RBC Economics & Thought Leadership

Canada's Biotech Reboot:

How to keep the vital life sciences sector strong



Canada's life sciences sector has been a paragon of strength and economic vibrancy.

Supported by a world-class science and research ecosystem, it's made the country a global leader in drug discovery and healthcare innovation, acted as an engine of economic growth, and helped develop, retain and attract top scientists in a growing, high-value field.

Despite the successes. Canada's life sciences sector is showing signs of weakness. Scientists in the field are lagging in terms of their ability to translate groundbreaking research into commercial success. That may partly explain why Canadian life science companies are having an increasingly difficult time keeping up with domestic needs for drugs, pushing the country from a net exporter of pharmaceuticals to a net importer. Canada is also falling behind its peers in the Group of Seven Nations (G7) and Organisation for Economic Co-operation and Development (OECD) in terms of relative spending in the sector.

These warning signs are flashing at a difficult moment for the Canadian economy. A shortfall in investment is impacting the country's overall productivity, a key measure of the amount of economic output we generate per hour of work. That has weakened the economic momentum that propelled the country through the 20th century and cut into our overall prosperity. If Canada is to reverse this long-term growth challenge, it will have to move to strengthen high-value sectors like life sciences, which have acted as strong economic catalysts over the past decades.

Recalibrating Canada's approach to life sciences will better position the country to take advantage of the enormous opportunities in a global sector that has been valued at US\$2.83 trillion. Strengthening the sector would also positively impact other advanced industries and have ripple effects throughout the country's science and technology communities.

A rethink could have implications that go beyond economic interests as well. The COVID-19 pandemic, which shocked and strained national healthcare systems and global supply chains, put a spotlight on a key reason Canada needs to have robust production capacity: to be able to support itself in times of health emergencies. Since health crises such as pandemics are expected to occur with greater frequency across the globe, at least for the foreseeable future, due to factors such as climate change and increased globalization and urbanization, the need for domestic production capacity in vaccines and therapeutics will continue to increase. At the same time, demand for all health-related products will inevitably rise as the population grows and ages.

If Canada is to bolster its strengths and realize its full potential, we will have to address those critical challenges. Some solutions will require increased funding, but others would necessitate changes to the way we deliver support to the sector and coordinate public and private resources. If the country gets it right, the life sciences sector can continue to serve as a foundational pillar of economic resilience and better prepare Canada to meet future public health challenges.

Key findings

a la	
@□□□₽₩	
We)	

The life sciences sector has long been a Canadian champion in research and development (R&D), but its stature risks eroding in the face of increasing global competition for investment and talent.

	5.201-
	20161-
_	S ~ -
	· · ·)_

Urgent investment in AI computing infrastructure – and policy changes to encourage private investment - will be essential to relieve chronic and rising shortages of computational resources facing Canadian researchers and life sciences companies, in particular those doing time- and capital-intensive drug discovery.

ናገ	3	
22	\$ 0000	
γ.v.	20000	

Canada would benefit from improved coordination of policies and resources between the artificial intelligence (AI) and life sciences sectors if it wants to remain a global leader in life science innovation and drug discovery and development.



To make scaling innovation easier and keep more locally developed Intellectual Property (IP) in the country, Canada needs better commercialization support in the form of favourable policies and more accessible and coordinated resources and funding.



Canadian public- and private-sector policymakers should prioritize actions that help retain and attract world-class researchers and innovators as the country addresses its systemic issues in life sciences

Where we are and how we got here

Life sciences is a rapidly evolving field spanning a broad array of activities that produce the tools needed to protect, maintain and improve health. These include biomanufacturing, which uses living organisms to develop products like vaccines; the pharmaceutical industry, which creates medicines from chemicals and synthetic processes; and manufacturers of health-related products such as diagnostic equipment and personal medical devices.

Canada is home to more than 2,000 life sciences firms, employing as many as 220,000 people across the country. Most of their activity focuses on research and development (R&D) at public and private labs, which creates various forms of IP used to advance health sciences. In turn, IP such as new drug formulas or medical device patents are then purchased – often by private firms outside the country – to be commercialized so it can be brought to market for healthcare organizations and consumers.

