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Talent shortage a priority for biotech sector emerging from pandemic

Canada is likely to face a shortfall of about 65,000 workers in the bio-economy by 2029, according to BioTalent Canada.

BY JESSE CNOCKAERT

Federal investments are allowing infrastructure to roll out in the biotechnology and life sciences sector, but a shortage of talent remains a critical concern to its long-term success, according to the president and CEO of BioTalent Canada.

"There seems to be a great deal of capital investment going along, and a lot of buzz around the industry, but it still faces a lot of challenges, and probably the one that is the most daunting is the talent," said Rob Henderson. "The fact that we've avoided recession probably makes it even worse, which means that companies are going to be hiring again assuming that the toxic recession has abated."

Canada is likely to face a shortfall of about 65,000 workers in the bio-economy by 2029, according to a report released on Oct. 13, 2021, by BioTalent Canada.

To help build Canada's domestic capabilities in biomanufacturing and life sciences, the Liberal government launched a biomanufacturing and life sciences strategy on July 28, 2021. Recent investments as part of the strategy include \$10-million announced on March 14, 2023, in support of the creation of five research hubs across Canada, including the Canadian Biomedical Research Fund (CBRF) PRAIRIE Hub, led by the University of Alberta, and the Canadian Pandemic Preparedness Hub, led by the University of Ottawa and McMaster University. The investment, made through Stage 1 of the integrated CBRF and Biosciences Research Infrastructure Fund competition, is intended to bolster research and talent development

efforts led by the institutions, working in collaboration with their partners.

"To continue to protect Canadians and to build a resilient biomanufacturing ecosystem, our government is taking every action possible to be equipped with the best tools. We're proud to foster the research needed to produce cutting-edge discoveries and products in our very own labs that will help us build a stronger, more robust life sciences sector that responds to the needs of Canadians for decades to come," said Innovation Minister François-Philippe Champagne (Saint-Maurice-Champlain, Que.) in a press release by the Tri-agency Institutional Programs Secretariat.

Henderson said the overall state of Canada's bio-economy is vibrant and growing, but federal investments announced since the launch of the biomanufacturing and life sciences strategy so far haven't gone far enough to address the talent shortage.

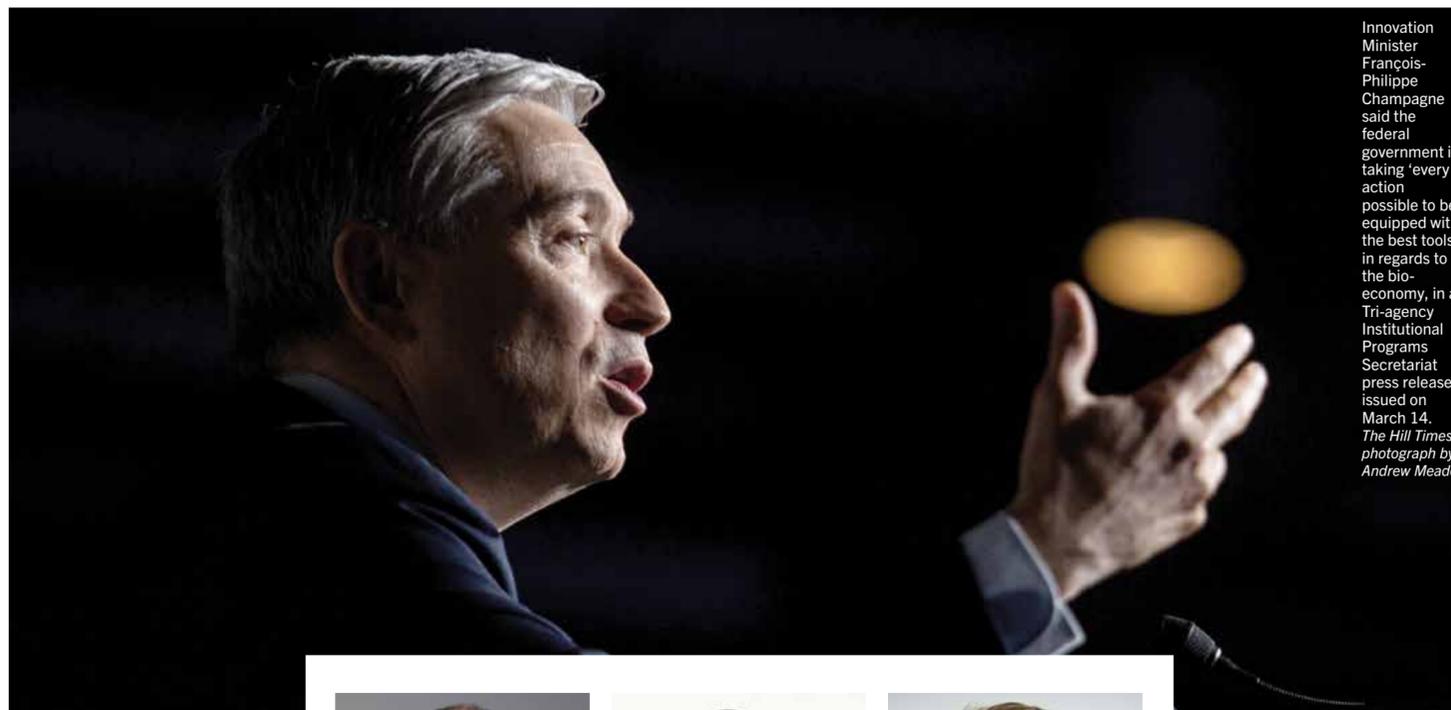
About 16,000 of the workers in BioTalent Canada's estimated talent shortage before the end of the decade will be in the biomanufacturing sector, which is an issue because "vaccines don't manufacture themselves," according to Henderson.

