. We're trying to bring all this into one hub within the centre. It's a new model," said Palaniyappan, Inaugural Director of the Centre for Youth Mental Health, which will be housed in the middle of three institutions: McGill University, the Douglas Research Centre and the Montreal West Island Integrated University Health and Social Services Centre (CIUSSS). The region is home to nearly 70,000 young people between the ages of 12 and 2, with 82% of families having children between 5 and 17.

politicians outlining expectations and mandates requiring organizations to put supports in place for the people that work there."

Grady said the MHCC report includes seven practical recommendations for healthcare leaders and decision-makers related to issues such as leadership development and fostering an ethical climate.

"No one solution will be applicable in every single healthcare setting," she added. "But doing nothing is not an option. Patient care as well as the retention of healthcare professionals should be of utmost concern to any government and organization."

University of Alberta

Entering palliative care is a very fearful and anxious period. For people with schizophrenia the experience is usually even worse. That's because end-of-life care providers often feel under-resourced and unprepared to address the needs of patients with mental illness, falling back on isolation and medication as their only recourses.

the last 12 years breaking down academic silos that discouraged faculty from medicine or nursing, for example, from working alongside colleagues in social work, urban planning, anthropology, kinesiology or engineering.

"In 2011, the university created cross-cutting research themes designed to pull people out of their faculty silos to create this campus-wide connection which is quite powerful," said Dr. William Ghali, Vice-President Research at UCalgary.

This interdisciplinary approach to brain and mental health research cuts across several faculties and research centres, including the Hotchkiss Brain Institute, the O'Brien Institute for Public Health, Werklund School of Education, School of Public Policy and the Alberta Children's Hospital Research Institute.

"It's also important to connect these partnerships with communities, including health systems, schools, and community organizations. These are the groups that translate research into practice," said Ghali.

In the area of children's mental health, for example, UCalgary clinical psychologist Dr. Sheri Madigan works with interdisciplinary teams and community partners to examine the social factors that shape children's mental health, including parental mental health, pandemic impacts, and experiences of adversity.

The recent winner of the Royal-Mach-Gaensslen Prize for Mental Health Research also examines the resilience factors that buffer children from developing mental illness, such as receiving support from caregivers, teachers, or community members.

A longstanding partner, the City of Calgary, collaborates with UCalgary to come up with the evidence needed to tackle pressing municipal issues, from transportation and waste reduction to youth crime, homelessness and immigration.

UCalgary recently worked with the city to develop its new Mental Health and Addictions Strategy. Researchers from different disciplines played a key role in designing the strategy, identifying service gaps in support networks, outreach services and emergency response systems.

"The University of Calgary leaders were a big part of working with the city on developing that strategy," said Ghali. "The connections across our campus and connections and partnerships beyond our campus are a big part of how we strive to be impactful for mental health and addiction."

Toronto Metropolitan University

Post-traumatic stress disorder is one of the most disabling mental health conditions. It is also one of the most treatable.

That message is one you will often hear from Dr. Candice Monson, a Professor of Psychology at the Toronto Metropolitan University (TMU) and one of the foremost experts on traumatic stress and the use of individual and conjoint (couples and family) therapies to treat PTSD.

"When it comes to both research and clinical training, she's setting new national and international bars for treating and supporting families experiencing post-traumatic stress injury," said Dr. Steven Liss, Vice-President, Research and Innovation at TMU.

In a project that received early support from the Department of National Defence and the Canadian Institute for Military and Veterans Health Research, Monson brought clinical psychologists together with



DR. WILLIAM GHALI Vice-President Research, University of Calgary



Université de Sherbrooke

A new national study is raising the alarm on high rates of psychological distress, depression, suicidal ideation and burnout among members of Canada's legal profession. Led by Dr. Nathalie Cadieux at the Université de Sherbrooke's Business School, with funding from the Federation of Law Societies of Canada and the Canadian Bar Association, this first-of-its-kind study fills a critical gap in the knowledge about the mental health of legal professionals.

Of the more than 7,300 legal professionals surveyed, psychological distress was reported by 59.4%, including 63.7% of female professionals. Moderate to severe depressive symptoms were reported by 28.6% of respondents.

"Now that the different stressors have been identified, the next step is to come up with the right interventions, the right solutions, for addressing this problem," said Dr. Jean-Pierre Perreault, Vice-Rector, Research and Graduate Studies, Université de Sherbrooke.

Faculties that traditionally haven't been involved in mental health research – such as business and education – are increasingly being drawn into the field at Sherbrooke. For example, the Royal Bank of Canada's support for the RBC Centre for University Expertise in Mental Health brings together 30 researchers from multiple research disciplines, including human sciences, medicine, education and human kinetics.

One project developed – the HARDIS program – pools the expertise of academia and the community to meet the needs of children, adolescents and young adults at risk of mental health problems. Efforts are now underway to scale up the program across Quebec.

"Moreover, we will have a big announcement in a few weeks on an important investment in partnership with several other institutions in mental health related to students at the graduate levels," said Perreault.

About two-thirds of Sherbrooke's research in mental health is driven by or with external partners, which Perreault credits to the university's five-yearold business development group's success in securing partnerships with community organizations.

"Our society has to address many questions around mental health and the wellness of people," he said. "These partnerships are essential for ensuring that university research aligns with those societal needs."

McGill UniversityEarly interventions to prevent severe mental illness

in adults don't always work with children and youth. "This is really an impactful problem because

young people don't often accept the interventions that were created for older people," said Dr. Lena Palaniyappan, a psychiatrist and researcher at the McGill University Douglas Research Centre.

McGill University Douglas Research Centre.

McGill is working to solve this longstanding problem with the launch later this year of the Centre of Excellence in Youth Mental Health.

Youth with lived experience have also been invited to help guide the direction of the new centre. "We involve them right from the beginning with activities like priority setting and planning services," said Palaniyappan.

To have a real impact, the centre plans to work with families over a period of several years to identify warning signs of mental illness, such as socially deprived families or families with a history of mental health problems.

"By the time symptoms start in young people, they already have dysfunctions, they've already lost employment, and they've already lost interpersonal connections," said Palaniyappan. "So the right time for intervention is before the symptoms start."

Queen's University

Healthcare worker burnout continues to rise across Canada, further straining an already overwhelmed health system plagued by long wait times and staff shortages. Having more compassionate working conditions would help to reduce this stress.

That's one recommendation in a report released last fall by the Mental Health Commission of Canada (MHCC) and led by Dr. Colleen Grady at Queen's University.

The report found that "while healthcare workers spend their working hours caring for others, many are challenged to find the time and energy for self-care".

Grady surveyed nearly 1,000 health care workers across the country and the results were startling: 40% reported being burned out, 50% intend to leave the profession, and just 60% are satisfied with the quality of care they provide. Participants included nurses, social workers, personal support workers, physicians and paramedics.

