Driving a Thriving Life Sciences Sector

Edmonton Global

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Deloitte professionals have experience working with life sciences companies across the country and globally to assess their strategic options; assist in forming, establishing and maintaining partnerships and alliances; develop commercialization strategic; enhance revenues; improve operating efficiencies; optimize asset utilization; strengthen management teams; provide due diligence and valuation support as part of a transaction; implement tax efficient structures; streamline the complexities related to industry auditing and accounting; mitigate enterprise risk; and provide negotiation and advisory assistance.

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6. This Report is a review based on the scope of our work (as listed in the "Scope of Review" section) and the information we gathered.

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Executive Summary

To drive a successful foreign direct investment and trade strategy, Edmonton Global recently identified key sectors of focus in which to target investment and foster economic growth, diversification, and prosperity. One of these sectors of focus is the health and life sciences sector. Since the health and life sciences sector has experienced sustained growth and momentum, Edmonton Global has identified the need to expand and strengthen current cluster assets to precipitate additional foreign direct investment to support the industry.

Within the scope of this report (Report), the following objectives were set out:

1. Identify the key determinants in the formation and development of a regional health and life sciences cluster;
2. Identify insights and recommendations to encourage and support the growth of the life sciences sector in the Edmonton Metropolitan Region (Edmonton region);
3. Consider the opportunities for life sciences and healthcare industries in the entire Edmonton region, including all fourteen municipalities;
4. Identify various types of government supports that have successfully been implemented in other jurisdictions and could have an impact in the Edmonton region; and,
5. Provide insights and evaluate the components of a cluster of assets within the Edmonton region when attracting Foreign Direct Investment (FDI) in the life sciences sector.

Elements of a Successful Life Sciences Cluster

Forming a regional cluster is essential in developing and commercializing innovative products because of the relationships they foster between industry, research institutions, incubators / accelerators, investors, and a skilled workforce through a centralized location.

Through our research and cross-jurisdictional analysis of competing jurisdictions, we have established the following ten elements as key determinants in building a thriving cluster:

1. Advanced education and research;
2. Access and retention of talent;
3. Access to capital;
4. Anchor tenants;
5. Early-stage commercialization support;
6. Entrepreneurial culture;
7. Cluster management and network;
8. Transportation infrastructure;
9. Government legislation/policy; and
10. Integration with healthcare providers.

Current State Analysis of Edmonton Metropolitan Region

Advanced education and research

The Edmonton region currently supports several postsecondary institutions and leading research facilities that provide the foundation to grow and support the region's health and life sciences sector. The University of Alberta is the fifth-ranked research university in the country in terms of sponsored research income, with $554 million received in 2022[1] and home to world-renowned institutes and centres that foster vital innovation, commercialization, and technology transfer to facilitate comprehensive contributions to the health and life sciences sector.

The Edmonton region is also home to other universities, colleges, and technical institutions that provide the education and training required to support the health and life sciences sector, including but not necessarily limited to:

- MacEwan University
- Concordia University
- The Northern Alberta Institute of Technology (NAIT)
- NorQuest College
- The King's University
- Athabasca University

Access and retention of talent

The Edmonton region has access to a consistent pipeline of graduates leaving postsecondary education to enter the workforce, including in the health and life sciences sectors. However, Alberta currently lags behind the national average in terms of physical and life sciences bachelor and graduate degrees awarded per 100,000 persons 15 years and older.

In the Edmonton region, the average salary for life sciences research occupations is higher than the annual cost of living but lower than some of the leading regions identified in our jurisdictional scan.[2]

Market	Biotechnologist	Biomedical engineer	Chemist	Microbiologist	Average	Annual Cost of Living*	Ratio of Average Salaries to Cost of Living
Edmonton	$91,023	$106,458	$104,560	$91,023	$98,266	$65,856	1.49

Source: https://alis.alberta.ca/occinfo/wages-and-salaries-in-alberta , accessed February 15, 2023.
* Source: https://www.expatistan.com/cost-of-living/edmonton, accessed February 15, 2023.

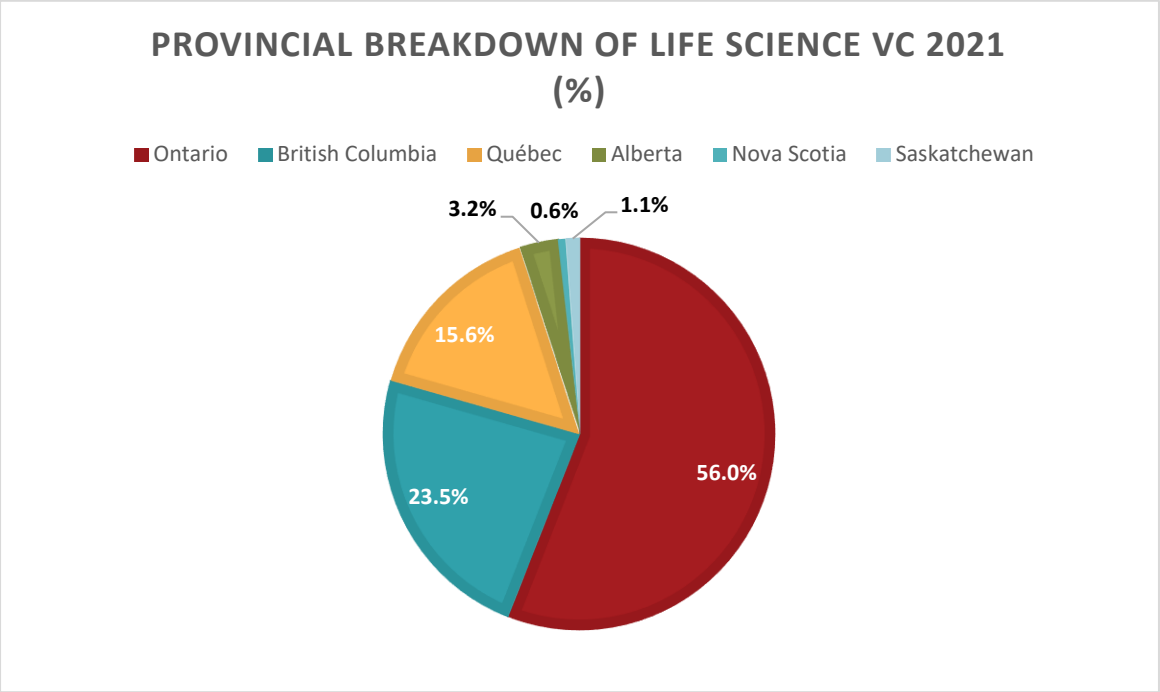
Access to capital

Among the many technology-based industries that engage in research and development processes before a product reaches the commercialization phase of development, the health

[1] Canada's Top 50 Research Universities 2022 - https://researchinfosource.com/top-50-research-universities/2022/list
[2] Salaries are based on the following National Occupation Classification (NOC) codes within the ALIS website: Biotechnologist and Microbiologist (2121), Biomedical Engineer (2148), and Chemist (2112).

and life sciences industry is a relatively high-risk sector given the capital-intensive nature of R&D phases and lower probability of success through clinical trials, and longer payback periods.

Venture Capital (VC) investments in Alberta have increased significantly over the past five years, from $60 million in 2016 to $561 million in 2021. Over this period, Alberta saw its proportionate share of total Canadian VC investment increase from 1.9% in 2016 to 3.8% in 2021. However, Alberta receives $126 in VC funding versus the national average of $213 on a per capita basis.



Source: PitchBook Data, Inc. based on deals from Jan 01, 2016, to Dec 31, 2021. (Excludes failed/cancelled deals)

Alberta ranked fourth in attracting VC investment in 2021, with 17 completed deals for a total of $65 million. Alberta's share of total Canadian VC investment in the health and life sciences was 3.2%.[3]

Anchor tenants

The Edmonton region is an emerging hub with most companies in the emerging and growth stages of development. In the Edmonton region, Gilead Sciences Inc. is currently a primary "anchor tenant" in the industry. In 2015, Gilead Sciences invested $100 million in expanding its facility in Edmonton, Alberta, to increase its R&D and manufacturing capabilities and create an additional 170 jobs.[4] Gilead's Alberta facility is involved in developing most of the small molecule programs and provides active ingredients for Gilead's worldwide research programs.

Additionally, the Edmonton region is home to the headquarters of DynaLIFE, a medical laboratory offering a complete range of diagnostic testing services. The company operates more than 30 locations, including hospital laboratories, community patient care centres, and

[3] Canadian Life Sciences: A Look Back At 2021 - https://www.mondaq.com/canada/life-sciences-biotechnology-nanotechnology/1166394/canadian-life-sciences-a-look-back-at-2021
[4] Pharmaceutical firm to invest $100M in Edmonton manufacturing site - https://www.canadianmanufacturing.com/supply-chain/pharmaceutical-firm-to-invest-100m-in-edmonton-manufacturing-site-148953/

central testing laboratories. The company employs over 1300 employees and provides over 19 million laboratory tests annually.[5]

Early-stage commercialization support

As the Edmonton region's health and life sciences industry continues to grow, companies are starting to transition from the emerging phase towards the growth phase of development. Currently, the cluster promotes early-stage commercialization through the following incubators and accelerators:

- Alberta Innovates – Health Solutions
- DynaLIFE's Accelerator Lab
- University of Alberta Health Hub & Accelerator
- Applied Pharmaceutical Innovation Incubator Program
- Edmonton Unlimited
- Prairies Economic Development Canada
- Edmonton Research Park

Entrepreneurial culture

The ability to continue cultivating an entrepreneurial culture and an innovative environment is critical to growing a successful health and life sciences sector. High levels of entrepreneurship can be reflected in a cluster with recently established companies, business start-ups, and spin-offs from academic or research institutes.

The regional cluster is still in the early stages of development as many companies were established within the last three to five years. More specifically, 26% of companies were founded in the previous two years, and 59% of companies were established between 2015 to 2021.[6]

Cluster management and network

The Edmonton region has developed several support organizations to encourage and sustain the development of the emerging health and life sciences industry. These organizations have a marketing role in promoting the region and strengthening networks and interaction with local, provincial, national, and international partners through collaboration and investment. Some of the key organizations supporting and promoting the interests of the health and life sciences industry within the Edmonton region are:

- Applied Pharmaceutical Innovation
- BioAlberta
- Health Cities
- Edmonton Global
- Alberta Health Services

[5] Overview of DynaLIFE - https://www.dynalife.ca/MeetDynaLIFE
[6] BioAlberta. Life Sciences in Alberta: State of the Industry 2021 - https://bioalberta.com/wp-content/uploads/2022/05/BioAlberta-State-of-the-Industry-2021_Final_Nov-10-2021-3.pdf

Transportation infrastructure

Edmonton is a vital, well-connected international shipping and logistics hub in western Canada. The Edmonton region has launched the concept of Port Alberta to highlight the region's competitive logistics and distribution advantages.