"The federal government, in bringing vaccine biomanufacturing back to Canada, has simply exacerbated that problem," said Henderson. "It's a great announcement, and it's a great initiative, but the problem is we're already starting in a deficit situation."

One important hurdle to company development in the bio-economy is a lack of human resources (HR) capacity to attract and retain candidates, according to Henderson. Small- and medium-sized companies dominate in the bio-economy, and few of them have their own formal HR departments, according to the BioTalent Canada report.

Henderson told *The Hill Times* that, as a result of missing HR personnel, many of these companies have scientists handling HR responsibilities.

"Seventy per cent of the companies don't have any HR resources. It's an area of expertise that they



Innovation Minister François-Philippe Champagne said the federal government is taking 'every action possible to be equipped with the best tools' in regards to the bio-economy, in a Tri-agency Institutional Programs Secretariat press release issued on March 14. *The Hill Times* photograph by Andrew Meade

lack, and as a result, it's like getting a plumber to do your taxes. It's just not a good fit," said Henderson. "These people were not trained, nor did they ever want to pursue a career in human resource management, but that's what they have to do as a small business."

To help access more talented workers, one of the most important programs for the federal government to continue is the Innovative Work Integrated Learning initiatives (I-WIL), said Henderson. The I-WIL are intended to help post-secondary students find opportunities, such as short-term work placements, related to their studies.

Canada also needs to encourage more immigration of skilled workers, according to Henderson. The BioTalent Canada report argues that wage subsidies could be effective in drawing skilled immigrants to Canada.

"As much as we have a great deal of an influx of new immigrants, we have to get some skilled immigrants, specifically in the areas of life sciences and bio manufacturing, and fast-track their entry into Canada. That's for sure," said Henderson. "It's very difficult to drive a car 300 miles without gas. The unfortunate thing there is the gas in the car is the talent."

Declan Hamill, vice-president of policy, regulatory and legal affairs for Innovative Medicines Canada, told *The Hill Times* that Canada's bio manufacturing and life sciences strategy is a step in the right direction, but more work needs to be done because a healthy life



Rob Henderson, president and CEO of BioTalent Canada, says bringing vaccine biomanufacturing back to Canada has exacerbated an existing talent shortfall problem. *Photograph courtesy of Rob Henderson*



Declan Hamill, vice-president of policy, regulatory and legal affairs for Innovative Medicines Canada, says the two-year average for an approved new pharmaceutical treatment to be listed on Canada's public drug plans is 'almost twice the amount of time that this process takes in peer [nation] jurisdictions.' *Photograph courtesy of Declan Hamill*



Jordan Thomson, the vice-president of strategic partnerships and programs for Ontario Genomics, says there should be synergy between the federal government's biomanufacturing and life sciences strategy, and the Pan-Canadian Genomics Strategy. *Photograph courtesy of LinkedIn*

sciences sector is a marathon and not a sprint.

A challenge for Canada's life sciences sector is a prolonged drug access pathway, according to Hamill. He described the approval process of new medicines in Canada as "highly fragmented," with involvement from Health Canada, the Patented Medicine Prices Review Board, the Canadian Agency for Drugs and Technologies in Health, the pan-Canadian Pharmaceutical Alliance, as well as provincial public drug plan components.

"It takes, on average, two years for an approved new pharmaceutical treatment to be listed on Canada's public drug plans. That's almost twice the amount of time that this process takes in peer [nation] jurisdictions. That's something that is noted internationally," said Ha-

mill. "We think that a reasonable, predictable, stable system whereby treatments can get to patients faster and in greater numbers would help from a life sciences ecosystem perspective."