"Healthcare is a high stress environment, that's nothing new," said Grady, Associate Professor and Research Manager with the Centre for Studies in Primary Care and Department of Family Medicine at Queen's. "Our study looked at the structural supports within teams or within organizations for psychological self-care or protection for moral distress."

The National Standard of Canada for Psycho-

logical Health and Safety in the Workplace recently added these two psychosocial factors to prevent psychological harm at work. In response, Grady stressed that in addition to caring for the sick, caring for people that work in those environments must also be a top priority.

for people that work in those environments must also be a top priority. "Our research found pockets of excellence. Some organizations are doing really well in acknowledging mental health struggles and putting supports

in place. But that's not across the board. You need

"There's a disconnect between mental health care and palliative care," said Dr. Tanya Park, Associate Professor in the University of Alberta's Faculty of Nursing. 'You may have a situation where a patient who has both schizophrenia and terminal cancer is not referred into palliative care from their psychiatric care. For those that do move into palliative care, that mental health treatment team they may have known their whole life don't get included."

Park said her research is about care and caring: understanding what it's like for nurses to care for patients in psychiatric distress, and what it's like for patients to receive that care. She interviewed nurses and patients to understand this disconnect, and to identify areas where their experiences overlap.

To help address this challenge, Park developed an educational tool that teaches nurses how to listen to patients and what they're going through, and to allow themselves time to reflect on what they heard. The tool uses video clips from the popular YouTube channel Living Well with Schizophrenia, hosted by Lauren Kennedy, a patient partner on Park's research team. Kennedy also used her YouTube channel to recruit patients for the project.

"We tested this tool recently with a small group and found that it made quite a difference – how listening to someone with a mental illness talk about what their everyday life actually can make you think differently about the care you provide," said Park.

The stories from nurses and patients will be turned into videos to help healthcare providers understand the needs people with mental illness face at the end of their lives.

"Our goal is to improve care. So when someone goes into palliative care and says they have schizophrenia, the staff will ask who they've been working with and then get that person involved," she added. "It's about reimaging caring and recognizing that when we connect we do better."

University of Calgary

No one scientific discipline has all the answers when it comes to addressing the complex challenges surrounding mental illness.

That's why the University of Calgary has spent

digital media experts from the IMPACT Lab at TMU to develop an online self-help program for PTSD.

Couple HOPES (Helping Overcome PTSD and Enhance Satisfaction) is an evidence-based program that targets both the individual with PTSD and their intimate partner, recognizing that partners are often the gateway to getting people to seek treatment.

TMU's Department of Psychology has a long history in mental health research. Today, the department has 30 labs that provide research and training space for over 30 faculty and more than 100 masters and doctoral students.

"Our strength in mental health research and psychology has really grown particularly over the last 10 to 15 years," said Liss. "It's one of the most sought out clinical psychology graduate programs in the province, if not the country."

More of this research is being used on campus to help students, faculty and staff struggling with mental health issues. Plans for a new Student Wellbeing Centre include consolidating all health services across the campus under one roof.

"There's a strong interest in student services at that intersection of supporting research, development and professional training," said Liss. "We're looking to create greater synergies and integration across all our initiatives to highlight the important role our university can play in supporting mental health and supporting community, people and families as well as our own staff and student community."

Sheridan College

Sheridan College is among a growing number of academic institutions leveraging its expertise to address mental health in our communities. Generator at Sheridan is a driver of this work – researchers, innovators, and changemakers propelling research, innovation and entrepreneurship forward.

"Health and well-being in our communities is a priority for Sheridan, and we continue to work collaboratively with our research partners to find

We're looking at our research from a holistic level, and how our ideas and innovations can support and drive the health and well-being of our communities.

DR. VICKI MOWAT
Director, Generator at Sheridan, Sheridan College



Continued from page 20

innovative solutions to the challenges they're facing. Our emerging research in the area of mental health, particularly the emotional and cognitive health of the elderly and their caregivers, is an important component of that work," said Dr. Vicki Mowat, Generator at Sheridan's Director, Research.

One example is Dr. Kate Dupuis' research into how arts-based approaches can enhance the health and well-being of older adults and those who care for them. The Schlegel Innovation Leader in Arts and Aging at Sheridan's Centre for Elder Research was awarded a new College and Community Social Innovation Fund grant from the Natural Sciences and Engineering Research Council of Canada (NSERC) to study how art and self-expression can help staff in long-term care homes experiencing chronic stress and burnout.

Community partners LUCID, the Research Institute for Aging, Concerts in Care Ontario and Schlegel Villages are involved in CreateMore - a music and meditation-based intervention to support staff and to help caregivers connect with residents on a deeper, personal level.

"Developing practical interventions is Seneca's sweet spot," said Dr. Namrata Barai, Director, Applied Research at Seneca College. "We're asked to develop guidelines, best practices and policy recommendations that can be used by organizations serving these communities. But it's our partners who work at the grassroots to convert these findings into

In 2020, the Intercultural Iranian Canadian Resource Centre in Toronto partnered with Dr. Bahar Biazar, a professor at Seneca's English Language Institute, to conduct research on how older adult immigrants coped during the pandemic.

The study found that the level of isolation and loneliness experienced by these seniors was more than what most people experienced. It was a problem many seniors reported grappling with even before the arrival of COVID-19, revealing a need for resettlement services that focus specifically on the needs of older immigrants.

"Most immigrants, especially those coming to join the workforce, have access to those services," said Barai. "But senior immigrants face isolation, language barriers and don't have much in terms of social structures. This project came up with several most of the mainstream psychological journals," said Ungar, Founder and Director of the Resilience Research Centre at Dalhousie University.

Last November, he was ranked the world's number one social work researcher based on the impact of his scholarly writing and citations. He and 22 other researchers from his field also ranked as the most influential among 100,000 scientists globally across all disciplines.

The Mental Health and Well-being Research and Training Hub (MeWeRTH) brings together researchers, students, and community partners to make research on mental health, well-being, and resilience more easily available to the public.

"This is a community with a focus on the multifactorial notion of wellness - not illness - and creating opportunities to provide evidence-based education and research around well-being," said

If you can provide quality, science-based information and education to the public in an accessible manner then hopefully that information can be used to improve their lives and the lives of others in the community.

> DR. JOANNA POZZULO Director, Well-being Research and Training Hub (MeWeRTH), **Carleton University**

Psychology and psychiatry research in the past mostly talked about individual qualities like motivation, self-control and grit. It was social workers, myself included, who pushed this idea of thinking about the contextual and cultural factors that play a much bigger role in resilience and mental health.

> DR. MICHAEL UNGAR Director, Resilience Research Centre, Dalhousie University

In a separate project funded by an NSERC Engage grant, Sheridan's Screen Industries Research and Training Centre has partnered with Reimagine AI (an artificial intelligence creative studio in Montreal) to build human-like digital characters for a mobile app that can provide meaningful companionship for patients with Alzheimer's and other forms

The technology also provides caregivers with an alternative and creative way of engaging with patients that mimics their interactions, freeing-up time that is required in their day-to-day work.