The Edmonton International Airport (YEG) is the only airport in Canada with the Center of Excellence for Independent Validators in Pharmaceutical Logistics (CEIV Pharma) certification, which means the airport meets the highest standards globally for handling temperature-sensitive cargo like pharmaceutical and medical cargo.

This infrastructure provides the Edmonton region with a potential opportunity to attract foreign investors by reducing logistical expenditures, providing stability in the supply chain, and accessing critical markets through Canada's current trade agreements.

Government legislation/policy

The province has been motivated to shift the Alberta economy from relying on resource production to a more diverse economy to improve the region's long-term prosperity. However, currently, the province does not include the health and life sciences industry as a key sector in the economic development plan and does not have a comprehensive strategy to drive growth in the industry.[7] Alberta presently provides the lowest corporate tax rate in Canada. Corporate income tax reductions do not offer these early-stage companies the same relief as other businesses. Many targeted tax credits and subsidies that encouraged the growth of the life sciences sector were eliminated in the 2019 provincial budget.

Integration with healthcare providers

Alberta Health Services (AHS) is the largest fully integrated provincial healthcare system in Canada, with programs and services to over 900 facilities throughout the province, including hospitals, clinics, continuing care facilities, mental health facilities, and community health centres.

Currently, there are 3,477 active or completed clinical trials within the Edmonton region[8], and there is an opportunity to increase the number of clinical trials happening throughout the Edmonton region at all hospitals, from WestView Health Centre to the Sturgeon Community Hospital, to Leduc Hospital and Strathcona Hospital.

Competitive Leading Practices

Through a global screen to identify other jurisdictions that have successfully nurtured a robust health and life sciences cluster, we identified nine regions (see Appendix A) based on similarities in size, business climate, culture, and industry. We compared the outcomes from these regions to assess performance and identify insights into encouraging growth in Edmonton region's health and life sciences sector. We selected three as having the most relevant leading practices from the cities in our high-level review. These jurisdictions include:

[7] In 2020, the Government of Alberta launched "Alberta's Recovery Plan" with a focus on key sector strategies in technology and innovation, finance, fintech, hydrogen, and film and television production. https://www.alberta.ca/alberta-recovery-plan-key-strategies.aspx

[8] NIH U.S. National Library of Medicine - https://clinicaltrials.gov/ct2/results?cntry=CA&city=Edmonton&dist=100&Search=Apply&recrs=b&recrs=a&recrs=f&recrs=d&recrs=e&age_v=&gndr=&type=&rslt=. Accessed January 27, 2023.

1. Austin, Texas
2. Raleigh-Durham-Chapel Hill, North Carolina
3. Toronto, Ontario

Recommendations

Based on the current state of the Edmonton region life sciences and healthcare cluster, our review of leading practices, insights from other experiences, objectives of the Edmonton region, and opportunity assessment for maximum impact, we have developed the following recommendations to further enhance the opportunities, growth, financial, economic and marketplace results, and to optimize the overall impact of the life sciences and healthcare cluster in the Edmonton region.

Our top five recommendations are:

1. **Encourage the provincial government to develop and implement a comprehensive health and life sciences strategy.** The successful implementation of the Texas Industry Cluster Initiative[9] or Ontario's "Taking life sciences to the next level" strategy[10] could serve as a framework for Alberta to adopt.
2. **Support incentives that have assisted in the creation, attraction, and sustained growth of life sciences and healthcare clusters, including:**
    a. Enhance awareness and visibility of the provincial Investment and Growth Fund to increase the province's ability to recruit relocation and expansion of job-creating companies within the region. The Texas Enterprise Fund and Job Development Investment Grant (JDIG) in North Carolina are leading examples of how this incentive has benefited the health and life sciences sector.
    b. Implement provincial grants for public institutions of higher education attempting to recruit distinguished researchers to incent more innovative research to be conducted within the region. The Governor's University Research Initiative offered in Texas is a leading example of how this grant could be implemented.
    c. Reintroducing the provincial portion of the Scientific Research and Experimental Development (SR&ED) tax credits for research and development expenditures. This tax credit was ended in 2020 in favour of the Innovation Employment Grant, which is targeted at SMEs and not at large multi-national life sciences companies that might consider expanding in Alberta.
    d. Voucher programs to support R&D and investment in the patenting process have shown success in Alberta and the UK.[11] In these programs, the entrepreneur or company receives a voucher, which provides funding to a service provider, such as a researcher or a patent attorney, to fund services associated with the patenting process.

[9] Texas Cluster Initiative - https://gov.texas.gov/business/page/target-industries
[10] Government of Ontario. (2023). "Tax Credits and Benefits by Topic | Ontario.ca." Www.ontario.ca. January 2023. https://www.ontario.ca/page/tax-credits-and-benefits-topic#section-9.
[11] Nationwide innovation voucher program in the UK. Kleine, M., Heite, J., & Huber, L. (2022). "Subsidized R&D collaboration: The causal effect of innovation vouchers on innovation outcomes." Research Policy, 51(6), 104515. https://doi.org/10.1016/j.respol.2022.104515

3. **Develop a memorandum of understanding between the technology transfer organizations and AHS to:**
    a. Support the commercialization of innovative ideas, technologies, and opportunities in our healthcare system.
    b. Find ways to mine the rich data that results from having one healthcare region with robust depth, number, and longitudinal data available regarding treatments and disease insights. Develop the policies, procedures, and systems to aggregate, organize, interrogate, and develop insights from the data that could be mined from bioinformatics, digital health, and clinical development perspectives.
4. **Provide personal income tax incentives for the benefit of highly qualified senior executives, including entrepreneurs and investors.** Quebec has successfully implemented a tax holiday from provincial personal income tax for foreign researchers or experts to assist employers who have trouble hiring people with the required scientific research and experimental development competencies. The tax holiday measure for foreign researchers is intended for companies located in Quebec performing SR&ED and having signed an employment contract with a foreign researcher that:
    a. Holds a second-cycle university degree recognized in Quebec in the field of pure and applied sciences or a related field;
    b. Does not reside in Quebec or Canada immediately before taking up employment with the eligible employer; and
    c. Exclusively or almost exclusively and continuously carries out SR&ED activities within the Quebec enterprise.
    d. The foreign researcher that meets the above requirements is eligible for a tax holiday, with an exemption rate of 100% for the first two years, and this amount is reduced by 25% for each preceding year for a maximum of up to five years.[12]
5. **Develop a formal network of hospitals that can further coordinate clinical trial sites** in the Edmonton region to attract pharmaceutical, biotechnology, medical device, digital health, and tool companies to the Edmonton region for running their clinical trials.

[12] Tax holiday for foreign researchers https://www.economie.gouv.qc.ca/bibliotheques/programmes/mesures-fiscales/conge-fiscal-pour-chercheurs-etrangers/

Introduction

For the purposes of this report, the Life Sciences sector includes the fields of biotechnology, pharmaceuticals, nutraceuticals, healthcare technologies, healthcare, biomedical technologies and devices, digital health technologies, tools, and research products and services.

Within the scope of this Report, the following objectives were set out:

- Identify insights and recommendations to encourage and support the growth of the life sciences sector in the Edmonton Metropolitan Region (Edmonton region);
- Consider the opportunities for life sciences and healthcare industries in the entire Edmonton region, including all fourteen municipalities;
- Identify various types of government supports that have successfully been implemented in other jurisdictions and could have an impact in the Edmonton region; and,
- Provide insights and evaluate the components of a cluster of assets within the Edmonton region when attracting Foreign Direct Investment (FDI) in the life sciences sector.

To drive a successful FDI and trade strategy, Edmonton Global recently identified key sectors of focus in which to target investment and foster economic growth, diversification, and prosperity. One of these sectors of focus is the health and life sciences sector. Since the health and life sciences sector has experienced sustained growth and momentum, Edmonton Global has identified the need to expand and strengthen current cluster assets to precipitate additional FDI to support the industry.

A life sciences cluster comprises a group of interconnected companies and supporting organizations that inhabit close geographical proximity, varying widely in structure, growth, evolution, and strategic objectives. The interest in clusters is based on substantial statistical evidence that indicates a positive relationship between the presence of clusters and the prosperity of regional economies.[13] They represent a complex ecosystem where research, innovation, and commercialization promote economic development within the sector and encourage sustained economic growth in the industry.[14] Business enterprises can operate in a cluster in the same industry and compete for the same market and therefore draw upon the same regional resources. Companies can simultaneously compete and collaborate, and both activities can enhance their competitiveness.

The life sciences industry is a growing and essential part of the Alberta economy. Currently, life sciences organizations are responsible for over $1.0 billion in revenues and employ 12,400 Albertans. The industry presently supports various companies in different life-cycle phases, with early-stage start-ups, emerging growth organizations, and a few mature companies serving as anchor tenants to support the current cluster, of which roughly 41% currently reside in Edmonton.[6]

[13] Ketels, Christian. (2017). "Cluster Mapping As A Tool For Development". Working Paper.
[14] Porter, Michael E., and Michael P. Porter. "Location, Clusters, and the 'New' Microeconomics of Competition." Business Economics 33, no. 1 (1998): 7–13. http://www.jstor.org/stable/23487685.

Alberta has seen consistent growth in this sector with an upward trend in the proportion of companies founded within the last three to five years throughout the province. More specifically, 25.9% of companies were established in the previous two years, and 59% of companies were founded between 2015 and 2021. This result is driven by growth in start-up companies servicing the health biotechnology and pharmaceuticals, medical technology and devices, and health IT sub-sectors.[6]

Data was collected primarily from publicly available reports and publications, including sector analyses, existing clusters in other geographies, industry associations, research studies, annual reports, strategic plans, and industry insight reports. These sources provided a largely qualitative overview of the sector throughout the Report. Where available, numerical data was used to complement this material and provide a quantitative picture.

All source material used for this Report is detailed in Appendix B, and includes material from the following sources:

- Alberta Government and Edmonton Global reports and publications
- Comparator jurisdiction life sciences sector websites, publications, and reports
- Industry association websites and reports
- Third-party and/or research reports, articles, and other publications

Elements of a Successful Life Sciences Cluster

This section examines the fundamental elements required to create a robust health and life sciences cluster. Forming a regional cluster is essential in developing and commercializing innovative products because of the relationships they foster between industry, research institutions, incubators/accelerators, investors, and a skilled workforce through a centralized location.

The development of regional clusters offers several key competitive advantages compared to a single company's typical vertical integration. These include:

- Productivity, which benefits from lower transaction costs and intangible benefits gained by firms that cluster together;
- Innovation, which is dependent on robust knowledge exchange between companies and the supporting organizations, mainly because of the proximity necessary for tacit knowledge exchange; and
- New business formation, which is facilitated by the mentoring, learning, communication, and commercialization gains that arise from operating in a cluster setting.[15]

Through our research and cross-jurisdictional analysis of competing jurisdictions, we have established the following ten elements as key determinants in building a thriving cluster.