The impact of life sciences on Canadian gross domestic product is hard to isolate because the government does not provide data or reporting on the sector's critical success indicators, such as GDP contribution, job figures, number of firms, and annual growth metrics. Sizing up Canada's life sciences performance and growth opportunity is made more difficult because there is no generally agreed upon definition of exactly which specific sub-sectors are to be included when analyzing the sector. Plus, some life science endeavours like biotechnology focus not only on human health but also on factors affecting animal and plant health.

No one doubts, though, that the size and scope of Canada's life sciences sector makes it an important and growing part of the economy. The pharmaceutical R&D subsector alone contributed \$16 billion in value, or about 0.7%, of Canada's GDP in 2021, with about half (\$8.2 billion) generated in Ontario and \$3.2 billion in Quebec.

The economic contribution of Canada's pharma R&D sector has been growing



Source: Statistics Canada

(GDP at basic prices), 2018-2021







Demand for Canadian-made drugs has been rising

Billions of Canadian dollars



The sector generates value for Canada in other ways. It develops and attracts highly skilled people whose specialized work is sought around the world. Demand for the research, products and services they develop has skyrocketed in line with the expanding needs of Canada's overall healthcare sector, which is projected to grow at a rate of 10% annually over the next decade.

Why Canada has excelled in life sciences

For over a century, Canada has had an outsized impact within the life sciences world, making revolutionary contributions to personal and public health. Researchers at the University of Toronto gave the world insulin in the 1920s and the discovery of stem cells in the 1960s. Montreal-based scientists developed life-changing treatments for AIDS/HIV in the 1980s. And in 2020, University of Alberta professor Michael Houghton was one of three scientists awarded a Nobel Prize for co-discovering a Hepatitis C vaccine.

These innovations were nurtured by government support and Canada's world-class R&D and innovation ecosystem. Clustered primarily in Toronto, Montreal and Vancouver, the life sciences sector is comprised of a remarkably strong nation-wide intersectoral network that spans academia, research labs, and the public and private sectors. These organizations include

government-supported research centres, top universities (many of which also have their own research centres), small to midsized enterprises, and the presence of major multinational corporations in the country such as Johnson & Johnson, AstraZeneca, and Pfizer.

Canada has other key ingredients needed to boost its life sciences sector. Much like its contribution to life sciences research. Canada has been a global leader in the development of artificial intelligence (AI) technology. Canada's three National AI Institutes are recognized as world leaders in the field, and some of the great minds in machine learning are based in Canada. Researchers working in one of the most multicultural countries have another national advantage: easier access to arguably the world's most diverse health data.

Who, and what, Canada is up against

While Canada has grown its technical prowess in life sciences, the rest of the world hasn't stood still. Viewed against its peers in the 38-member OECD, Canada's sector has lost ground in relative investment levels and R&D spending in life sciences for the past two decades. The U.S. leads by a wide margin among the developed nations in virtually all metrics of participation and investment. There has been one bright spot for Canada. though: the ratio of researchers in Canada's employment base has increased by 45% over the past 20 years, placing Canada above the OECD average.

Amid the underperformance in investment, Canada has become increasingly dependent on other countries to supply some of its critical domestic needs. Once a net exporter, Canada has become a net importer of the life sciences products it needs for its growing and aging population, resulting in the country's pharmaceutical trade deficit tripling since 2016. Today, Canada imports 85% of the vaccines and therapeutics that it uses, while health spending, especially on drugs, continues to rise. Sector dynamics tend to play out without much regard for borders. And staying competitive is not getting easier as the costs of

Canada's pharmaceutical trade deficit doubled from 2013 to 2022



asset and intellectual property development rise. It can take more than a decade and several billion dollars to bring one new drug to market, half of which is spent on clinical trials that fail 90% of the time, according to a 2022 study. And despite major advances in technology, generating investment returns has been challenging in some fields as the number of new drugs produced in relation to the money needed to fund their development has

The competitive market for resources in the field – and the broader demands of an increasingly strained healthcare system and ballooning Canadian health budgets - point to a pressing need for new thinking and improved support for productivity and innovation in Canada's life sciences sector. Canada already has many of the key ingredients needed to boost its life sciences sector. How can those parts be better supported and coordinated to stoke the sector's prospects?