A successful bio manufacturing and life sciences strategy requires an attractive market for life science investments and innovation, and that requires innovations to become available to Canadians more quickly, according to Hamill.

"This really needs to be pan-Canadian approach," said Hamill. "There needs to be greater coordination ... with those other provincial life sciences strategies. It doesn't have to be one strategy, but we need to understand that the world perceives us as an entity, and therefore we need to act accordingly when we're making improve-

reduce the cost and increase the availability of drugs," Duclos told the committee. "We need the two. We need drugs to be affordable, but we also need drugs to be developed and accessible to those who need them."

Consultation for the Agile Licensing framework were held from Dec. 17, 2022, to April 26, 2023.

Hamill said that the finalization of the agile licensing framework will probably be a positive development, but "we'll have to wait and see what happens."

In terms of addressing talent in the biomanufacturing and life sciences sectors, Hamill said significant efforts have been undertaken, but more can be done.

"It's both important to attract talent from other jurisdictions, but also to cultivate talent here through our colleges, through our universities," he said. "Attracting and retaining talent, both in terms of research, but also managerial talent, is very important, and it's something that Canada has had great success in many other areas — of attracting talent from other jurisdictions."

Murray McCutcheon, the senior vice-president of partnering for biotechnology firm AbCellera, told *The Hill Times* Canada has a gap between research and clinical testing.

"[Canada is] recognized as being innovative and productive from a research standpoint," said McCutcheon. "Where we have recognized gaps is our ability to advance the products of that research and bring them through preclinical development and into a

clinical setting where they can be tested in patients."

On May 24, Champagne and David Eby, Premier of British Columbia, jointly announced funding of \$300-million to AbCellera. The federal and provincial funding contributes to a \$701-million project by AbCellera to create a new biotech campus equipped with a preclinical antibody development facility, as well as to make upgrades to the company's existing facilities in Vancouver, B.C. McCutcheon said that Canadians should understand that the life sciences is a high growth sector, but requires continuous investment because of the length of time involved in building infrastructure and developing medicines.

"It takes typically more than 10 years to move from an idea to a medicine that has been shown to be safe and effective, and authorized for treating patients," he said. "These are decades-long problems that we're working on. They're complex, and they require a long view to building the base of the foundation to be successful at that."

AbCellera has grown from a company of about 200 employees to more than 600 in the last two years, according to McCutcheon.

"We're building a major tech campus and manufacturing facility in Vancouver, which collectively is about 600,000 square feet of space, [which are] really sorely needed facilities," he said. "This is I think, exemplary of the kind of investments that we need to be doing as a nation, and I think it's proof-point of the bio manufacturing strategy of the federal government."

Another federal government approach intended to support the bio-economy is the Pan-Canadian Genomics Strategy (PCGS). The 2021 federal budget announced an investment of \$400-million for the design and implementation of the PCGS, which is intended to advance the translation and commercialization of genomics and related technologies, and strengthen Canada's position in the global bio-economy.

Jordan Thomson, the vice-president of strategic partnerships and programs for Ontario Genomics, told *The Hill Times* that success in the bio-economy will require synergy between the PCGS and the biomanufacturing and life sciences strategy.

"In the Canadian genomics strategy, they talked about bio manufacturing [and] synthetic biology, which is really core technology that allows these vaccines and other products to be made," he said. "Trying to ensure that there's connectivity between those and a recognition of how the two can feed into each other, I think that's going to be a trickier thing for our government to do — and just make sure that these kinds of synergistic investments do actually yield the most synergy possible."

Thomson argued that the federal government shouldn't forget about supporting the smaller biotechnology and life sciences companies in Canada while showing support for the larger firms.

"Making sure that we support those homegrown small firms and



Image courtesy of Pixabay

not just ... attracting these international companies, which seems to be a really big focus for [the federal government], I think that's important. I think we can't forget about nurturing those smaller

Canadian companies to grow into larger players. We need them in the next pandemic, or whatever challenge we face," said Thomson.

Jcnockaert@hilltimes.com
The Hill Times

Canada Pharmaceutical Research and Development Statistics:

- In 2020, the research and development (R&D) pharmaceutical sector contributed \$15.9-billion to the Canadian economy in gross value added (GVA), an increase of 5.8 per cent from the \$15-billion generated in 2019. Just under half of this (\$7.9-billion) was attributable to the direct impacts of the sector, which rose 4.5 per cent from the \$7.6-billion generated in 2019. Indirect impacts accounted for 28.3 per cent of the total GVA in 2020 and increased 6.1 per cent to \$4.5-billion, while indirect impacts advanced 8.7 per cent to \$3.5-billion.
- Nearly \$13.9-billion (87.4 per cent) of the total GVA that the sector contributed to the Canadian economy was generated in Ontario (\$8.7-billion) and Quebec (\$5.2-billion). Likewise, 88 per cent of all labour income was related to these provinces, with close to \$5-billion coming from Ontario and \$3.1-billion from Quebec.
- R&D pharmaceutical businesses in Canada generated \$31.3-billion in operating revenues in 2020, up 3.9 per cent (\$1.2-billion) from the year before. Operating expenses also rose, increasing by three per cent to \$30.6-billion with the sector paying \$190-million (4.1 per cent) more in wages, salaries and benefits, and \$953-million (four per cent) more in raw materials and services.
- An additional 5,378 jobs were created by the Canadian R&D pharmaceutical sector in 2020, increasing overall employment to 107,973 full-time equivalent jobs, up 5.2 per cent from the previous year.
- The R&D pharmaceutical sector is comprised largely of three core industries: pharmaceutical and medicine manufacturers; pharmaceuticals and pharmacy supplies merchant wholesalers; and R&D performers in the physical, engineering and life sciences.

Source: *The Canadian Research and Development Pharmaceutical Sector, 2020, Released on Jan. 30, 2023, by Statistics Canada*

Canada Biomanufacturing and Life Sciences Strategy:

- The 2021 federal budget included \$2.2-billion toward implementing a comprehensive strategy to build a strong domestic biomanufacturing and life sciences sector in Canada. The strategy consists of five pillars: Strong and coordinated governance; Laying a solid foundation by strengthening research systems and the talent pipeline; Growing businesses by doubling down on existing and emerging areas of strength; Building public capacity; and Enabling innovation by ensuring world-class regulation.
- To advance the Strategy, the 2021 federal budget announced investments in bio-innovation research, including \$500-million over four years for the Canada Foundation for Innovation for a new Bio-Science Research Infrastructure Fund to support the bio-science infrastructure needs of post-secondary institutions and research hospitals; and \$250 million over four years for the federal research granting councils to create a Tri-Agency Biomedical Research Fund.
- The 2021 budget also included \$1-billion on a cash basis over seven years of support through the Strategic Innovation Fund, which will be targeted toward promising domestic life sciences and biomanufacturing firms.
- On March 2, 2023, the Liberal government announced an investment of \$10-million in support of the creation of five research hubs: CBRF PRAIRIE Hub, led by the University of Alberta; Canada's Immunology and Biomanufacturing Hub, led by the University of British Columbia; Eastern Canada Pandemic Preparedness Hub, led by the Université de Montréal; Canadian Pandemic Preparedness Hub, led by the University of Ottawa and McMaster University; and Canadian Hub for Health Intelligence & Innovation in Infectious Diseases, led by the University of Toronto.
- The investment in the five research hubs, made through Stage 1 of the integrated Canada Biomedical Research Fund and Biosciences Research Infrastructure Fund competition, is intended to bolster research and talent development efforts led by the institutions, working in collaboration with their partners.

Source: *Canada's Biomanufacturing and Life Sciences Strategy, released on June 28, 2021, and a March 2 press release from Tri-agency Institutional Programs Secretariat*



Image courtesy of Pixabay

Biotech Policy Briefing

Biotech sector is having a generational moment in Canada

It is not possible to predict what or when the next global health challenge will be, or what solutions will be needed.

Andrew Casey

Opinion



Finance Minister Chrystia Freeland, left, and Innovation Minister François-Philippe Champagne, pictured July 26, 2023, at Rideau Hall. Canada has the foundational elements for the next phase of a competitive biotechnology economy, writes Andrew Casey. *The Hill Times* photograph by Andrew Meade

The pandemic's economic, social, and health impact has effectively focused the attention of policy-makers and the public on the strategic importance of building a competitive domestic life-sciences industry and biomanufacturing capacity. Nearly four years after the onset of the pandemic, all governments, including those in Canada, are prudently preparing for another pandemic or some other global health emergency.

It is not possible to predict what or when the next global

health challenge will be. Correspondingly, it is impossible to know what solutions will be needed. In this context, when considering how to prepare for the next inevitable health crisis, the more strategic approach for Canada is to build its life sciences and biomanufacturing sector broadly so it can offer many potential solutions while also acting as an innovator and economic driver during non-crisis periods. Both objectives can be met by focusing on creating a competitive environment which generates

ideas and attracts the investors, partners, and talent required to turn ideas into businesses, and scale them to become Canadian anchor companies.

With the 2021 federal budget, the government began investing significantly to grow Canada's life-sciences sector and biomanufacturing capacity. The commitments and corresponding life sciences and biomanufacturing strategies have accelerated the growth of our biotech sector beyond just a crisis response. Accordingly, now is the time for the

federal government to capitalize on the sector's momentum. In so doing, they will deliver on the preparedness objective and, if done strategically, will drive the sector's growth.