Advanced education and research

A solid scientific base is a necessary precursor to establishing and growing a thriving regional health and life sciences cluster. Universities, research organizations, and hospitals lead innovation, drive discoveries, and create an essential talent pipeline within the ecosystem. The presence of leading researchers, facilities, and supportive grants can serve as a catalyst to gain prominence and a national/international reputation for the cluster built from a robust scientific base. A shared research database is perceived to be a driver for increasing research efficiency and collaboration.

To foster innovation and entrepreneurialism, universities and research organizations establish technology transfer organizations to streamline the transfer of intellectual property (IP) to a spinout company in the most efficient and cost-effective manner and avoid any encumbrances or special terms that would be detrimental to attracting capital from future investors.

Access and retention of talent

Talent is a critical input to developing and sustaining a thriving cluster. Health and life sciences companies compete for talent with highly specialized skill sets. Often to obtain the skills and industry knowledge required, employees will pursue post-graduate or doctoral degrees. Due to the time an individual needs to invest in attaining the required skillset, much of the potential talent is established within a city and may not be keen to relocate. Since there is scarcity

[15] Cooke, Philip. 2002. "Biotechnology Clusters As Regional, Sectoral Innovation Systems". International Regional Science Review 25 (1): 8-37.

associated with attracting top talent, companies, in turn, have started to come to the source of talent, which has led life sciences companies to cluster around established postsecondary institutions and/or renowned research institutions.

Additionally, since the health and life sciences are highly regulated industries with highly skilled workers, the effects of turnover can have a more considerable impact than in other fields. Therefore, attracting and retaining this workforce is critical in establishing the foundation for a thriving cluster. Some key performance indicators include STEM degree graduates, year-over-year growth in industry employee headcount, and founders of start-ups with a technical background.

Access to capital

Among all other key determinants necessary to develop a thriving health and life sciences cluster, the ability to attract pre-seed, seed, and Venture Capital (VC) investments are among the most important contributors to the long-term viability and success of developing companies and the sector. Due to the risk and extended investment horizon required to develop early-stage companies toward successful commercialization, government funding and grants need to bridge the commercialization gap and get innovative companies past the trials of early-stage development to commercialization in order to attract more sophisticated investors and private capital. Obtaining sustainable and sufficient investment in the sector is the top priority in developing the reputation and competitiveness of a cluster on the world stage that serves to attract talent, employers, and FDI. Some key performance indicators to analyze in this area are the number of government grants to early-stage companies, the amount and stage of funding completed by companies within the sector, and the amount of financing deals completed within the cluster.

Anchor tenants

An anchor tenant is a large, locally present organization with significant operations that anchors local economies. The presence of large biotech or pharmaceutical companies creates a foundation to develop and strengthen the value chain and ecosystem within a regional cluster. They can support small and medium-sized enterprises (SME) by creating demand for products and services and providing capital through deals for product development and innovation to help facilitate commercialization.

Large companies can provide a foundation for top industry talent to receive formal and informal (mentoring and coaching) training and rapidly develop skills and expertise within the industry. These experienced employees can leverage their knowledge into a start-up venture or become attractive targets that small innovating firms can hire and accelerate growth through a tacit knowledge exchange. Indications of success regarding the role of anchor tenants within the ecosystem can be evaluated through the activity and support they present within a cluster. Key performance indicators include cooperation with SMEs, merger and acquisition (M&A) transactions, education and training programs, and technology sharing arrangements.[16]

[16] PricewaterhouseCoopers. (2011) "Regional biotechnology: Establishing a methodology and performance indicators for assessing bioclusters and bioregions relevant to the KBBE area: Final report." PWC, Luxembourg; European Commission, DG Research and Innovation, Brussels.

Early-stage commercialization support

Life sciences and healthcare accelerators and incubators hold the potential to help a region's cluster grow in size and impact by extending the broader culture of innovation and fostering an entrepreneurial culture. Incubators and accelerators support early-stage start-ups with technology transfer efficiency, enabling new business creation and growth by offering dedicated infrastructure and networking opportunities. Other support includes business model development, developing financial systems, marketing, Board development, and helping secure additional rounds of funding from outside investors once the business is more sophisticated. These programs are essential to spin-off/start-up companies as they face substantial challenges in accessing funding/investment for the earlier, riskier stages of commercialization (i.e., the commercialization gap, sometimes dubbed the valley of death), as these are typically not yet ready for "prime time" early-stage/commercialization-stage financing sources, such as VC investors.[17] They aim to stimulate entrepreneurship by creating an entrepreneurial climate and strengthen early-stage projects by providing resources and financial stability.

Entrepreneurial culture

Entrepreneurship and innovation are highly correlated. Start-up firms are often the mechanisms through which innovations are developed, especially where larger, more mature organizations may not be agile enough to pivot to a new market segment. High levels of entrepreneurship are generally reflected in growing companies, business start-ups, and spin-offs from existing companies or research institutes. The level of entrepreneurial culture can be classified as a critical success factor in measuring a cluster's success, whereas low levels of entrepreneurship would be a cause for concern. This can form a positive feedback loop as knowledgeable entrepreneurs from successful ventures can serve as mentors within the industry and instill insights and learnings into the next generation of the workforce. Some key performance indicators are founders with previous experience establishing a start-up, university entrepreneur programs, and the number of start-up companies based within the sector.

Service organizations[18] also support and nurture entrepreneurs and emerging companies. Service organizations play a critical role in providing insights, support, access to relationships, experienced-based advice, and programs to help with company start-up, development, and commercialization.

Cluster management and network

For clusters in the early stages of development, growth in the industry is primarily driven by spin-off entities, start-ups, and SMEs. To encourage and sustain the development of these early-stage clusters, cluster initiatives and organizations can help provide clear strategic direction and mandates to promote the industry internally within the market and externally to investors, regulators, and researchers. Through these initiatives, cluster management organizations can set clear initiatives around encouraging capital investment, programs to link educational and

[17] Evaluation of Commercialization of Research https://www.nserc-crsng.gc.ca/_doc/EvaluationCECR_e.pdf
[18] Service organizations in the Edmonton region include: Applied Pharmaceutical Innovation, Alberta Innovates, Health Cities, Edmonton Unlimited, BioAlberta and others.

industrial resources, affect public policy, and enhance workforce recruitment and development.[16]

For a cluster to provide value to the ecosystem, there must be meaningful interactions between cluster members. Networks are a means of building trust, notably spreading knowledge and experience. The growth of an influential network can lead to collaboration between different stakeholder groups. This can take the form of cooperation in R&D, contract research, publications, and sharing of facilities. The growth of the cluster network is a critical driver in attracting FDI and an essential factor in the long-term success of the cluster.

Transportation infrastructure

The ability to create stable distribution networks and supply chains is an essential factor in the growth and development of a life sciences cluster both on a micro and macro scale. In attracting FDI, national trade agreements and international reputation are essential factors as stability of the supply chain and access to markets are vital determinants in the investment decisions made by health and life sciences companies. On a more regional scale, logistical costs and supply chain stability are essential considerations for investors when making investment decisions, as this helps reduce inventory costs and overhead by utilizing just-in-time inventory systems.

Government legislation/policy

Government partners can implement policies and regulatory incentives to mitigate the burden of R&D activities and help foster innovation and increase the sector's competitiveness on the global stage. These can include research grants, tax credits for R&D spending, subsidies to incentivize established companies to move into the region, favourable corporate tax rates, tax exceptions to promote investment in start-ups and grants to foster innovation and economic diversification. Government can also enact policies to help employers access a global skilled labour force through expedited immigration processes.

Integration with healthcare providers

It is critical that the life sciences and healthcare industries are integrated with local and regional healthcare providers. This permits several dimensions of cross-pollination, including the commercialization of technologies created in the healthcare system, the testing of opportunities in the healthcare system (e.g., clinical trials, physician surveys, etc.), and the sale of approved technologies to the local healthcare system.

Current State Analysis of Edmonton Metropolitan Region[19]

Advanced education and research

The Edmonton region currently supports several postsecondary institutions and leading research facilities that provide the foundation to grow and support the region's health and life sciences sector. These institutions offer a pipeline of skilled talent and play a key role in fostering an entrepreneurial culture by providing research opportunities and commercialization support. The life sciences industry in Alberta employs individuals from a broad spectrum of educational backgrounds, but one commonality is that over 80% of the workforce has a bachelor's degree or higher.[6] This result reinforces the competitive advantage of top-tier postsecondary institutions in developing a suitable and sustainable talent pool to attract investment in a globally competitive industry.

The University of Alberta

The University of Alberta is a member of the U15 Group of Canadian Research Universities, attracting exceptional researchers, academics, and students whose accomplishments form the foundation of the research and development capacity and provide the necessary training to develop the skilled workforce required to support the growth of the sector. The University is the fifth-ranked research university in the country, providing sponsored research income of $554 million, and is home to world-renowned institutes and centres that foster vital innovation, commercialization, and technology transfer to facilitate comprehensive contributions to the health and life sciences sector.[1] Through the University's commitment and investment in health and life sciences research, it has ranked in the top ten of the U15 Group of Canadian Research Universities in terms of licensing activity.

University of Alberta	Annual Average (2018 to 2022)
Patents Issued (US)	13
Patents Issued (Rest of World)	20
New Licensing Deals (Excluding Spinoffs)	20
New Spin-Off Companies	5
Products Launched	1

Source: University of Alberta

Universities play a substantial role in driving the innovation economy through entrepreneurial businesses. This plays a significant part in building the foundation of the ecosystem as more than 86% of new companies remain in their institution's home province.[20] To continue to convert this research into commercialization opportunities, industry stakeholders have noted a need to enhance technology transfer from universities, colleges, and institutions.[6]

[19] All dollar amounts are denoted in CAD
[20] AUTM. (2021). "AUTM Canadian Licensing Activity Survey: (2020)." Retrieved from https://autm.net/AUTM/media/SurveyReportsPDF/FY20-CAN-Licensing-Survey-FNL.pdf

Some of the leading research institutes and research centres contributing to life and medical sciences research and innovation at the university include:

- Northern Alberta Clinical Trials and Research Centre (NACTRC) – A joint venture between Alberta Health Services and the University of Alberta, developing a comprehensive clinical research administration, operation, and support framework. It aims to increase studies and streamline processes to help investigators conduct clinical research, develop new treatments, and bring them to the market for human use.
- Alberta Diabetes Institute - Canada's largest stand-alone research facility dedicated to translating science into health solutions for the prevention, treatment, and cure of diabetes. The Institute provides a space for leading researchers, and an integrated and collaborative research environment, with new therapies and technologies being developed and evaluated in the Clinical Research Unit.
- Cross Cancer Institute – A leader in innovative cancer research, prevention, treatment, and care initiatives within the region.
- Li Ka Shing Institute of Virology – The Institute builds on an international reputation for virology expertise and is home to Nobel laureate Michael Houghton, who was awarded the Nobel Prize in Medicine for his discovery of the hepatitis C virus. The research interests of the consortium encompass viral pathogenesis, oncolysis, vaccine development, correlates of immunity, enhancement of vaccine efficacy, and development of novel antivirals.
- Mazankowski Alberta Heart Institute – The Institute is a world-class centre for advancement in pediatric and adult heart disease prevention, treatment, research, and education. Its advanced diagnostic and treatment technology and leading-edge research lead the way for pioneering open-heart surgery in Canada.
- Glycomics Institute of Alberta – Glycomics is the study of types of carbohydrates or sugars known as glycans. Glycans are the powerhouses behind a wide range of functions in the human body, helping with everything from eliminating damaging bacteria to moving cells through the body. Glycomics could play a critical role in solving health challenges related to cancer, infectious diseases, neurodegenerative illnesses like Alzheimer's and more. This is one of the top centres in the world focused on this field.