"The opportunities to explore and incorporate new technologies in mental health research are incredibly exciting. We're looking at our research from a holistic level, and how our ideas and innovations can support and drive the health and well-being of our communities," said Mowat.

Seneca College

No one is immune from mental illness. At Seneca College, a growing and diverse number of community partners are approaching their experts for help in tailoring solutions for specific groups facing unique challenges, from older immigrants struggling with isolation to post-secondary students at risk of developing a gambling addiction.

recommendations for improving service delivery for this specific group."

The project was funded through Seneca's Centre for Health and Social Innovation, which includes a focus on community health and mental health.

"Seneca Innovation brings together faculty from different schools who can develop products and services that touch upon health and social innovation," she said.

In another project, Dr. Farah Jindani and a research team from Seneca's School of Community Services collaborated with the Centre for Addiction and Mental Health to design and evaluate an online gambling self-help tutorial for college students. The aim is to teach postsecondary students about the fallacies of gambling and what they can do to avoid or decrease their problem gambling.

Dalhousie University

What does it mean to be resilient in the face of adversity? There was a time when the research community believed individuals were mostly respon-

Dr. Michael Ungar began challenging that established thinking nearly 30 years ago as a young scholar in the nascent field of social work.

"When I started out I was being rejected by

"Psychology and psychiatry research in the past mostly talked about individual qualities like motivation, self-control and grit," he said. "It was social workers, myself included, who pushed this idea of thinking about the contextual and cultural factors that play a much bigger role in resilience and mental health."

Ungar has shown that several factors contribute to resilience, including positive relationships, an extended family, cultural connections, social cohesion, education, housing and social justice, as well as access to resources like affordable recreational programs.

"We're looking at how all these systems collide to either build or tear down a person's resilience," he explained.

Ungar's pioneering research has also contributed to greater acceptance of using qualitative - instead of only quantitative - methods to better understand the impact of culture and society on resilience.

"Today it would be considered rude and almost abusive to do this type of research without also accounting for people's exposure to risks or their understanding of their own lived experience," he said.

Ungar is on a mission to put his research into the hands of even more scholars. Last year he published his 18th book, and paid the publisher, Oxford University Press, \$30,000 to make the text globally accessible online as a downloadable PDF, forgoing any royalties the sales would have generated.

"I did that because I wanted scholars all around the world to latch onto the idea of multisystemic resilience," he said. "If you really want to jumpstart the conversation, you have to be bold and maybe a bit audacious."

Carleton University

Research has its greatest impact when it's shared and used. That was Carleton University's goal during the first months of the COVID-19 pandemic when it launched a virtual space to share research that can make a positive impact on people's lives and the broader community.

Dr. Joanna Pozzulo, a Chancellor's Professor in the Department of Psychology who created and heads MeWeRTH.

In addition to creating knowledge, the hub also disseminates it in a way that is available and accessible to all. Part of this knowledge transfer includes hosting public events and providing educational opportunities.

MeWeRTH's latest offering was a Lived Experience Luncheon series held virtually that included presentations from a researcher at the Department of National Defence and the CEO of a local camera business who shared their challenges and resilience along their path to wellness.

Always with the goal of providing the audience with the latest research on wellness, a presentation by Dr. Alex Auerbach, Director of Wellness and Development for the Toronto Raptors, discussed the states and traits that support high performance in elite sport and the parallels to overcoming and thriving in everyday life.

"MeWeRTH launched in the middle of the pandemic and much to my surprise it became far bigger than I ever thought," said Pozzulo. "There was a real appetite for this information both locally and globally."

If anyone is interested in more in-depth knowledge on wellness but aren't currently a university student, non-credit courses based in science on a variety of empowering topics are available through MeWeRTH.

"If you can provide quality, science-based information and education to the public in an accessible manner then hopefully that information can be used to improve their lives and the lives of others in the community," said Pozzulo. "Intervening earlier can lead to better outcomes, less intensive care later, and ultimately freeing up resources for others who may

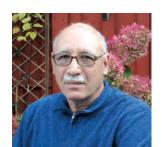
Debbie Lawes, Debbie@dovercourteditorial.ca, is an Ottawa-based writer specializing in science, technology and innovation.







FROM THE CEO'S DESK



Ron Freedman
CEO
Research Infosource Inc.

Taking the "temperature" of research in Canada

he mission of Canada's Innovation Leaders (CIL) is to take the "temperature" each year of the state of research at the country's universities, colleges, hospitals, and companies. We do this by gathering, analyzing and reporting on some key indicators of research performance such as research income/spending and research personnel participation. From time to time we produce additional metrics, such as scientific publications, research partnerships and intellectual property (IP). Over the twenty-one years we have been doing this we have built up a trove of data that provides insight into the health of the research enterprise. We also work to bring the raw numbers to life with examples or stories that illustrate the richness of the research being undertaken. In addition, we strive to highlight issues and challenges facing the research ecosystem, as with this year's feature article on Advancing Research in Uncertain Times.

CIL2022 included a *Focus on Mental Health Research* as a way of gaining further insight into this specialized area of research in Canada. Our report on mental health research serves as a reminder that research here in Canada is flourishing. While it focuses on just one field of research among many – mental health – it also reveals broader truths about research in general.

First, that research is multidisciplinary; in this instance it spans the health and life sciences, social sciences and humanities, and natural sciences and engineering. As the mental health research vignettes make clear, developing and implementing successful approaches requires input



We have built up a trove of data that provides insight into the health of the research enterprise.

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from diverse scientific disciplines, as well as the involvement of patients, caregivers and communities.

students who work with them. Furthermore, research is not the province of any one type of institution – university,

A second truth is that research is at root a bottom-up activity. It is the sum of the creativity and hard work of individual researchers and research teams working on their own and with collaborators to define the key challenges and issues, and find ways to address them. The research institutions they work in and with are also important, providing infrastructure, administrative and often financial support, but progress is ultimately down to the inquisitiveness of researchers and the

students who work with them. Furthermore, research is not the province of any one type of institution – university, college, hospital or company. Rather, all can and do make useful contributions in order to move a field forward.

As many of the contributors to our feature article on *Advancing Research* in *Uncertain Times* make clear, while excellent research is a necessary condition for social and economic progress at the national and international levels, it is by no means sufficient. The ability to translate research success into goods and services that raise standards of living and well-being

demands a different set of conditions. On those measures Canada clearly has some way to go.

Like it or not, we are in an ongoing race with other countries... and with ourselves. Canada's levels of productivity and per capita GDP have stagnated for a considerable time. We are inching slowly forward, but others are moving more rapidly. We can debate whether rising levels of wealth in comparison with other countries is necessary or even moral, but what is less debatable is that with our economically active population in steady decline we will need additional economic and social capital just to maintain our standards of living and quality of life, leaving aside any improvement. For this we will rely on our research community working hand in hand with other parts of society.