Importantly, Canada is building its capacity from a position of strength. Our country has a vibrant ecosystem founded on a global reputation for excellent scientific research. As a result, Canada is home to an ecosystem which includes hundreds of early-stage biotech companies, and a strong global pharma presence. The sector's strategic competencies include regenerative medicine, artificial intelligence in the field of drug discovery and development, vaccines, clinical trial expertise, and genomics. The more than \$4-billion in investments and partnerships Canadian biotech firms have signed with global pharma companies and other investors over the past few months alone demonstrate the sector's value as a generator of scientific discovery and business creation.

Looking ahead, Canada must acknowledge it is not alone in recognizing the value of a domestic life sciences sector. Indeed,

other nations are equally aware of the sector's strategic value, making the global competition for biotech ideas, companies, talent, and investment more intense than ever before. In this context, it is imperative for us to act urgently, aggressively, and ambitiously to enhance our competitive position by establishing: a globally competitive tax and policy environment that drives the creation and scaling up of biotech companies; a modern and agile regulatory system for domestic innovation and the attraction of global biotech and pharma partnership and investment; and a dedicated life sciences investment fund to grow our domestic life sciences investment pool.

Canada has the foundational elements for the next phase of a competitive biotechnology economy. The generational moment before us presents a significant opportunity for us. Creating an enabling policy environment and setting the stage for anchor company growth will position our biotech ecosystem as a global leader in generating the solutions for the challenges already before us, and the ones which lie ahead.

Andrew Casey is president and CEO of BIOTECCanada, the national industry association representing biotechnology companies in Canada. For more than 25 years, Casey has provided government relations and communications advice to various trade associations.

The Hill Times

New safety guidance sets up corporate self-regulation of GMOs

Health Canada and the Canadian Food Inspection Agency both recently updated their guidance on regulating genetically engineered foods and seeds.

Lucy Sharratt

Opinion



The emergence of new genetic engineering techniques for food and farming renewed the deregulation ambitions of the biotechnology industry. The federal government has responded quickly with a hands-off approach. However, the use of new genomic technologies in our food system, such as gene editing, demands strong regulatory oversight.

Health Canada and the Canadian Food Inspection Agency both recently updated their guidance on regulating genetically engineered foods and seeds. These updates are significant policy decisions about the future of genetic engineering and consumer choice that will change how many Canadians view the food system and federal regulation, and may impact food and environmental safety.

The regulatory guidance results in corporate self-regulation of most future genetically engineered foods and seeds (genetically modified organisms or GMOs). Health Canada has described this conclusion as mistaken, but this is precisely the outcome, and it is both dangerous and anti-democratic. More than 100 environmental, farmer, and social justice organizations jointly wrote to the ministers of health and agriculture to demand that all genetically engineered foods and seeds be subject to government safety assessments and mandatory reporting to government.

Rather than strengthen oversight and ensure transparency, the government is deferring to industry and unseen industry-generated science. Faced with

the advent of the new genetic engineering techniques of gene editing, government departments have chosen to further narrow regulatory triggers in order to exempt many gene-edited products from pre-market regulation. The sound option is to expand the triggers to capture all new products of genetic engineering.

The updated regulatory guidance could have ensured that all GMOs, including those produced with gene editing, are assessed for safety. At the very least, "novelty" could have been defined such that departments secured the option to review them. Establishing this regulatory authority would have allowed the government flexibility into the future, to regulate as the technology changes and the science evolves. Instead, the guidance confirms the ability of many (or most) new GMOs to make it to market without any government oversight or public knowledge. This includes products of future—as yet undeveloped—genomic technologies. There is no government tracking of "non-novel" GMOs, and no ability to reliably track them.

Until now, all of the GMOs we eat have been reviewed for

safety by government regulators, but this is about to change. Now, how should we refer to "non-novel" GMOs that do not trigger the pre-market regulations? Is it accurate to refer to these GMOs as "unapproved" or "unregulated" GMOs?

Like all foods that we eat, there are regulations that will still govern GMOs generally. For example, companies are required to report any food safety issues that may arise. However, unless a non-novel GMO is linked to an observable or reported problem once on the market, it may never be seen by any department or made known to the public.

Health Canada has disputed our description of its approach as corporate self-regulation because the guidance defines five categories of product characteristics that would trigger regulation. Critically, however, Health Canada will not be assessing whether products meet any of these categories. That determination is left to product developers, and Health Canada will be dependent on them to adequately investigate these questions and to truthfully report any negative results.