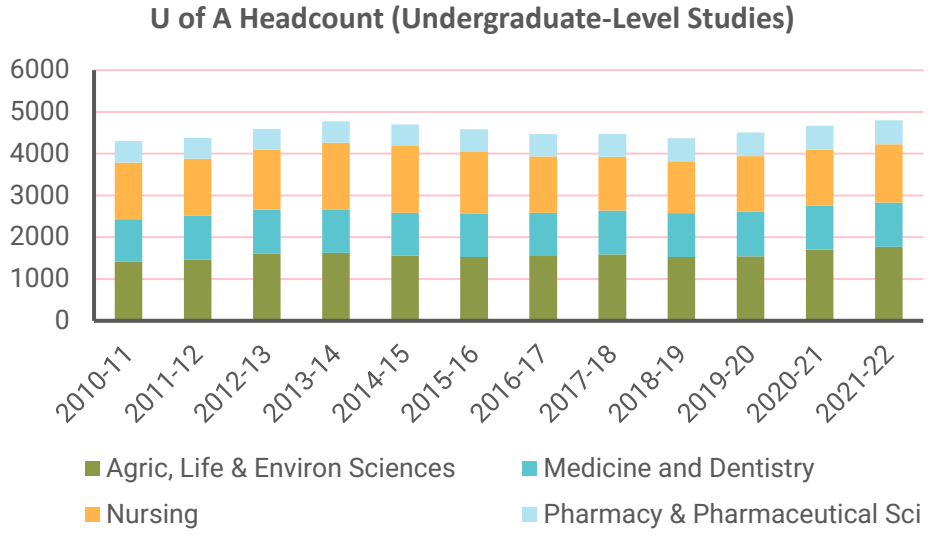
The following faculties are crucial elements to sustaining a pipeline of graduates ready to enter the workforce with the skills and specializations needed to increase the talent pool in the health and life sciences sector:

- Faculty of Medicine and Dentistry – The University of Alberta's medical and dental school is ranked fifth in Canada for top doctoral schools and fourth for total research dollars contributed.[21] The faculty is critical to developing a skilled and specialized workforce in the Edmonton region and conducts life and medical sciences research and innovation across seven research institutes and fifteen research centres.
- Faculty of Pharmacy & Pharmaceutical Sciences – The University of Alberta's pharmacy school is among the top three institutions in Canada, top 50 globally, and top 15 for global research. The faculty hosts Applied Pharmaceutical Innovation (API) to help

[21] Canada's top medical/doctoral schools 2020 https://www.macleans.ca/education/university-rankings-2020-canadas-top-medical-doctoral-schools/

bridge the gap between industry and academia and unlock pharmaceutical treatments and innovation.[22]

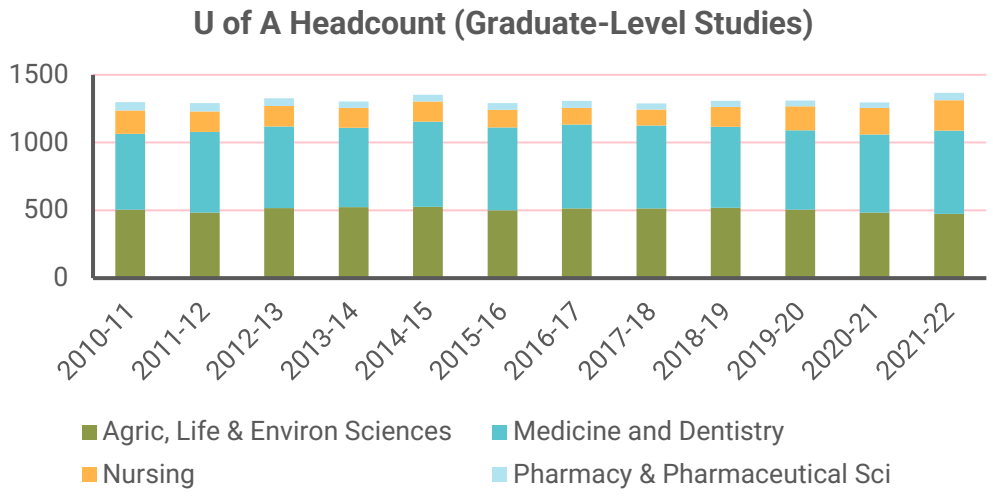
- Faculty of Nursing – The University of Alberta's nursing program is ranked as the top nursing education in Canada,[23] which has built a strong brand globally, as is evidenced by international students accounting for almost 40% of the doctoral programs at the University.
- Faculty of Agricultural, Life & Environmental Sciences (ALES) – The University of Alberta's ALES faculty trains undergraduate and graduate students to pursue employment in environmental, animal care, food and agriculture, and human services sectors. The faculty provides a robust research program in agriculture and food, the environment, community, and individual well-being, and bioresource innovation. The University of Alberta's Agriculture Science program is ranked second in Canada.[24]



Source: University of Alberta

Through these faculties, the University has seen undergraduate enrolment increase by an average of 12% since 2010. The ALES and Pharmacy & Pharmaceutical Sciences programs have seen the most significant growth, with 25% and 12%, respectively.

[22] Faculty of Pharmacy & Pharmaceutical Sciences – https://www.ualberta.ca/pharmacy/index.html
[23] Canada's best medical doctoral universities: Rankings 2022 https://www.macleans.ca/education/canadas-best-medical-doctoral-universities-rankings-2022/
[24] University Rankings - https://www.ualberta.ca/about/university-rankings/index.html



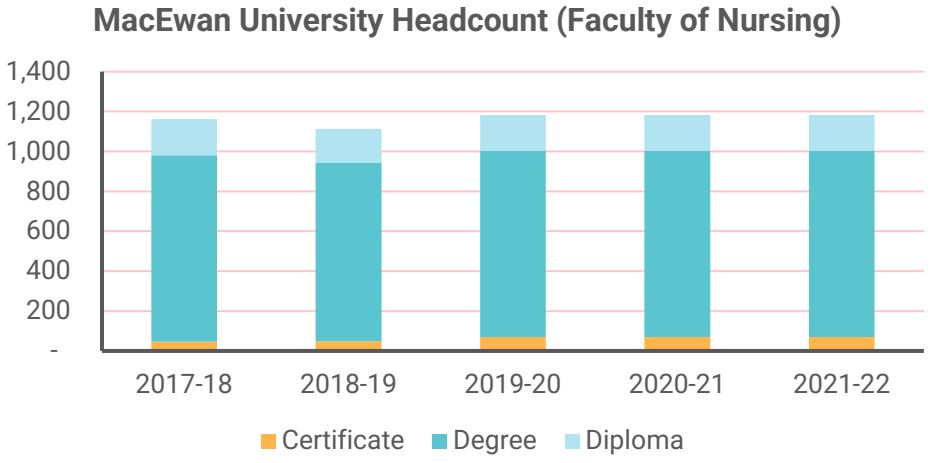
Source: University of Alberta

Additionally, the University has seen enrolment in graduate-level health and life sciences studies increase by an average of 5% since 2010. Nursing and the Faculty of Medicine and Dentistry have seen the most significant growth, with 30% and 9%, respectively.

The Edmonton region is also home to other universities, colleges, and technical institutions that provide the education and training required to support the health and life sciences sector, including but not limited to:

MacEwan University

MacEwan University serves primarily as an undergraduate institution with an annual enrollment of 19,000 students interested in pursuing health and community studies, arts and sciences, fine arts and communication, business, and continuing education.



Source: MacEwan University Comprehensive Institutional Plan

The University's Faculty of Nursing has an annual enrollment of almost 1,200 students and includes five departments offering certificates, degrees, and diplomas in the nursing field. The University has recently entered a partnership with Alberta Health Services (AHS), which offers students an option to accept paid positions linked to their practicum learning to help address staffing shortages experienced by the region.

The Northern Alberta Institute of Technology (NAIT)

NAIT provides technical and applied education, including undergraduate degrees, applied degrees, certificates, and diplomas, at its four campuses (three in Edmonton and one in Spruce Grove). NAIT enrolls 28,000 students annually, and through its School of Health and Life Sciences it supports the development of skilled graduates who enter the workforce in essential health professions, applied research, and technical support roles.

NorQuest College

NorQuest College has an annual enrollment of 13,000 students and offers diplomas and certificates in health, business, community services, hospitality, and personal services. Norquest trains students in frontline healthcare and technical support roles to support the region's health and life sciences industry.

In 2020–2021, NorQuest College approved a college-wide applied research strategy supporting Alberta and Canada's social advancement and economic development through embedded applied research opportunities in all credit programs. The college secured $3.9 million in new research funding and supported 27 research projects.

Postsecondary institutions provide the foundation for a successful health and life sciences cluster by providing a pipeline of skilled talent into the sector and supplying top researchers and facilities required to lead innovation and drive discoveries. Additionally, supporting research and development enables these institutions to facilitate innovation within the ecosystem, leading to organic growth within the sector.

Concordia University

Concordia University has an annual enrollment of 2,000 students. It offers undergraduate and professional programs in arts, science, management, and post-degree programs in education and public health.