RE\$EARCH Infosource Inc.

For 21 years Research Infosource has been proud to be associated with Canada's top innovators in our universities, hospitals, colleges and companies.

We celebrate their contributions and achievements – individually and collectively – that remind us of the value of our investments in research and innovation and the importance of linking our research capacity to those who can put it to its best use.

WE SALUTE AND THANK THEM ALL







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Granting Council Research Income **Performance** FY2019-FY2021

Research Infosource shines the spotlight on the granting councils research income performance – as measured by research income received by colleges from each national granting council between FY2019-FY2021.

NSERC	Research Income		Research Council of Canada (NSERC) NSERC Research Income as % of Total College Research Income			
Rank Large \$000				Large	%	
1	NAIT - Northern Alberta		1	Algonquin College	35.4	
	Institute of Technology	\$10,358	2	Saskatchewan Polytechnic	32.5	
2	Southern Alberta Institute of		3	Centennial College	30.9	
	Technology (SAIT)	\$8,628				
3	Sheridan College	\$7,097				
Rank	Medium	\$000	Rank	Medium	%	
1	Lambton College	\$10,606	1	La Cité	38.0	
2	RRC Polytech	\$5,856	2	Nova Scotia Community College	35.2	
3	Collège de Maisonneuve	\$4,614	3	Camosun College	34.8	
Rank	Small	\$000	Rank	Small	%	
1	Cégep de Trois-Rivières	\$16,358	1	Cégep de l'Abitibi-Témiscamingue	45.5	
2	Cégep de Thetford	\$4,991	2	Selkirk College	43.2	
3	Cégep de La Pocatière	\$4,932	3	Holland College	37.3	

SSHRC Research Income				SSHRC Research Income as % of Total College Research Income				
Rank	Large	\$000	Rank	Large	%			
1	George Brown College	\$1,891	1	Algonquin College	9.3			
2	Algonquin College	\$662	2	George Brown College	7.9			
3	Conestoga College	\$555	3	Fanshawe College	4.5			
Rank	Medium	\$000	Rank	Medium	%			
1	Mohawk College	\$745	1	Durham College	7.8			
2	Collège de Maisonneuve	\$573	2	Loyalist College	4.2			
3	Durham College	\$538	3	Nova Scotia Community College	4.0			
Rank	Small	\$000	Rank	Small	%			
1	Selkirk College	\$306	1	Selkirk College	3.7			
2	Aurora College	\$265	2	Aurora College	3.3			
3			3					

Canada Foundation for Innovation (CFI)								
CFI Research Income				CFI Research Income as % of Total College Research Income				
Rank	Large	\$000	Rank	%				
1	NAIT - Northern Alberta		1	Fanshawe College	16.1			
	Institute of Technology	\$3,128	2	Centennial College	12.0			
2	Southern Alberta Institute of		3	NAIT - Northern Alberta				
	Technology (SAIT)	\$2,762		Institute of Technology	9.3			
3	Sheridan College	\$2,030		o,				
Rank	Medium	\$000	Rank	Medium	%			
1	Lethbridge College	\$3,466	1	Lethbridge College	24.6			
2	RRC Polytech	\$3,311	2	Loyalist College	17.5			
3	Lambton College	\$3,287	3	Camosun College	16.4			
Rank	Small	\$000	Rank	Small	%			
1	Cégep de Trois-Rivières	\$7,388	1	Cégep de Lévis	17.2			
2	Cégep de Shawinigan	\$1,581	2	Collège d'Alma	16.0			
3	Collège d'Alma	\$1,577	3	Cégep de Trois-Rivières	13.4			

1. Based on colleges on the Top 50 Research Colleges list for all 3 years; and reported \$50,000 or more in total from each

Based on colleges on the 10p 30 Kesearch Colleges list for all 3 years; and reported \$30,000 or granting council between FY2019-FY2021.

Data were obtained through a survey of publicly-funded colleges and from financial statements.

College size tiers are based on Fiscal 2021 total college income: Large = \$250 million or more; Medium = \$75 million to less than \$250 million; Small = less than \$75 million.

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Canada's **TOP 100 CORPORATE** R&D SPENDERS 2022