Pre-market government assessments of gene edited products will be rare. Most safety assessments will be conducted by product developers without independent government review. There will be no government access to these private safety assessments and there may be no relevant published science. How is this not corporate self-regulation?

There is no mandatory labelling of GM foods in Canada, and the updated guidance does not establish mandatory reporting of non-novel "unregulated" GMOs. Canadians may soon be eating some unknown GMOs that regulators have not assessed for safety. The federal government has concluded that this does not matter. We think it does. A majority of Canadians, according to public opinion polling, agree with us.

Creating a supportive environment for innovation does not require the surrender of government authority. This approach shows either a lack of imagination and foresight, or a lack of commitment to safety and transparency.

Lucy Sharratt is co-ordinator of the Canadian Biotechnology Action Network (CBAN), a network of 15 organizations including farmer associations, environmental and social justice organizations, and regional coalitions of grassroots groups. CBAN is a project of the MakeWay Charitable Society. www.cban.ca
The Hill Times



Canada is ranked ninth by the World Intellectual Property Organization, however this success has not translated into growth in domestic commercialization, writes Gordon McCauley, president and CEO of adMare BioInnovations. Image courtesy of Pixabay

Seizing the moment: building Canada's academic leadership into a commercial powerhouse

Too much high-quality research is failing to make it out of laboratories to the benefit of patients and the Canadian economy.

Gordon McCauley

Opinion



For years, Canada's life sciences research community has punched above its weight on a global scale. Over the last few years, tremendous progress has been made to convert that research into innovative companies serving Canadians and the world.

We cannot stop now. We are living in a generational moment where the opportunity exists, if we act swiftly, to finally build a sustainable industry commensurate with our research leadership.

Life science companies not only generate innovative treatments to improve the health of the population and resolve major public health challenges, but they are also key contributors to the economy, generating high-quality jobs and attracting worldwide investments and talent.

Our country is ranked ninth by the World Intellectual Property Organization, which grades nations based on markers such as research and development, venture capital, and high-tech production. Unfortunately, this success has not translated into growth in the domestic commercialization. On other indicators, such as infrastructure and business sophistication, Canada falls behind, leaving us 17th overall in the global innovation index rankings.

Canada's knowledge infrastructure is strong. Within the ecosystem of our universities, teaching hospitals, research institutes, and private sector life sciences industry, our researchers are producing original research at a high rate. We are ranked in the top 10 countries for overall research output worldwide, we produce 3.8 per cent of global research publications, and we are over-represented in the top one per cent of publications across all specialties.

To reach patients, however, that research needs to move from bench through clinical trials to commercialization. And that is not happening with nearly enough frequency as it should.

To create a new biotech company, the first step is to identify the research with the highest potential of commercialization, and then support and nurture the research journey to venture creation. While researchers are experts in the science, they need to be supported with drug

development expertise, business strategies, capital, and infrastructure. An extensive ecosystem and network are needed to develop a scientific discovery into a successful company.

Unfortunately, the success rate in drug development—the so-called “valley of death” from research to commercialization—is extremely low: among the 9,700 development programs active from 2011-2020, the overall likelihood of approval for a drug candidate entering Phase I clinical trials was only 7.9 per cent.

It's common knowledge that numerous companies must be launched before one drug can successfully treat patients. Encouraging a more active entrepreneurial spirit in Canadian universities is key to improving our performance—we must inspire the researchers to embark on the entrepreneurial journey and facilitate their onboarding.

The pandemic demonstrated the urgent need for a strong and well-aligned domestic life scienc-

es industry—especially for the security of domestic medication supply, and for continued innovation to drive economic recovery.

Governments have taken decisive actions in response to the pandemic. For example, the 2021 Biomufacturing and Life Sciences Strategy allocated \$2.2-billion over seven years for life sciences. This is a significant step for the industry, but we can't stop there; we must continue to ramp up our collective efforts and investments.

As it stands today, too much high-quality research is failing to make it out of laboratories to the benefit of patients, the Canadian economy, and our leadership role. It doesn't need to be that way.

Instead, by leveraging the good work and investments made, and working together to build a national ecosystem of ideas, talent, and companies, we will increase the opportunity and the outcomes from this important industry and its contribution to the Canadian biotech economy.

Gordon McCauley is president and chief executive office of adMare BioInnovations, a position he assumed in 2016 after serving on adMare's Board for four years. McCauley earned a BA in political science from McMaster University, an MBA (with honours) from IMD in Lausanne, Switzerland, and holds the ICD.D certification from the Institute of Corporate Directors and the Rotman School of Business at the University of Toronto.