The King's University

The King's University has an annual enrolment of about 1,000 students and offers 24 programs, including a specialized Health Sciences stream as part of its Interdisciplinary Science bachelor degree program.[25]

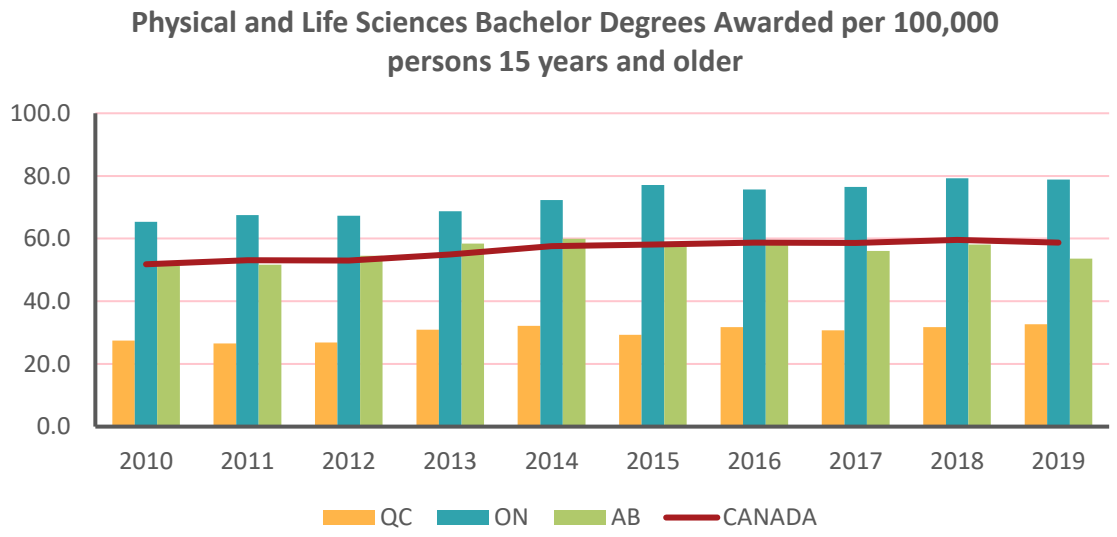
[25] The King's University - https://www.kingsu.ca/about-us/about-kings. Accessed February 1, 2023.

Athabasca University

Athabasca University is one of Alberta's comprehensive academic and research universities and is an online university. Most of its teaching and research faculty live and work in the Edmonton region. It has more than 43,000 students (38,600 undergraduate and 4,670 graduate).[26]

Access and retention of talent

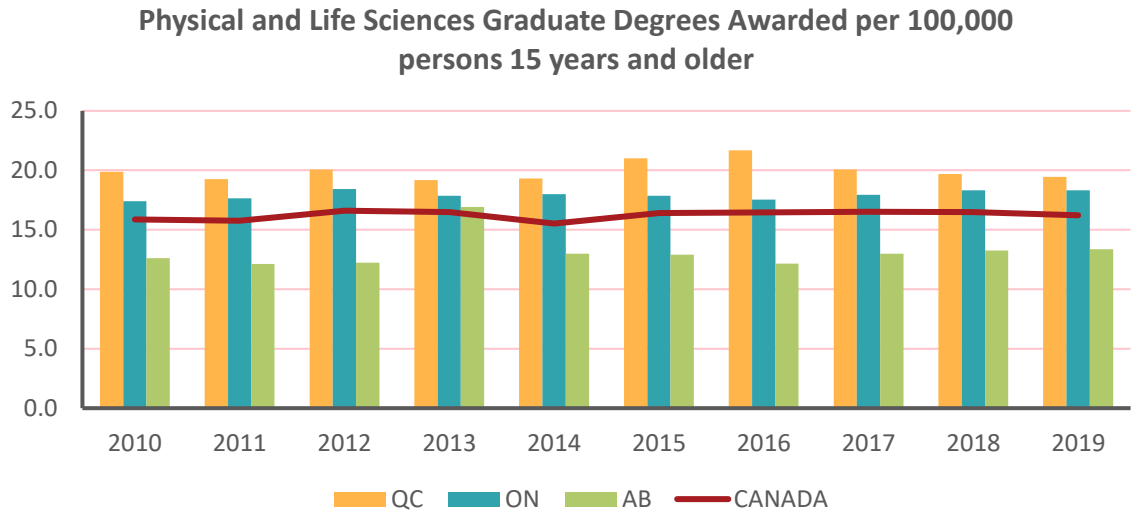
As mentioned in the previous section, Alberta and, more specifically, the Edmonton region has access to a consistent pipeline of graduates leaving postsecondary education to enter the workforce in the health and life sciences sectors.



Source: Statistics Canada

Alberta has increased slightly in terms of bachelor degrees awarded from 51.3 (2010) to 53.6 (2019) per 100,000 people (aged 15 years or older), but down from its high of 60.0 in 2014. However, Alberta lags behind Ontario and the Canadian average in 2019 of 78.8 and 58.7, respectively.

[26] Athabasca University - https://www.athabascau.ca/aboutau/glance.html, accessed February 15, 2023.



Source: Statistics Canada

Alberta has increased slightly in terms of graduate degrees awarded from 12.6 (2010) to 13.4 (2019) per 100,000 people (aged 15 years or older). However, Alberta lags behind Ontario and Quebec, which averaged 17.9 and 20.0, respectively.

In the Edmonton region, the average salary for life sciences research occupations is higher than the annual cost of living but lower than some of the leading regions identified in our jurisdictional scan.[27]

Market	Biotechnologist	Biomedical engineer	Chemist	Microbiologist	Average	Annual Cost of Living*	Ratio of Average Salaries to Cost of Living
Edmonton	$91,023	$106,458	$104,560	$91,023	$98,266	$65,856	1.49

Source: https://alis.alberta.ca/occinfo/wages-and-salaries-in-alberta, accessed February 15, 2023.
* Source: https://www.expatistan.com/cost-of-living/edmonton, accessed February 15, 2023.

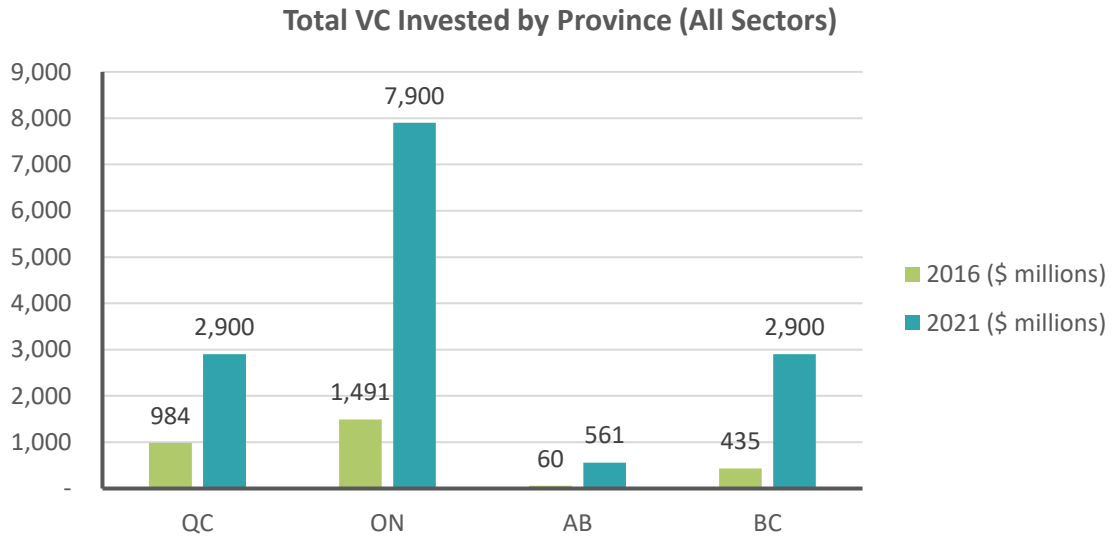
Attracting and retaining talent can be difficult due to career uncertainty and the availability of more competitive opportunities outside the province. Alberta competes for talent in Canada against leading jurisdictions such as Ontario, Quebec, and BC. These jurisdictions have more mature health and life sciences clusters that elevate them as top destinations for workers in the industry. They have a strong presence of health and life sciences companies, ready access to capital infrastructure that includes venture capitalists and successful entrepreneurs, and access to a large skilled workforce. This aids these regions in attracting talent because they focus on innovation and technology, and have a more extensive range of job openings within the critical mass of firms in these locations.

[27] Salaries are based on the following National Occupation Classification (NOC) codes within the alis website: Biotechnologist and Microbiologist (2121), Biomedical Engineer (2148), and Chemist (2112).

When attracting FDI into the industry, talent and human capital are drivers of where health and life sciences firms choose to locate. Sources of skilled workers, such as postsecondary institutions, clusters of similar early-stage firms or large anchor companies, and large urban centres, are strong indicators of a region's performance in location decisions.

Access to Capital

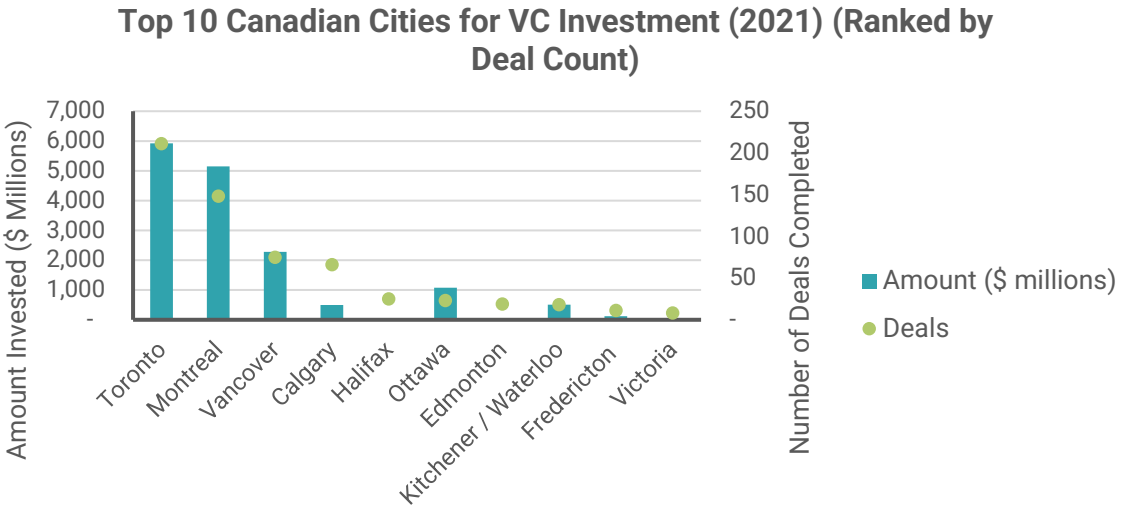
Among the many technology-based industries that engage in R&D processes before a product reaches the commercialization phase of development, the health and life sciences industry is a relatively high-risk sector given the capital-intensive nature of R&D phases, lower probability of success through clinical trials, and longer payback periods. The ability of start-up and early-stage companies to secure pre-seed, seed, and VC funding has been a challenge in Canada, specifically in the health and life sciences industry. Limited access to capital has historically led many Canadian firms to exit the market through mergers or acquisitions.[28]