Challenges and Solutions: What can be done to remain competitive

AI can energize drug discovery and development

The Challenge:

Al offers a potential key to reinvigorating Canada's life sciences sector. Datasets in this space, especially those based on living organisms, are vast and highly complex - exactly the kind of environment where AI can be of great assistance. Al can be used to drive efficiency and productivity through its ability to process and learn from vast amounts of data quickly to generate and improve predictions, such as isolating an ideal molecule structure for a new drug therapy. Among sectors, life sciences could see some of the most significant positive impacts from AI in terms of efficiency and revenue.

AI is already showing great promise across the life sciences ecosystem and value chain. The southern Ontario-Quebec corridor is a hub for innovation in AI and health care, with companies like Deep Genomics in Toronto using AI for drug discovery and development, and the Vector Institute in Toronto applying AI to genomics and medical diagnostics.

Billions of Canadian dollars

steadily declined since the mid-20th century.

Canada's challenges are intensified because of its relatively small market, which hampers the viability of commercialization. This results in foreign firms buying up Canadian-made IP and commercializing it in more favourable/profitable environments, sometimes taking the talented creators with them.

Continued progress in the use of AI, however, will only be possible if the right infrastructure is in place. The combined computational capacity - referred to as AI compute - needed to develop and operate AI systems can require enough electricity to power big cities. What's more, demand for these resources is increasing exponentially as AI systems become more prevalent and powerful across the whole economy. Yet, Canada sits last among its G7 peers in AI computing capacity. As Canada's Minister of Innovation, Science, and Industry François-Philippe Champagne said this year: "We have the brain. Now we need the mainframe."



The confluence of demand for more AI tools and more AI computing power is already causing a bottleneck in Canada as researchers and firms in virtually every industry and research field face chronic shortages of this high-cost, critical input.

Solutions:

A healthy life sciences sector depends on robust technological infrastructure. Public and private funding is needed quickly to secure more AI computing capacity. Otherwise, organizations may make plans that avoid Canada, creating long-term pain. Public-private cooperation would certainly go a long way in narrowing the AI computing gap, which will act as a key confidence indicator for further investment.

Reversing the trend of lagging investment in Canadian R&D

The Challenge:

The lagging investment in AI computing infrastructure is symptomatic of a larger challenge in the life sciences space. Canada has ranked below the OECD average in terms of domestic R&D expenditures as a share of GDP since at least 1991, a gap largely attributable to the Canadian government and business enterprise sectors spending less on R&D as a percentage of GDP than the OECD average, and substantially less than in the U.S.

This is despite one-off injections of Canadian public funding. The federal government committed over \$2.4 billion in 2014 toward science, technology, and innovation, \$2.2 billion to biomanufacturing and life sciences in 2021, and \$2.4 billion for its national AI strategy in 2024. Despite the idiosyncratic spending, R&D investment as a percentage of GDP has been on a downward trend for the past two decades.



Gross domestic spending (%) on research and development (R&D)



Relatively low R&D spending is a particularly acute problem for the life sciences sector, which relies on intensive and expensive testing and trials more than most other industries.

Solutions:

If the sector is to maintain its momentum as a global leader and attract future investments, Canadian public and private institutions will have to take the lead in addressing the funding gap. What's more, the entire sector would benefit if the government committed to a permanent funding mechanism that didn't depend on political expediency. A key target and priority should be reaching, at a minimum, the OECD average level of funding.

Heavy on R&D funding, light on commercialization supports

The Challenge:

Canada's life sciences ecosystem is supported by robust mechanisms such as the Strategic Innovation Fund (SIF) and Canadian Foundation for Innovation (CFI). These federal programs provide billions of dollars to fund research projects, and to increase capabilities of research organizations at universities, hospitals and public and private companies.

Relatively little of that money, though, is being directed to help researchers commercialize their discoveries. About 80% of the funding for Canadian life sciences work is targeted toward R&D, as opposed to helping research teams bring their work to market. That could be a problem for researchers who need help with such tasks as finding and investment partner a venture capital firm.

The relatively low level of go-to-market funding for these so-called early-stage life science companies is especially glaring when compared with the capital available in the U.S., hampering foreign investment in Canada. It also discourages Canadian firms from committing to longer-term projects.