researchinfosource.com

	16	KD 3PE					4 0	
Ra	nk		R	R&D Spending		Revenue	R&D Intensity	
2021	2020	Company	FY2021 \$000	FY2020 \$000	% Change 2020- 2021	FY2021 \$000	R&D Spending as % of Revenue**	Industry
1	3	Shopify Inc.*	\$1,070,969	\$740,678	44.6	\$5,780,961	18.5	Software & Computer Services
2	2 6	Constellation Software Inc.* TELUS Corporation	\$965,195 \$799,000	\$808,925 \$553,000	19.3 44.5	\$6,400,371 \$17,258,000	15.1 4.6	Software & Computer Services Telecommunications Services
4	1	Magna International Inc.*	\$794,719	\$1,113,445	-28.6	\$45,429,347	1.7	Automotive
5 6	9 7	Rogers Communications Inc. BCE Inc.	\$682,428 \$618,024	\$500,104 \$535,000	36.5 15.5	\$14,655,000 \$23,449,000	4.7 2.6	Telecommunications Services Telecommunications Services
7	5	Pratt & Whitney Canada Corp. (fs)	\$590,002	\$597,783	-1.3	nd	2.0	Aerospace
8 9	4 7	Bausch Health Companies Inc.* Suncor Energy Inc.	\$582,878 \$565,000	\$606,358 \$535,000	-3.9 5.6	\$10,572,019 \$39,101,000	5.5 1.4	Pharmaceuticals/Biotechnology Energy/Oil & Gas
10	10	Open Text Corporation*	\$503,000	\$496,906	6.3	\$4,244,495	12.4	Software & Computer Services
11	12	AMD Canada (fs)	\$480,016	\$426,844	12.5	nd	1.5	Electronic Systems & Parts
12 13	14	Canadian Natural Resources Limited SAP Canada Inc. (fs)	\$450,000 \$400,000	\$340,670 na	32.1	\$30,057,000 nd	1.5	Energy/Oil & Gas Software & Computer Services
14	13	Ericsson Canada Inc. (fs)	\$390,000	\$350,000	11.4	nd		Comm/Telecom Equipment
15 16	16 18	CGI Group Inc. BRP Inc.++	\$303,170 \$289,800	\$304,103 \$242,300	-0.3 19.6	\$12,126,793 \$7,647,900	2.5 3.8	Software & Computer Services Other Manufacturing
17	17	BlackBerry Limited* ++	\$274,517	\$288,423	-4.8	\$900,013	30.5	Software & Computer Services
18 19	20 19	Zymeworks Inc.* CAE Inc.	\$250,389 \$202,800	\$226,088 \$241,200	10.7 -15.9	\$33,443 \$2,981,900	748.7 6.8	Pharmaceuticals/Biotechnology Aerospace
20	21	Cisco Canada (fs)	\$186,476	\$172,832	7.9	nd		Comm/Telecom Equipment
21 22	25 23	Hydro-Québec Sanofi Canada (fs)	\$144,300 \$142,416	\$133,800 \$145,278	7.8 -1.3	\$14,526,000 \$889,025	1.0 16.1	Electrical Power & Utilities
23	28	Teck Resources Limited	\$143,416 \$129,000	\$143,276	33.0	\$13,481,000	1.0	Pharmaceuticals/Biotechnology Mining & Metals
24	43	Repare Therapeutics Inc.*	\$114,253	\$54,989	107.8	\$9,527	1,199.3	Pharmaceuticals/Biotechnology
25 26	26 40	Novelis Inc.* (fs) GlaxoSmithKline Inc. (fs)	\$104,041 \$94,137	\$112,686 \$60,501	-7.7 55.6	\$15,387,966 \$774,361	0.7 12.2	Mining & Metals Pharmaceuticals/Biotechnology
27	27	Sierra Wireless, Inc.*	\$89,741	\$110,432	-18.7	\$593,167	15.1	Comm/Telecom Equipment
28 29	24 22	Imperial Oil Limited Bombardier Inc.*	\$89,000 \$88,999	\$140,000 \$162,322	-36.4 -45.2	\$37,508,000 \$7,627,548	0.2 1.2	Energy/Oil & Gas Aerospace
30	29	Evertz Technologies Limited	\$79,895	\$90,827	-12.0	\$342,888	23.3	Comm/Telecom Equipment
31 32	33 45	Descartes Systems Group Inc.* ++ Ballard Power Systems Inc.*	\$78,431 \$77,920	\$72,530 \$47,649	8.1 63.5	\$532,349 \$130,997	14.7 59.5	Software & Computer Services Machinery
33	53	AbCellera Biologics Inc.*	\$77,795	\$39,431	97.3	\$470,317	16.5	Pharmaceuticals/Biotechnology
34 35	31 30	Northland Power Inc. Enghouse Systems Limited	\$77,660 \$77,197	\$74,615 \$79,757	4.1 -3.2	\$2,093,255 \$467,177	3.7 16.5	Electrical Power & Utilities Software & Computer Services
36	42	AstraZeneca Canada Inc. (fs)	\$75,886	\$58,076	30.7	\$914,968	8.3	Pharmaceuticals/Biotechnology
37 38	61 39	BELLUS Health Inc.*	\$74,003	\$31,832	132.5	\$20	1 1	Pharmaceuticals/Biotechnology
39	37	Canadian Solar Inc.* Kinaxis Inc.*	\$73,213 \$71,981	\$60,592 \$63,614	20.8 13.2	\$6,614,931 \$314,285	1.1 22.9	Energy/Oil & Gas Software & Computer Services
40	47	Lightspeed POS Inc.* +	\$68,676	\$46,268	48.4	\$277,936	24.7	Software & Computer Services
41 42	34	MDA Ltd. Aurinia Pharmaceuticals Inc.*	\$66,000 \$64,103	\$7,400 \$67,514	791.9 -5.1	\$476,900 \$57,166	13.8 112.1	Aerospace Pharmaceuticals/Biotechnology
43		Rio Tinto Iron & Titanium Inc. (fs)	\$61,025	\$40,675	50.0	\$1,405,000	4.3	Mining & Metals
44 45	50 54	D2L Inc.* ++ Aptose Biosciences Inc.*	\$58,412 \$57,642	\$42,390 \$39,290	37.8 46.7	\$190,382 \$0	30.7	Software & Computer Services Pharmaceuticals/Biotechnology
46	38	Canopy Growth Corporation	\$57,582	\$61,812	-6.8	\$607,198	9.5	Pharmaceuticals/Biotechnology
47 48	35 48	Linamar Corporation Syncrude Canada Ltd.	\$54,477 \$53,890	\$66,950 \$45,786	-18.6 17.7	\$6,536,574 nd	0.8	Automotive Energy/Oil & Gas
49	49	Novartis Pharmaceuticals Canada Inc. (fs)	\$49,760	\$45,000	10.6	nd		Pharmaceuticals/Biotechnology
50 51	52 55	Pharmascience Inc. Celestica Inc.*	\$49,461 \$48,134	\$40,893 \$38,635	21.0 24.6	nd \$7,063,096	0.7	Pharmaceuticals/Biotechnology Electronic Systems & Parts
52	46	Ontario Power Generation Inc.	\$48,000	\$47,000	2.1	\$6,877,000	0.7	Electrical Power & Utilities
53 54	94 51	Titan Medical Inc.* Martinrea International Inc.	\$47,577 \$41,155	\$10,647 \$41,215	346.9 -0.1	\$25,187 \$3,783,953	188.9 1.1	Medical Devices & Instrumentation Automotive
55	60	Cascades Inc.	\$40,522	\$32,021	26.5	\$3,956,000	1.0	Forest & Paper Products
56 57	56 44	Thales Canada Inc. (fs) Dorel Industries Inc.*	\$40,100 \$36,199	\$37,863 \$53,956	5.9 -32.9	\$521,000 \$2,204,537	7.7 1.6	Aerospace Other Manufacturing
58	69	Theratechnologies Inc.*	\$35,789	\$24,570	45.7	\$87,523	40.9	Pharmaceuticals/Biotechnology
59 60	65 63	Pason Systems Inc. Westport Fuel Systems Inc.*	\$32,220 \$31,581	\$26,977 \$28,139	19.4 12.2	\$206,686 \$391,608	15.6 8.1	Software & Computer Services Other Manufacturing
61	84	Essa Pharma Inc.*	\$30,409	\$16,294	86.6	\$0	0.1	Pharmaceuticals/Biotechnology
62 63	70 66	Absolute Software Corporation* IMV Inc.*	\$29,161 \$28,931	\$24,547 \$26,605	18.8 8.7	\$151,403 \$0	19.3	Software & Computer Services Pharmaceuticals/Biotechnology
64	62	Héroux-Devtek Inc.	\$28,534	\$30,650	-6.9	\$570,685	5.0	Aerospace
65	64	mdf commerce inc.	\$28,399	\$27,870	1.9	\$84,719	33.5	Software & Computer Services
66 67	71 81	Sangoma Technologies Corporation Docebo Inc.*	\$27,194 \$26,701	\$23,913 \$17,440	13.7 53.1	\$167,345 \$130,667	16.3 20.4	Computer Equipment Software & Computer Services
68 69	72 74	Vecima Networks Inc.	\$26,247 \$25,940	\$22,862	14.8	\$124,177	21.1	Comm/Telecom Equipment Software & Computer Services
70	74 79	Magnet Forensics Inc.* Neo Performance Materials Inc.*	\$25,940 \$24,893	\$21,779 \$18,411	19.1 35.2	\$88,105 \$675,951	29.4 3.7	Mining & Metals
71 72		Thinkific Labs Inc.* Edesa Biotech, Inc.*	\$24,382	\$8,512	186.4 403.7	\$47,780 \$0	51.0	Software & Computer Services Pharmaceuticals/Biotechnology
72 73	73	Winpak Ltd.*	\$22,497 \$22,351	\$22,150	0.9	\$1,255,999	1.8	Rubber & Plastics
74 75	83	Coveo Solutions Inc.*	\$20,154	\$16,993 \$17,276	18.6	\$69,286	29.1	Software & Computer Services
75 76	82 41	TECSYS Inc. Liminal BioSciences Inc.	\$18,568 \$18,347	\$17,276 \$58,594	7.5 -68.7	\$123,101 \$643	15.1	Software & Computer Services Pharmaceuticals/Biotechnology
77	98	Blackline Safety Corp.	\$16,394	\$9,241	77.4	\$54,312	30.2	Software & Computer Services
78 79	77 86	Computer Modelling Group Ltd. Intertape Polymer Group Inc.*	\$15,864 \$14,894	\$20,751 \$15,019	-23.6 -0.8	\$67,363 \$1,919,696	23.6 0.8	Software & Computer Services Rubber & Plastics
80	100	Antibe Therapeutics Inc.	\$14,434	\$8,223	75.5	\$9,713	148.6	Pharmaceuticals/Biotechnology
81 82	100 87	Q4 Inc.* Baylin Technologies Inc.	\$13,894 \$13,682	\$8,773 \$13,272	58.4 3.1	\$69,429 \$102,494	20.0 13.3	Software & Computer Services Comm/Telecom Equipment
83	58	Optiva Inc.*	\$13,174	\$34,258	-61.5	\$81,773	16.1	Software & Computer Services
84 85	89 90	Oncolytics Biotech Inc. Knight Therapeutics Inc.	\$12,920 \$12,692	\$12,945 \$11,725	-0.2 8.2	\$0 \$243,478	5.2	Pharmaceuticals/Biotechnology Pharmaceuticals/Biotechnology
86	88	AcuityAds Holdings Inc.	\$12,680	\$13,157	-3.6	\$122,026	10.4	Telecommunications Services
87 88	93	Acceleware Corp. Servier Canada Inc. (fs)	\$12,615 \$12,157	\$2,459 \$10,836	413.0 12.2	\$753 \$119,408	10.2	Engineering Services Pharmaceuticals/Biotechnology
89	91	Tetra Bio-Pharma Inc.	\$11,938	\$11,655	2.4	\$0	10.2	Pharmaceuticals/Biotechnology
90 91	68	Willow Biosciences Inc. Aurora Cannabis Inc.	\$11,667 \$11,447	\$7,433 \$26,070	57.0 -56.1	\$133 \$290,469	3.9	Pharmaceuticals/Biotechnology Pharmaceuticals/Biotechnology
91	92	DiaMedica Inc.*	\$10,987	\$11,148	-1.4	\$0	3.7	Pharmaceuticals/Biotechnology
93	96	Cardiol Therapeutics Inc.	\$10,870	\$10,515	3.4	\$79 \$0		Pharmaceuticals/Biotechnology Pharmaceuticals/Biotechnology
93 95	97	Medicenna Therapeutics Corp. Stingray Group Inc.	\$10,870 \$10,689	\$6,821 \$9,919	59.4 7.8	\$0 \$249,468	4.3	Telecommunications Services
96 07	00	Eupraxia Pharmaceuticals Inc.	\$10,256	\$1,704	501.9	\$0		Pharmaceuticals/Biotechnology
97 98	99	POET Technologies Inc.* Appili Therapeutics Inc.	\$10,235 \$10,222	\$8,900 \$2,078	15.0 391.9	\$262 \$0		Electronic Systems & Parts Pharmaceuticals/Biotechnology
99	85	TC Energy	\$10,110	\$16,168	-37.5	\$13,387,000	0.1	Energy/Oil & Gas
100		Alpha Cognition Canada Inc.*	\$9,994	\$6,269	59.4	\$0		Pharmaceuticals/Biotechnology