Source: Canadian Venture Capital Association

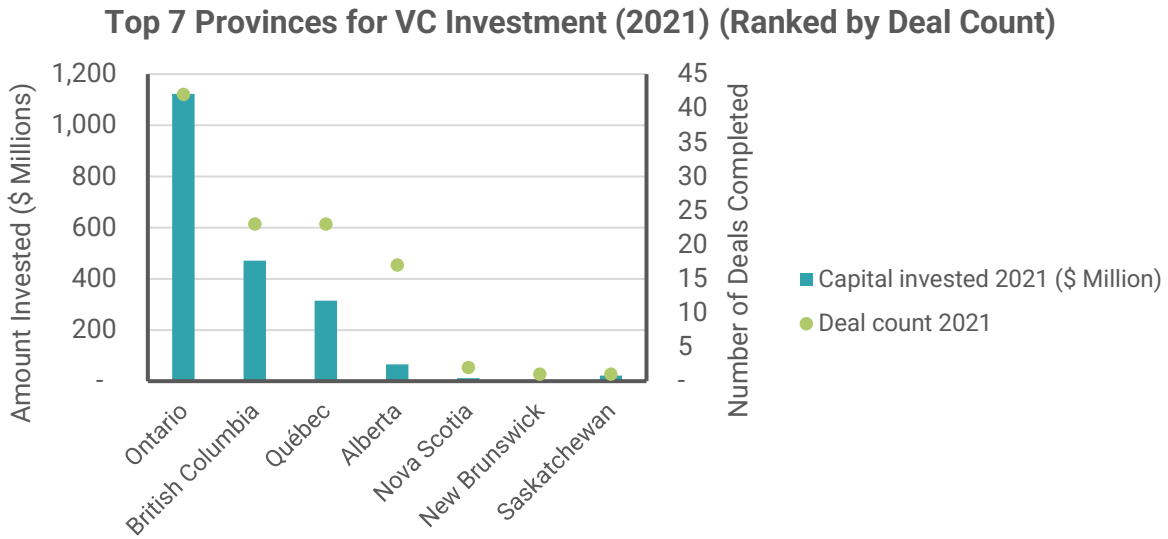
VC in Canada reached record-breaking levels in 2021, with $14.7 billion invested across 752 deals, which more than doubled the previous record set in 2019 of $6.2 billion invested. Of the $14.7 billion invested in 2021, life sciences companies received $1.8 billion across 102 deals, a 50% increase from the previous record set in 2020.[29] VC investments in Alberta have increased significantly over the past five years, from $60 million in 2016 to $561 million in 2021. Over this period, Alberta saw its proportionate share of total Canadian VC investment increase from 1.9% in 2016 to 3.8% in 2021. However, Alberta receives $126 in VC funding versus the national average of $213 on a per capita basis. For an economy that contributes 13.3% of the national GDP,[30] this is well below the potential and opportunity that should exist in Alberta.

[28] BDC Capital. (2017). Canada's Venture Capital Landscape: Challenges and Opportunities. Retrieved from https://www.bdc.ca/en/documents/analysis_research/venture-capital-landscape-paper-en.pdf
[29] CVCA VC key insights 2021 https://www.cvca.ca/research-insight/market-reports/year-end-2021-canadian-vc-pe-market-overview
[30] Statistics Canada. Table: 36-10-0222-01



Source: Canadian Venture Capital Association

In comparing Canadian cities' ability to attract VC investments in 2021, Edmonton ranked seventh in terms of the total number of VC deals (19 deals), but eighth in terms of the total amount of VC dollars invested ($59 million), averaging $3.11 million/deal.



Source: PitchBook Data, Inc. based on deals from Jan 01, 2016, to Dec 31, 2021. (Excludes failed/cancelled deals)

Specifically in the health and life sciences sector, Alberta ranked fourth in attracting VC investment in 2021, with 17 completed deals for a total of $65 million. Alberta's share of total Canadian VC investment in the health and life sciences was 3.2%.[3]

To help mitigate capital constraints experienced in the region, governments can provide support through public policy creation to attract private sector investment by utilizing tax and investment incentives and providing early-stage funding to innovative companies to foster organic growth within the ecosystem.

The provincial government has taken steps to support the VC industry in Alberta by creating Alberta Enterprise Corporation (AEC), with the purpose of:

- Attracting VC investment and VC firms to the province;
- Investing in VC funds that support early-stage investment in Alberta technology companies;
- Supporting and promoting a VC industry in Alberta that is viable and sustainable;
- Creating high-value jobs in the province; and
- Encouraging and supporting an entrepreneurial culture through investing in innovation.

Since its inception, AEC has committed $318 million for investment in 29 VC funds, which has resulted in 69 Alberta companies receiving VC funding, leading to the creation of 2,568 direct jobs.[31]

Anchor Tenants

The Edmonton region is an emerging hub with most companies in the emerging and growth stages of development. The presence of large biotechnology or pharmaceutical companies creates a foundation to develop and strengthen the value chain and ecosystem networks within a regional cluster. Only 19% of companies in the region have entered the maturity stage of the business's life cycle in Alberta's life sciences sector.

In the Edmonton region, Gilead Sciences Inc. is currently a primary "anchor tenant" in the industry. In 2015, Gilead Sciences invested $100 million in expanding its facility in Edmonton to increase its R&D and manufacturing capabilities and create an additional 170 jobs.[4] Gilead's Alberta facility is involved in developing most of the small molecule programs and provides active ingredients for Gilead's worldwide research programs. Gilead also utilizes Canadian contract manufacturing capabilities to supply local and global production. Roughly one-third of worldwide Gilead tablet requirements are produced through Canadian contract manufacturing.[32]

Additionally, the Edmonton region is home to the headquarters of DynaLIFE, a medical laboratory offering a complete range of diagnostic testing services. The company operates more than 30 locations, including hospital laboratories, community patient care centres, and central testing laboratories. The company employs over 1,300 employees and provides over 19 million laboratory tests annually.[5] The company just won a contract to take over from public provider Alberta Precision Laboratories, which will see demand for its services rise within the province to perform approximately 65% of provincial lab work or about 50 million tests per year in non-urgent hospital work.[33]

Early-stage commercialization support

As the Edmonton region's health and life sciences industry continues to grow, companies are starting to transition from the emerging phase towards the growth phase of development. In June 2021, TEC Edmonton, a joint venture between the City of Edmonton and the University of

[31] Alberta Enterprise. "How we work. Our successes." Retrieved from https://www.alberta-enterprise.ca/how-we-work/success-stories/ Accessed January 31, 2023.
[32] Gilead website- https://www.gilead.ca/about/gilead-in-canada
[33] Alberta awards medical test contract to DynaLife - https://edmonton.ctvnews.ca/alberta-awards-medical-test-contract-to-dynalife-to-take-over-majority-of-community-lab-work-1.5757892

Alberta that supported the growth of local tech and health and life sciences sectors, shut down operations. Due to this closure, the University of Alberta regained control of its technology-transfer services and started developing internal innovation programs. Currently, the cluster promotes early-stage commercialization through the following incubators and accelerators (non-exhaustive):

Alberta Innovates – Health Solutions

Alberta Innovates is the province's largest research and innovation agency. From funding to commercialization, it fosters a robust entrepreneurial ecosystem enabling economic growth in the region. Alberta Innovates supports postsecondary researchers, entrepreneurs, and companies by offering targeted funding programs, services, and expertise to achieve the province's research and innovation goals.

Alberta Innovates also provides a Voucher Program, part of a funding program focused on commercializing new product development and technology solutions. In this program, eligible applicants can apply for funding of up to $100,000 to help cover the costs of service providers that provide support services related to:

- New product research and development;
- Leading-edge design, engineering, and prototype development;
- Advanced product testing and refinement;
- Patent development; and/or
- Advanced market assessments.

DynaLIFE's Accelerator Lab

The accelerator aims to validate pioneering diagnostics technologies in a lab setting for approval into the healthcare system. DynaLIFE's Accelerator Lab provides access to clinical samples, wet lab space, mentorship, and funding to advance research, translation, and application of diagnostic companies in the region.

University of Alberta Health Hub & Accelerator

The Health Hub & Accelerator is poised to be the community incubator for innovators and entrepreneurs working toward better human health outcomes by providing programming support, access to facilities and resources, coaching, and consulting support. Currently, 34 companies are involved in the Health Hub, ranging from early-stage start-ups to larger firms.[34]

Applied Pharmaceutical Innovation (API) Incubator Program

The incubator program supports innovators and academic researchers with ideas that could be the beginning of a potential treatment. They assist these companies through professional mentorship to bring their discovery on the path to regulatory-compliant clinical trials and successful investment from the industry. Additionally, API provides access to facilities, lab

[34] Health Innovation Hub - https://www.ualberta.ca/folio/2022/01/health-innovation-hub-the-go-to-place-for-health-innovators-on-campus.html

equipment, collaboration with a network of experts, and a model that builds capacity within the company by providing access to talent.[35]

Edmonton Unlimited

Edmonton Unlimited is a non-profit organization that aims to help provide funding and assistance for innovators, start-ups, investors, accelerators, scale-ups, and postsecondary institutions. The organization provides mentoring programs, and educational programming to help build the competencies of companies across different stages of development.

Prairies Economic Development Canada (PrairiesCan)

PrairiesCan is the federal department that promotes economic growth in Alberta, Manitoba, and Saskatchewan. Its mandate is to support economic growth and diversification within the prairie region and advance the region's interests in national economic policy, programs, and projects. It accomplished these objectives by providing strategic investments and targeted initiatives, supporting collaboration and growth, acting as an advocate for Prairie interests, and helping individuals navigate the federal economic programs and services.[36]

Edmonton Research Park (ERP)

The Edmonton Research Park has a 40-year history as a place for advanced research in medicine, biotechnology, software, research, engineering, nanotechnology, business incubation, and clean energy. It is home to over 1,500 members at over 55 companies working in diverse fields and provides access to adapted workspaces, mentorship, and business and entrepreneurial development to help early and growth-stage companies move from innovation to commercialization.[37] Recently, the city has moved to sell two buildings at the ERP, the Advanced Technology Centre and Research Centre 1.[38]

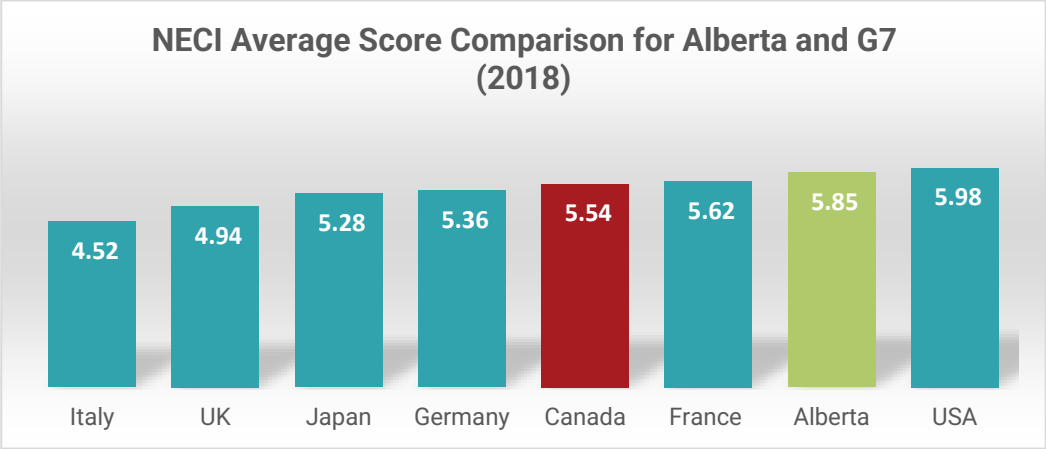
As the Edmonton region's health and life sciences industry continues to grow, companies are starting to transition from the emerging phase towards the growth phase of development. While there is strong early-stage commercialization support for some subsectors within the health and life sciences ecosystem, for example, health AI and digital health, there are still gaps in support for subsectors like biotechnology and pharmaceuticals. Stakeholders within the sector highlighted the need to build a more supportive environment for innovation and a need to generate sustainable funding for research and commercialization. This suggests that life sciences companies want to solidify an industry culture where innovation, emerging technologies, and research are supported and championed to enable commercialization.[6]