The Hill Times

Biotech Policy Briefing



The values of Canada graduate scholarship masters and postgraduate scholarship doctoral have not changed since 2003, and Canada's postdoctoral fellowships stipend has not changed since 2015, writes NDP MP Richard Cannings. Photograph courtesy of Pixabay

Canada's place in the world of biotechnology research and application is in jeopardy

Government of Canada-funded scholarships and fellowships are the primary sources of income for many biotechnology researchers. To stem the brain-drain, Canada must significantly increase the value and number of graduate student scholarships and post-doctoral fellowships and to index them to the cost of living.

NDP MP
Richard
Cannings

Opinion



Humans have been using biotechnology for millennia—the making of cheese, wine, and beer are only a few examples—but recent developments point to a dramatic increase in its applications.

One indication of that change is in the speed and cost of DNA sequencing. The Human Genome Project was an endeavour by 20 research institutes in six countries that began in 1990 and reached its goal—to discover the chemical sequence of the entire human genome—after spending US\$3-billion over 13 years. Less than 20 years later, the average cost to sequence a genome was US\$525 with results in days if not hours, according to the U.S.-based National Human Genome Research Institute.

Worldwide, the pace of biotechnology research and application is expected to continue this acceleration over the next 20 years. The U.S. director of national intelligence in 2021 found “a more multidisciplinary and data-intensive approach to life sciences will shift our understanding of and ability to manipulate living matter. Scientists are increasingly treating genetic instructions as a form of computational code and incorporating insights and new tools from the rapidly advancing realm of computational science. These disciplines, combined

with cognitive science, nanotechnology, physics, and others, are propelling new leaps in our understanding.”

Canada has always played an outsized role in biotechnology. In addition to the well-known invention of insulin, Canadians developed the first Ebola vaccine, and discovered the genes that cause ALS and cystic fibrosis. We pioneered in the field of regenerative medicine through the discovery of stem cells, while work by UBC's Dr. Pieter Cullis developed the lipid nanoparticle technology that is a key component of the m-RNA Pfizer-BioNTech COVID-19 vaccine.

However, Canada's place in the world of biotechnology research and application is in jeopardy. The danger does not come from lack of support for research infrastructure such as the new Canada Immuno-Engineering and Biomanufacturing Hub announced for my home province of British Columbia. The danger comes from the fact we have forgotten to support the people who do the research.

The vast majority of actual work done in scientific research is carried out by students working on their master's or doctorate degrees, or is done by post-doctoral fellows. Government of

Canada-funded scholarships and fellowships are primary sources of income for many of these researchers.

Shockingly, the values of Canada graduate scholarship masters (C\$17,500) and post-graduate scholarship doctoral (C\$21,000) have not changed since 2003. Canada's post-doctoral fellowships stipend (C\$45,000) has not changed since 2015. As both the cost of living and tuition have steadily increased since then, these levels no longer provide adequate support for graduate students. These government-funded scholarships amount to less than minimum wage, forcing some of the brightest minds in Canada into poverty or to seek better funded positions abroad. The economic hardship is even greater than it might first appear since students must also pay for their university tuition fees with these awards, and those graduate program tuition fees average C\$7,472 each year.

These low rates are especially problematic for scientists who have families, which may contribute to the fact that women make up only 37 per cent of post-doctoral fellowship applicants, but comprise 59 per cent of master's scholarship applicants. Moreover, these

funds come with essentially no social benefits or unemployment insurance.

However, other nations are willing to provide much more financial assistance to their scientists. For example, the American National Science Foundation graduate scholarship is worth US\$37,000, plus US\$12,000 for research expenses. It's no wonder many students leave Canada to continue their studies.

University of Ottawa PhD student Sarah Laframboise put this clearly to the House Standing Committee on Science and Research: “This means that every day we are losing our highly trained scientists to the United States and Europe where they don't have to live in poverty and will make two to three times more money than they would here in Canada. This means that our businesses are losing highly skilled workers. This means that every day, we are failing Canadian innovation by defining who can take on the financial challenges of higher education and excluding those who can't. This is a lost potential on a personal level and a national level.”

To stem this brain-drain, Canada must significantly increase the value and number of graduate student scholarships and post-doctoral fellowships and to index them to the cost of living. Unless we give young researchers reasonable funding so that they can live above the poverty line, we will lose them and their innovative ideas. Ideas that will be the basis of the Canadian economy for decades to come.

NDP MP Richard Cannings represents the riding of South Okanagan-West Kootenay, B.C. He is his party's deputy critic for innovation, science and industry. *The Hill Times*

Can biotechnology put patients' needs ahead of profits?