Notes:

- 1. Data were obtained through annual reports, financial statements, securities commission filings, other company issued documents, and/or through a survey.
- 2. We have attempted, whenever possible, to provide gross R&D spending before deduction of
- investment tax credits or government grants.
- 3. We have attempted, wherever possible, to provide revenue net of interest and investment income. 4. FY2020 R&D spending figures may have been adjusted as more accurate information became available.
- Canadian-owned company results include worldwide revenue and R&D spending; foreign subsidiaries (fs) for their Canadian operations only.
- * Converted to CDN\$ at annual average 2021 = 1.2535; 2020 = 1.3415 (Bank of Canada)
- **Based on companies with \$2 million or more of revenue
- +Not current name/acquired/merged
- ++Fiscal 2022 figures were used for year-ended January or February fs = Foreign subsidiary (includes revenue and R&D spending for Canadian operations only)
- na = Not available nd = Not disclosed

CANADA'S TOP 100

Corporate R&D Spenders

R&D Spending Defies Economic Gravity

Canada's Top 100 Corporate R&D Spenders posted \$13.92 billion in combined research and development (R&D) spending in Fiscal 2021. This was a hefty increase of 10.9% over Fiscal 2020 among the 99 companies for which data were available. Encouragingly, R&D spending increased at 71 companies and declined at 28. Combined revenue of 92 of the Top 100 that disclosed their data was \$378.19 billion. This produced an overall R&D intensity (R&D spending as % of revenue) of 3.1%.

For Fiscal 2021, the leading R&D spender was Shopify Inc. which devoted \$1.07 billion to R&D (up 44.6%), followed by Constellation Software Inc. (\$965.2 million, up 19.3%) and TELUS Corporation (\$799.0 million, up 44.5%). Magna International Inc. fell to 4th spot with \$794.7 million of R&D spending (down -28.6%) and Rogers Communications Inc. rounded out the top five R&D spenders with \$682.4 million (up 36.5%).

\$100 Million Club

Twenty-five Top 100 firms each reported R&D spending in excess of \$100 million in Fiscal 2021, thus qualifying for membership in Research Infosource's \$100 Million Club. In Fiscal 2021, total Club members' R&D spending was \$11.06 billion, accounting for 79% of total Top 100 R&D spending.

R&D Spenders Tiers

Grouping the Top 100 companies into three R&D spending tiers (Tier 1 = \$100 million or more of R&D spending, Tier 2 = \$30 million - \$99.9 million, Tier 3 = less than \$30 million), three firms emerged as the respective tier leaders: Tier 1 - Shopify Inc. (\$1.107 billion), Tier 2 - GlaxoSmithKline Inc. (\$94.1 million) and Tier 3 Absolute Software Corporation (\$29.2 million).