That may be a key reason why Canada has fallen behind its peers in terms of scaling innovation. Government statistics show that the majority of products remain in pre-market/development stages. Canada's competitiveness in the field is further hindered by its relatively small population among G7 nations, as smaller markets are less likely to offer the incentive needed to bring products to market.

Canada is falling further behind its peers in R&D spending



These realities may also help explain Canada's mounting deficit in the pharma trade – even as Canada leads G7 nations in clinical trial productivity, and sales of Canadian pharmaceuticals continue to grow.

Solutions:

After increasing financial support to build out Canada's AI computing capacity, the government should prioritize a comprehensive, interdisciplinary review of available programs and policies with the aim of shifting more of the available and new support to commercialization efforts.

Enhancing the support infrastructure also could help ensure changes are relevant beyond financial considerations. Other supports, such as entrepreneurial training or skills development, can go a long way in helping researchers turn their discoveries into economic opportunities.

Better coordination of commercialization supports will boost the sector

The Challenge:

Aside from spending more to increase the likelihood that R&D will be commercialized in Canada, leaders in the sector can do a better job of working smarter. To encourage firms to keep Canadian-made IP – and the talent that builds it – in Canada, researchers would benefit from more favourable, less-complicated government policies and more coordination among financial supports and incentives.

Access to Canadian funding for life sciences work can be convoluted, spread across a patchwork of programs and does not optimally encourage monetization of discoveries. What's more, about 80% of the funding programs are geared toward aiding research, with just 15% of those programs taking into account possible commercialization activities. Less than 10% of the funding is solely targeted at commercialization.

Canadian policy also favors spreading the limited wealth. That's meant that researchers in Canada can spend more time applying for smaller sums across a broad array of different programs than their peers in other countries. In the U.S., for instance, programs administered by the National Institutes of Health (NIH) and Small Business Association (SBA) offer far larger grants, giving researchers the ability to gain funding in a one-stop approach.

Solutions:

Policy analysts have argued that Canada needs a federal champion for the life sciences sector. An office of this kind could act as an advocate for the sector, foster collaboration and ensure follow-through on policy objectives, creating a level of cohesion and sector leadership that does not exist today. It might also be used to provide a coordinated voice for scientists to advise the government on life-science matters.

At the least, this office would help scientists connect with all the resources they might need to bring their ideas to the market. These include AI and robotics specialists, venture capitalists, and experts in management and operations. It might also help researchers connect with like-minded colleagues around the world who have successfully commercialized their work.

Capitalizing on a skilled workforce: Talent flows toward opportunity

The Challenge:

As in other areas, people who experiment, innovate and build are the core generators of success in life sciences. If we are to create the ground for the sector to realize its growth potential, Canada will need to step up efforts to train, retain and attract highly skilled talent.

It will also need to have a competitive operating environment. As other leading jurisdictions outpace Canada in developing infrastructure and investment plans to drive innovation, there is an increasing risk of a brain drain and loss of intellectual property. In other words, it will be challenging to retain world-class, in-demand talent if Canada does not ensure they have continued access to world-class resources and economic support.

Solutions:

In addition to nurturing a vibrant innovation ecosystem, and investing in the infrastructure to support it, as recommended in previous sections, Canada should boost direct investments in people and educational institutions. For instance, increasing funding targeted at developing specific expertise – in pure science programs, but also in related technological and business areas – would help the sector.

The stopwatch is ticking

Public and private entities can decide to quickly pump more money into the life sciences sector. But when talent decides to leave the country, it doesn't generally return in a heartbeat. And talent is at the core of what makes the sector strong. That's why action is needed sooner rather than later, ideally with greater coordination between governments, businesses, academia and researchers across all sectors.

Canada has an economic growth challenge that has seen productivity gains dissipate for decades. To meet that challenge, Canadians need to develop a growth mindset – one that better rewards innovation and invests more heavily in two critical economic drivers: people and technology.

Focusing that thinking on life sciences, an area where Canada has excelled, would be one good place to start. Moving quickly to bolster the sector would improve its capacity to act as an important driver of economic growth, provide residual benefits to other advanced industries and promote a healthier future for Canadians.

Contributors

Ajay Nandalall, Research Associate Steven Frank, Contributing Editor Caprice Biasoni, Graphic Design Specialist



Published by RBC Economics & Thought Leadership rbc.com/the-growth-project/