Entrepreneurial culture

The ability to continue cultivating an entrepreneurial culture and an innovative environment is critical to growing a successful health and life sciences sector. High levels of entrepreneurship can be reflected in a cluster with recently established companies, business start-ups, and spin-

[35] API Incubator - https://appliedpharma.ca/programs/for-innovators/
[36] PrariesCan mandate and structure - https://www.canada.ca/en/prairies-economic-development/corporate/about/role-structure.html
[37] Edmonton Research Park Business Consortium https://erpbc.ca/our-programs/
[38] Announced sale of two buildings in the ERP - https://edmonton.taproot.news/news/2022/04/22/decision-to-sell-edmonton-research-park-assets-upsets-some-tenants

offs from academic or research institutes. An external measure of the existence of an entrepreneurial culture can be extrapolated from the National Entrepreneurship Context Index (NECI), which assesses the environment for entrepreneurship to allow for quick comparison across economies.



Source: GEM Alberta Report 2018

- Alberta (5.85) is above the average Canadian NECI score (5.54) and is second only to the United States in G7 comparator jurisdictions.
- Strengths in the Alberta ecosystem:
    - Physical infrastructure and services access - Ease of access to physical resources (i.e.: communication, utilities, transportation, land, or space)
- Gaps identified in Alberta's ecosystem:
    - R&D level of transference - Extent to which research and development will successfully lead to commercialization opportunities
    - Financial environment related to entrepreneurship - Availability of financial resources for SMEs.[39]

The regional cluster is still in the early stages of development as many companies were established within the last three to five years. More specifically, 26% of companies were founded in the previous two years, and 59% of companies were established between 2015 to 2021..[6] This result is driven by growth in start-up companies servicing the health biotechnology and pharmaceuticals, medical technology and devices, and health IT sub-sectors.

Cluster management and network

The Edmonton region has developed several support organizations to encourage and sustain the development of the emerging health and life sciences industry. These organizations have a marketing role in promoting the region and strengthening networks and interaction with local, provincial, national, and international partners through collaboration and investment. Some of the key organizations supporting and promoting the interests of the health and life sciences industry within the Edmonton region include:

[39] GEM Alberta Report 2018

API

Applied Pharmaceutical Innovation (API) is a not-for-profit organization in the life sciences industry that helps to bridge the gap between academia and industry. API has an expert interdisciplinary team that works with collaborating organizations to provide a pharmaceutical company's expertise, services, and infrastructure. API's strategic priorities are to define and disseminate API's role and value provided to Alberta's life sciences industry, create solid and strategic partnerships in Alberta's life sciences community, enable sustainable growth and continue to provide value to Alberta's life sciences industry, and to increase awareness and trust in API's brand and mandate within Alberta's life sciences ecosystem.[40]

API has been awarded $5.6 million from the provincial government to build Canada's first integrated research, commercialization, and manufacturing cluster to ensure the security and stability of the supply of critical medicines at commercial volumes. This crucial initiative increases the manufacturing capacity of the health and life sciences cluster and creates meaningful collaboration with academia (Li Ka Shing Applied Virology Institute).

BioAlberta

BioAlberta is a private, not-for-profit industry association that acts as the centralized coordinating entity to advance the interests of Alberta's emerging health and life sciences industry. The strategic focus of this organization is to provide advocacy for the sector, promote/market the competencies of the industry internally and to outside investors, increase industry development within the province, and grow networks and collaborations.[41]

Health Cities

Health Cities is a not-for-profit organization that works with innovators, clinicians, charitable organizations, and industry to provide better health outcomes within the region and encourage economic growth in the health sector. It aims to complete these strategic goals by fostering an innovative ecosystem, creating a policy environment that accelerates growth, enhancing access to capital, and building the region's reputation on the global stage. Health Cities recently launched "Companies Growing Companies" in partnership with Invest Alberta[42], a new series designed to highlight Alberta assets in order to help companies find market success and grow networks within the innovation community.

Edmonton Global

Edmonton Global focuses on transforming and growing the economy of the Edmonton region by attracting FDI and promoting the export of goods and services from the region. Edmonton Global markets the region to businesses in the health and life sciences industry as an attractive place for them to do business.

[40] Applied Pharmaceutical Innovation Visioning Strategy 2022
[41] BioAlberta: What we do -https://www.bioalberta.com/what-we-do
[42] Health Cities: Companies Growing Companies - https://healthcities.ca/companies-growing-companies/

Alberta Health Services

Alberta Health Services is a provincewide, fully integrated system, responsible for delivering health services to more than 4.4 million people. For economic development organizations to provide value to the ecosystem, they must encourage meaningful interactions, partnerships, and collaboration between cluster members and develop and implement strategic plans with short- and long-term goals and a clear mandate. Networks are a means of building these connections and facilitating knowledge exchange that helps increase the cluster's competitiveness and attractiveness to outside investors. AHS has an innovation team that is running some of its own programs and it has partnered with other stakeholders, such as Alberta Innovates.

Glenrose Rehabilitation Hospital

An AHS facility, the Glenrose Rehabilitation Hospital is the largest free-standing, comprehensive tertiary hospital in Canada, serving patients of all ages who require complex rehabilitation to enable them to participate in life to the fullest.[43] It plays a key role in Canada for innovation and takes part in clinical trials.

Stollery Children's Hospital

An AHS facility, the Stollery Children's Hospital is a full-service pediatric hospital and centre for complex pediatric care and research. It has among the highest inpatient volumes of any children's hospital in Canada and is affiliated with the University of Alberta.[44]

Transportation infrastructure

Edmonton is a vital, well-connected international shipping and logistics hub in western Canada. The Edmonton region has launched the concept of Port Alberta to highlight the region's competitive logistics and distribution advantages. It highlights the area as a significant manufacturing, cargo and shipping hub for air, road, rail, and pipeline distribution.[45]

The region is connected through a comprehensive road network to the United States and Mexico through the CANAMEX trade corridor and connected east to west by the TransCanada Highway.

The Edmonton International Airport (YEG) is Canada's closest major airport to Asia by circumpolar routes, providing Edmonton with an opportunity to leverage this proximity to one of the world's most significant health and life sciences consumer markets. It offers direct flights to key US health and life sciences cluster locations, which promotes the accessibility of the region to potential investors and networking opportunities. It also provides stability to the region's supply chain as R&D and advanced manufacturing increasingly rely on air transport for just-in-time delivery. YEG is the only airport in Canada with the CEIV Pharma certification, which means the airport meets the highest standards globally for handling temperature-sensitive cargo like pharmaceutical and medical cargo. YEG has also secured funding for a $100 million cargo expansion project to expand its growth and export opportunities.[46] This continued development

[43] Glenrose Rehabilitation Hospital - https://www.albertahealthservices.ca/grh/grh.aspx
[44] About Us – Welcome to the Stollery Children's Hospital - https://www.albertahealthservices.ca/stollery/Page14264.aspx
[45] Port Alberta - https://edmontonglobal.ca/port-alberta/
[46] Government of Canada investment in EIA - https://flyeia.com/corporate/media/news/government-of-canada-invests-to-expand-supply-chain-capacity-at-the-edmonton-international-airport/

of the airport as a major multi-modal hub has served as a catalyst to drive further industrial development in south Edmonton and Nisku.

Canada has entered into 15 trade agreements with 51 different countries, helping companies gain access to markets containing 1.5 billion consumers and more than one-half of the world's GDP.[47] The Edmonton region is a designated national Foreign Trade Zone, allowing investors to save on operating expenses, increase cash flow, and improve supply chain efficiency through eligible duty and tax relief programs.

This infrastructure provides the Edmonton region with a potential opportunity to attract foreign investors by reducing logistical expenditures, providing stability in the supply chain, and accessing critical markets through Canada's current trade agreements.

Government legislation/policy

As noted above, in developing an emerging cluster, the ease and availability of receiving government funding is highly correlated to the viability and growth of the industry within the region. All three levels of government can implement policies and regulatory incentives to attract foreign investors or firms looking to expand their production capacities. Since a large portion of the life sciences sector in the region consists of emerging (14%) and growth companies (68%), these companies are less enticing to institutional investors that are more risk-averse to companies in this stage of development. This is corroborated by industry statistics that show a significant portion (61.5%) of funding was attained from government facilitated programs.[6]

Provincial government

The province has been motivated to shift the Alberta economy from relying on resource production to a more diverse economy to improve the province's long-term prosperity. However, currently, the province does not include the health and life sciences industry as a key sector in the economic development plan and does not have a comprehensive strategy to drive growth in the industry.[48] Alberta presently provides the lowest corporate tax rate in Canada. Corporate income tax reductions do not offer these early-stage companies the same relief as other businesses. Many targeted tax credits and subsidies that encouraged the growth of the life sciences sector were eliminated in the 2019 provincial budget. Many industry stakeholders have noted that continuing or enhancing these programs would benefit the industry's competitiveness. Examples of these phased-out provincial tax credits and subsidies include:

- Alberta Small Business Innovation and Research Initiative (ASBIRI) - The ASBIRI program through AI gives small businesses funding opportunities to solve significant industry challenges. This is accomplished by responding to industry challenges with innovative solutions and, through industry R&D spending, creating innovation to enhance global competitiveness. This program supported 3% of SMEs in the health and life sciences sector, and a vast majority of industry stakeholders (89%) want the initiative enhanced and extended.[6]

[47] Invest in Canada - https://www.investcanada.ca/programs-incentives/canadas-free-trade-agreements. Accessed January 31, 2023.
[48] In 2020, the Government of Alberta launched "Alberta's Recovery Plan" with a focus on key sector strategies in technology and innovation, finance, fintech, hydrogen, and film and television production. https://www.alberta.ca/alberta-recovery-plan-key-strategies.aspx

- Capital Investment (Manufacturing) Tax Credit Program (CITC) - The CITC provides a non-refundable tax credit valued at 10% of a corporation's eligible capital expenditures up to $5 million. This was aimed at increasing the manufacturing capacity within the province, and 52% of respondents within Alberta thought the continuation of this tax credit program was very important for the health and life sciences industry.[6]

Federal government

The Government of Canada has made deliberate efforts to advance the growth and development of the life sciences sector by supporting domestic companies with incentives, talent attraction, building manufacturing capabilities, and encouraging research and development. This has become a priority after COVID-19 highlighted the need to increase national capabilities to be better positioned to respond to future health crises. Some of the initiatives include:

- Strategic Innovation Fund - This program was implemented to enhance innovation in priority areas identified by the government. Biomanufacturing and life sciences were outlined as a specific investment priority to support firms with high growth potential, build resilience, and improve long-term pandemic preparedness by filling gaps in biomanufacturing and supply chains. Entos Pharmaceuticals, an Edmonton-based healthcare biotechnology company, received $5 million through The National Research Council of Canada Industrial Research Assistance Program (NRC-IRAP) for phase 1 clinical trials of its Covigenix VAX-001 vaccine candidate.
- Scientific Research and Experimental Development (SR&ED) - SR&ED is a program that uses tax incentives to encourage all sectors to conduct R&D within Canada. This program allows companies to deduct SR&ED expenditures against current-year income, or a company can earn the SR&ED investment tax credit and use it to reduce its income taxes.