R&D Spending Growth

The leading firms for growth in R&D spending in Tier 1 were Repare Therapeutics Inc. (107.8%), Shopify Inc. (44.6%) and TELUS Corporation (44.5%). The Tier 2 leaders were MDA Ltd. (791.9%), Titan Medical Inc. (346.9%) and BELLUS Health Inc. (132.5%). Tier 3 R&D growth leaders were: Eupraxia Pharmaceuticals Inc. (501.9%), Acceleware Corp. (413.0%) and Edesa Biotech, Inc. (403.7%).

R&D Intensity

Combined Top 100 R&D intensity (R&D spending as a percent of revenue) was 3.1% in Fiscal 2021. Among the 92 firms for which complete data were available, a number posted very strong gains in R&D intensity. In Tier 1, the leading firms were: Repare Therapeutics Inc. (1,199.3%), Zymeworks Inc. (748.7%) and BlackBerry Limited (30.5%). Tier 2 leaders were: Titan Medical Inc. (188.9%), Aurinia Pharmaceuticals Inc. (112.1%) and Ballard Power Systems Inc. (59.5%). Heading Tier 3 were: Antibe Therapeutics Inc. (148.6%), Thinkific Labs Inc. (51.0%) and mdf commerce inc. (33.5%).

Regional Performance

In Fiscal 2021, 44 companies headquartered in Ontario reported combined R&D spending of \$7.41 billion, representing 53% of the Top 100 total, followed by 26 Quebec-based companies (\$3.51 billion, 25% of the total) and 28 firms located in Western Canada (\$2.96 billion, 21% of the total). Overall R&D growth jumped by a combined rate of 20.2% in Western Canada, 11.0% in Ontario and 3.6% in Quebec.

Industry Performance

A selection of industry sectors posted the most R&D spending: 23 companies in the Software &

Computer Services sector accounted for 30% of total Top 100 R&D. Five Telecommunications Services companies accounted for 15% of the top 100 total, 31 Pharmaceuticals/Biotechnology firms accounted for a combined 14% of spending, six Energy/Oil & Gas companies accounted for 9% of the total, and six Aerospace firms accounted for 7% of the total. Six (6) companies in the Comm/ Telecom Equipment sector accounted for 6% all R&D spending and three companies in Automotive sector accounted for another 6% of the Top 100 total.

R&D spending growth among these industry sectors was strongest in Fiscal 2021: Telecommunications Service (up 31.8%), Software & Computer Services (up 18.4%), Pharmaceuticals/Biotechnology (up 14.0%) and Energy/Oil & Gas (up 9.0%).

Bucking the Trend

Normally, Research Infosource expects R&D spending trends to broadly align with revenue trends. In Fiscal 2021 several industry sectors performed counter to expectations: the Automotive sector experienced a combined increase of revenue of 5.2%, but posted an overall drop in R&D spending of -27.1%. The Comm/Telecom Equipment sector had a drop in revenue of -7.3%, while posting a combined increase in R&D spending of 3.4%. Firms in the Pharmaceuticals/Biotechnology sector recorded revenue gains of only 0.9% whereas their R&D spending growth expanded by 14.0%. The Telecommunications Services sector posted revenue gains of 5.8% and their combined R&D spending growth was much higher at 31.8%. The Software and Computer Services sector had revenue gains of 10.3% and expanded their R&D spending by 18.4%. The Energy/Oil & Gas sector increased revenues in Fiscal 2021 by 54.5%, but R&D spending growth was only 9.0%.

Top 100 – Leading Industries Software & Computer Services (23) 30 Telecommunications Services (5) 15 Pharmaceuticals/Biotechnology (31) 14 Energy/Oil & Gas (6) Aerospace (6) 7 Automotive (3) 6 Comm/Telecom Equipment (6) 6

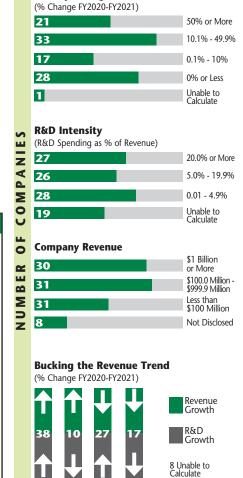
This Year and Next

Corporate R&D performance rebounded in Fiscal 2021 from a disappointing prior year. Contrary to expectations, COVID-19's effect on the economy did not appear to suppress R&D spending in Fiscal 2021. In fact, many companies and industry sectors posted very solid gains.

Economic conditions in Fiscal 2022 threaten corporate revenues and earnings in some sectors, but it remains to be seen if companies will weather an economic slowdown and maintain their investments in the future.

Top 100 Corporate R&D Spenders **Key Demographics FY2021**

R&D Spending Growth



Top Corporate R&D Spenders by Tier FY2021

R&D Spending			R&D S	R&D Spending Growth (% Change FY2020-FY2021)			R&D Intensity* (R&D Spending as % of Revenue)		
Rank	nk Tier 1 \$000		Rank Tier 1 %			Rank	Tier 1	%	
1	Shopify Inc.	\$1,070,969	1	Repare Therapeutics Inc.	107.8	1	Repare Therapeutics Inc.*	1,199.3	
2	Constellation Software Inc.	\$965,195	2	Shopify Inc	44.6	2	Zymeworks Inc.	748.7	
3	TELUS Corporation	\$799,000	3	TELUS Corporation	44.5	3	BlackBerry Limited	30.5	
Rank	Tier 2	\$000	Rank	Tier 2	%	Rank	Tier 2	%	
1	GlaxoSmithKline Inc. (fs)	\$94,137	1	MDA Ltd.	791.9	1	Titan Medical Inc.	188.9	
2	Sierra Wireless, Inc.	\$89,741	2	Titan Medical Inc.	346.9	2	Aurinia Pharmaceuticals Inc.	112.1	
3	Imperial Oil Limited	\$89,000	3	BELLUS Health Inc.	132.5	3	Ballard Power Systems Inc.	59.5	
Rank	Tier 3	\$000	Rank	Tier 3	%	Rank	Tier 3	%	
1	Absolute Software Corporation	\$ 2 9,161	1	Eupraxia Pharmaceuticals Inc.	501.9	1	Antibe Therapeutics Inc.	148.6	
2	IMV Inc.	\$28,931	2	Acceleware Corp.	413.0	2	Thinkific Labs Inc.	51.0	
3	Héroux-Devtek Inc.	\$28,534	3	Edesa Biotech, Inc.	403.7	3	mdf commerce inc.	33.5	
Notes:		nore of R&D spendir	ng, Tier 2 = \$	\$30 million-\$99.9 million, Tier 3 = less than \$30		, ,	mar commerce me.	33.	