Prime Minister Justin Trudeau, pictured outside Rideau Hall on July 26, 2023, after shuffling his cabinet. 'Let's hope the cabinet shuffle breathes ethical reflection into the government's pursuit of excellence in the biotechnology sphere,' writes Sharon Batt. *The Hill Times* photograph by Andrew Meade

These are challenging dilemmas for a government that gutted a suite of policies designed to cap excessive drug prices, and that 'waxed lyrical' about the importance of accelerating vaccine access worldwide, then failed to support an intellectual property waiver that would expand global production of COVID-19 vaccines.

Sharon Batt

Opinion



When Canada launched a biotechnology strategy in 1998,

feminist scholar Nandita Sharma opposed it. The strategy was focused on economic benefits, she said. It didn't address the objections of women and scientists to biotech corporations profiting from the commons by patenting seeds and life forms like the human genome.

Sharma's arguments still resonate. The federal government's Biomanufacturing and Life Sciences Strategy, introduced in 2021, promises a future in which Canadian innovation "leads in preventing, treating and curing all kinds of illness and disease," while also touting the sector's creation of high-paying jobs and economic growth, as if equitable access to health products flow naturally within capitalist structures.

Consider insulin, which the 2021 strategy document cites as evidence of Canada's "long and impressive history of achievement in health and life sciences innovation." Health researcher Colleen Fuller has documented the history of insulin and the biotech industry, and considers the 1921 discovery at Toronto's Connaught Laboratories an argument *against* modern biotech. Co-discoverers Frederick Banting, Charles Best and James Collip wanted to ensure "the best insulin is supplied at the lowest possible cost" to countries around the world, and reluctantly patented

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Economist Marian Mazzucato calls on governments to improve transparency about R&D costs, and to recognize the considerable investment in virtually all drugs brought to market today.

their discovery to prevent others from doing so.

Fifty years later, three American research teams competed fiercely to clone the human insulin gene sequence. The California start-up Genentech won the race, filed a patent on the process the next day, and signed an exclusive licensing agreement with pharmaceutical giant Eli Lilly. A campaign followed to use patents, aggressive marketing, and misinformation to shift patients first from animal insulin to the genetic imitation then to long-acting insulin analogues. Today, three global corporations control the multi-billion-dollar market, and insulin is unaffordable to many.

As a professor at the University of Toronto, Geoffrey Hinton pioneered the mathematical technique behind AI innovations like chatbots. Known as "the Godfather" of artificial intelligence, he deflected questions about his discovery's potential for serious harm until Google and Microsoft began competing in a global race. Last April, he resigned from a job at Google and went public with regrets about his life's work—the knowledge basis for misinformation flooding the internet. Hinton foresees the technology replacing jobs and creating "killer robots."

Chinese scientist He Jiankui shocked the genetic research community in 2019 when he

used the gene-editing technology CRISPR to create three "edited" babies from embryos. CRISPR can both snip out bits of genetic matter known to cause serious diseases and introduce mutations that harm the subject they are meant to benefit. If performed on embryos, these errors can be passed on to future generations. Jiankui, a self-described "research-type entrepreneur," protected his research team's commercial secrets, while exempting the researchers from responsibility for any unexpected mutations. The health status of the three edited girls is shrouded in secrecy.

Editing heritable genes is currently a criminal offence in Canada, and scientists working through the Stem Cell Network argue this blocks the public's right to benefit from scientific discoveries. The federal biotech strategy aims to build strength in both artificial intelligence and gene therapies, citing their "high potential to solve current and future health challenges." The potential of these therapies to create problems goes unmentioned in the strategy, as do their potential price tags.

Canadian bioethicist Françoise Baylis argues for an approach to heritable genome editing she calls "slow science": taking the time to reflect on the big questions; and not just an inner circle, because the human genome belongs to all of us. She discusses CRISPR's hazards, including its unique potential harms to women research participants. She recognizes that slow science is in tension with the political drive to commercialize knowledge, but asks, "at what cost do we keep racing about without knowing or understanding where we are racing to?"

Commerce also drives the patent games that increase profits without improving patient outcomes, a congressional investigation of drug pricing in the United States concluded. Governments "must create the conditions to ensure new drugs remain affordable and easily accessible" says economist Mariana Mazzucato. She calls on governments to improve transparency about R&D costs, and to recognize the considerable public investment in virtually all drugs brought to market today.

These are challenging dilemmas for a government that gutted a suite of policies designed to cap excessive drug prices, and that "waxed lyrical" about the importance of accelerating vaccine access worldwide, then failed to support an intellectual property waiver that would expand global production of COVID-19 vaccines. Let's hope the cabinet shuffle breathes ethical reflection into the government's pursuit of excellence in the biotechnology sphere.

Sharon Batt is an adjunct professor in Dalhousie University's Departments of Bioethics and Political Science, and has an adjunct appointment at Georgetown University in D.C. She is a member of Independent Voices for Safe and Effective Drugs.

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