COVER STORY

Advancing Research in Uncertain Times

Continued from page 16

"We promote transparency in our work by making available all of our formal reports and recommendations to government," said Nemer, "as well as by maintaining regular public outreach through media engagements and on social media."

*Based on companies with \$2 million or more of revenue

All Levels of Government Need Science Advice

Compared to other developed countries, Canada is still playing catch up when it comes to establishing science advisors that report to government. Quebec is the only province to appoint its own chief scientist, a position it established in 2011. Ontario dismissed its first – and so far only - chief scientist after just a few months on the job when the Progressive Conservative government came to power

Quebec's Chief Scientist Dr. Rémi Quirion supports having chief scientists at the provincial level. In Quebec, he said more ministries are seeking advice on the development of new rules, regulations and laws. For example, the Minister of the Environment asked Quirion's office to develop a course for MPPs on what the most recent climate change report from the Intergovernmental Panel on Climate Change means for Quebec.

"I also just had a request from the Minister of Finance to organize a session with scientists from Quebec in the context of the new provincial budget, addressing issues like AI, access to data and rare minerals."

Having a science advice structure in place before an emergency strikes is particularly important. When the pandemic started in early 2020, Quirion's office already had strong links with the province's ministry of health, "so the trust was there and we were able to work very closely together".

"Developing trust takes time. You can't do it in times of crisis, like a forest fire or a flood, when everyone is stressed and busy responding to the crisis."

The need for timely and trusted scientific advice has become a bigger issue for municipalities as well. They are where policy and theory intersect directly with people's lives, Quirion said.

In January, Victoriaville became the first municipality in Quebec, if not Canada, to appoint a chief scientific advisor. The unpaid position was awarded to Université du Québec à Trois-Rivières professor Dr. Simon Barnabé, who holds the municipal research chair for sustainable cities, a new position created in June by UQTR and Victoriaville, a small city about an hour south of Trois-Rivières.

in 2002, the CCA has produced more than 65 independent expert assessments on topics as diverse as antimicrobial resistance, public safety in the digital age, nature-based climate solutions and medical assistance in dying. Its most recent report examined the financial and human toll of science and health misinformation, and leading practices for assessing and responding to misinformation.

"We're in the business of providing evidence for decisions and evidence for policy," not science advice or specific recommendations, said Dr. David Castle, Chair of the CCA's Scientific Advisory Committee.

Canada woefully underinvests in international [science, technology and innovation], compared to our peers in the OECD. It's grim and I think everyone knows we need to do better.

DR. DAVID CASTLE Chair, Scientific Advisory Committee, Council of Canadian Academies

Quirion hopes to build on that momentum during his two-year appointment as President of the International Network for Government Science Advice (INGSA), an organization he helped found in 2014. One idea is for the Quebec Research Fund to pay postdoctoral students a stipend to work as scientists-in-residence at a municipality.

"A lot of them would probably end up getting jobs with the city after they're finished their post-doc, which would help build science capacity at the municipal level," said Quirion.

Reaching Out to **External Experts**

Government departments do not always have the capacity in-house to examine the current state of science around a pressing public policy issue. When that happens, they may turn to the Council of Canadian Academies for help.

In response to requests from government departments and other groups, the CCA assembles experts from different disciplines and sectors to assess the best available evidence on complex issues that are in the public interest -

evidence that is used by government to

inform policy. Since it was established

One current study sponsored by Global Affairs Canada is examining international science, technology and innovation (STI) partnerships.

"Canada woefully underinvests in international STI, compared to our peers in the OECD (Organisation for Economic Co-operation and Development). It's grim and I think everyone knows we need to do better," said Castle, an expert on science, technology and innovation policy at the University of Victoria, and member of the International Science Council and the OECD's Global Science Forum.

Recent efforts aim to bolster those bilateral and multilateral collaborations, including an agreement signed over a year ago between the the Natural Sciences and Engineering Research Council of Canada and the National Science Foundation in the U.S. Canada is also negotiating with the European Commission to participate in the next phase of Horizon Europe, the world's largest science, research and innovation collaboration program.

"The fundamental challenge though still remains - how we move money around to enable those activities with shared resources?" cautioned Castle. "Domestic finance departments don't like common pools of money."

Expanding International Collaboration

The OECD has identified international cooperation as critical in providing science advice in international crises like COVID-19.

Canada appears to be listening. Last year, the New Frontiers in Research Fund (NFRF) awarded \$144 million to seven, Canadian-led international and interdisciplinary projects. Topics range from developing new methods to repair spinal cord injuries to designing inclusive workplaces for persons with disabilities.

Dr. Ted Hewitt, President of the Social Sciences and Humanities Research Council, said the five-year-old NFRF was a new mechanism that allowed the granting councils to partner in ways they hadn't been able to in the past.

"The NFRF was specifically designed to be international, strongly interdisciplinary to promote risk taking, to focus on high reward, be transformative and to act in a more rapid-response format. It's a program that delivers on a number of firsts," said Hewitt, who also chairs the Canada Research Coordinating Committee (CRCC), which coordinates policies and programs between Canada's four main research granting agencies.

Hewitt said "one of the most impactful" changes was opening NFRF competitions to foreign researchers who collaborate with Canadian scientists. Currently, about 25% of all participants in NFRFfunded projects are from other countries. Funders in other countries are looking at adopting a similar model.

"It would allow Canadians to be coapplicants on European projects or UK projects or French projects, for example, where our international partners would fund them the same way we would fund

them." The CRCC is also facilitating Canada's lead on some international projects. For example, it engaged with the United Nations to develop the UN Research Roadmap for the COVID-19 Recovery, released in 2020.

An even bigger effort launched in January. It sees Canada leading a \$90-million international competition for research on climate change adaptation and mitigation in partnership with research funders from Brazil, Germany, Norway, South Africa, Switzerland, the UK and the US, among others.

"The NFRF gives the research funding agencies and the CRCC incredible flexibility to act quickly to get the best

We're finally starting to build the type of system Canada needs. For people who say, well it's not there yet, I'd say be a little patient because we're building it and we will definitely get there.

DR. TED HEWITT President, Social Sciences and Humanities Research Council; Chair, Canada Research Coordinating Committee

Some NFRF funding supports Canadian researchers participating on international projects through Horizon Europe. A \$40-million NFRF competition currently underway will award grants of up to \$250,000 per year over two years.

The CRCC is also establishing more formal linkages with research councils in other countries, including the National Science Foundation in the U.S., UK Research and Innovation and the European Commission. Meetings are planned early this year with the major research funding agencies in South Africa and Japan to discuss opportunities for joint programming.

and the brightest in the world together to start cracking some of these thorny problems," said Hewitt. "We're finally starting to build the type of system Canada needs. For people who say, well it's not there yet, I'd say be a little patient because we're building it and we will definitely get there."

Debbie Lawes, Debbie@dovercourteditorial.ca, is an Ottawa-based writer specializing in science, technology and



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