Integration with healthcare providers

AHS is the largest fully integrated provincial healthcare system in Canada, with programs and services to over 900 facilities throughout the province, including hospitals, clinics, continuing care facilities, mental health facilities, and community health centres. In the Edmonton region, there are 14 hospitals, with 32,000 employees who work in the healthcare system.[49] and including hospitals with deep expertise in particular technologies or disease areas. For example, the Cross Cancer Institute, the Mazankowski Alberta Heart Institute, and the University of Alberta Hospital have unique and deep expertise that is recognized globally in the healthcare and research communities.

Currently, there are 3,477 active or completed clinical trials[8] within the Edmonton region, and there is an opportunity to increase the number of clinical trials happening throughout the Edmonton region at all hospitals, from WestView Health Centre to the Sturgeon Community Hospital, to Leduc Hospital and Strathcona Hospital.

[49] AHS Edmonton Zone - https://www.albertahealthservices.ca/assets/zone/ahs-zn-edmonton-map-brochure.pdf

Since AHS is the largest centralized provider of healthcare services within Canada, health and life sciences companies within the Edmonton region are uniquely positioned to provide a strong local market to have AHS support early-stage companies as first-time buyers of goods and service procurement within the industry. There are excellent Canadian examples where this is happening: in Ontario, the provincial government has outlined a comprehensive strategy called "Taking life sciences to the next level." It has identified a benchmark goal aimed at adopting Ontario innovations in the health and life sciences industry to improve healthcare in Ontario. The province intends to achieve this goal through modernization of the province's supply chain and early adoption of local innovation and technologies across Ontario's healthcare system.[50] In Quebec, the provincial government has introduced its 2022–2025 Quebec Life Sciences Strategy, which aims to stimulate private investment in the entire life sciences value chain and development of new industrial sectors in future niches, and to increase the presence of Quebec companies in the local and international supply chains.[51]

Competitive Leading Practices

Through a global screen to identify competing jurisdictions that have successfully nurtured a robust health and life sciences cluster, we identified nine regions (see Appendix A) based on similarities in size, business climate, culture, and industry. We compared the outcomes from these regions to assess performance and identify insights into encouraging growth in Edmonton region's health and life sciences sector. We selected four as having the most relevant leading practices from the nine cities in our high-level review.

Austin, TX[52]

Similar to Alberta, Texas is well known for its oil and natural gas-based economy and business-friendly climate. In the past decade, Texas has become a leading example of how policies and incentives can create a diversified economy that leads to innovation, population growth, and job creation. Austin is among the top emerging health and life sciences clusters within the United States. The city has started leveraging its robust technology infrastructure to support established and emerging companies' growth and innovation within the sector. The region is home to over 300 life sciences companies and an industry workforce of over 18,000. Austin has started to find its niche within the Texas ecosystem by focusing on high-growth segments and research areas, including medical devices, diagnostics, biotechnology, pharmaceutical, and contract research, focusing on small and mid-size companies.

Advanced education and research

The Austin region benefits from 20 postsecondary institutions within a 60-mile radius. The University of Texas at Austin is positioned within the top ten schools for the most life sciences graduates in the US, with 1,186 annual graduates, providing the region with a strong pipeline of

[50] Government of Ontario. 2023. "Tax Credits and Benefits by Topic | Ontario.ca." Www.ontario.ca. January 2023. https://www.ontario.ca/page/tax-credits-and-benefits-topic#section-9.
[51] Gouvernement du Québec. (2022). "2022–2025 Québec Life Sciences Strategy." Gouvernement Du Québec. 2022. https://www.quebec.ca/en/government/ministere/economie/publications/2022-2025-quebec-life-sciences-strategy.
[52] All dollar amounts are denoted in USD

new talent to enter the workforce. The University also receives $600 million in annual research funding that supports over 50 research units dedicated to health and life sciences.[53]

In 2016, the unveiling of the University of Texas at Austin's new Dell Medical School solidified efforts towards the development of a centralized location aimed at encouraging innovation and collaboration towards the creation of new models of health and economic growth in the city's health and life sciences industry. The Innovation District is focused on advancing life sciences and translational medicine in downtown Austin, and partners business with educational and healthcare institutions.[54]

Access and retention of talent

Among Austin's most substantial assets is the talent pool, which provides companies with one of the most educated workforces within the United States, with 46.6% of adults having attained at least a bachelor's degree. The workforce is supported by the country's seventh fastest-growing high-tech market.[55] Austin's health and life sciences sector is well-positioned to benefit from the convergence of talent, innovation, and capital between the industries.

Austin provides an attractive destination to recruit talent and for recent graduates to remain, as the average salary for life sciences research occupations is high compared to the low cost of living.

Market	Biochemist	Biomedical engineer	Chemist	Biophysicists	Average	Annual Cost of Living	Ratio of Average Salaries to Cost of Living
Austin	$91,931	$ 89,442	$72,217	$ 94,750	$ 87,085	$52,267	1.67

Source: https://www.cbre.com/en/insights/reports/us-life-sciences-talent-2022

Opportunity Austin (OA) is a series of five-year regional economic development initiatives led by the Greater Austin Chamber of Commerce, started in 2004 and aims to maximize job creation through strategic investment across the Austin metropolitan region. Since its inception, the initiative has added over 465,900 jobs (a 69% increase since 2004) and added $29.9 billion in payroll in the region.[56]

OA 2.0 focused on talent attraction and retention initiatives, including:

- Out-of-market events to advertise the advantages of relocating to greater Austin.
- Partnering with Universities to leverage their alumni to recruit top talent back to the Austin Region;
- Establishing one centralized organization to serve the networking needs of the diverse talent base so that informal networking is organized, tracked, and optimized under the purview of a single organization;

[53] Life Sciences in Austin - https://www.austinchamber.com/economic-development/key-industries/life-science
[54] OA implementation guide - https://cdn1.austinchamber.com/general/Opportunity_Austin_4_0_Strategy_and_Implementation_Guidelines_FINAL_3.pdf?mtime=20190529145850&_ga=2.263259852.1929432258.1656283642-1475127402.1656283642
[55] CBRE life science sector highlights - https://www.cbre.nl/en-gb/press-releases/cbre-report-strong-growth-of-life-sciences-sector-favors-real-estate-in-select-markets-austin
[56] OA initiative - https://www.austinchamber.com/about/opportunity-austin

- Continuing efforts to close achievement gaps and integrate courses into the K-12 curriculum that support the Greater Austin Chamber of Commerce's target industries; and
- Increasing the retention of college graduates by ensuring internship programs and career-services offices are connected with private businesses to facilitate talent retention.[57]

These strategies have been successful in growing the skilled labour force in Austin, as seen in the growth of the job market over the past five years:

Employment by Industry, Austin MSA

Industry	2016	2021	Difference	% Change
Total non-farm	1,000,900	1,165,700	164,800	16%
Educational & Health Services	115,600	133,900	18,300	16%

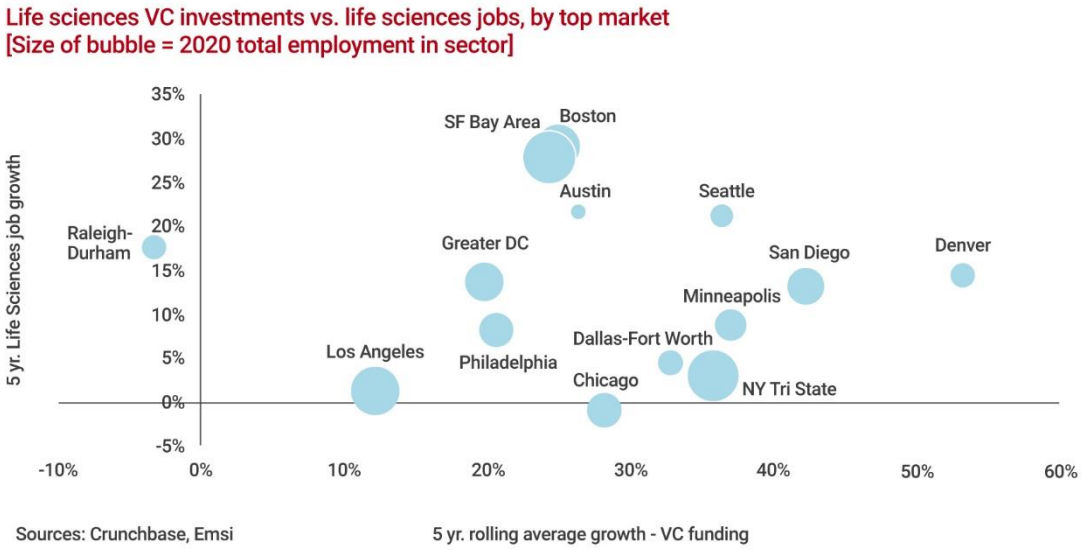
Source: https://www.austinchamber.com/economic-development/austin-profile/workforce/employment-by-industry

The 2021 Site Selector Survey also noted that Texas was fifth in states implementing successful talent attraction and retention strategies. Respondents to the survey indicated that companies prioritize locations with a strong labour supply, and there is an emphasis on sites with vital workforce development programs, proximity to higher education institutions or access to certification programs.[58]

Access to capital

The city's innovative tech sector has successfully attracted VC funding to the region, which the health and life sciences industry has been able to leverage to support the development and commercialization potential of SMEs within the industry. Additionally, funding from the National Institutes of Health (NIH), state-funded programs, and research grants have secured the region with a diverse stream of funding to support growth and innovation:

[57] Tamanini, J. (2013). Talent Attraction and Retention Strategies and Tactics: The Case of the City of Austin, Texas. Tendensor.
[58] Site Selectors Survey - https://siteselectorsguild.com/site-selectors-survey-reveals-impact-of-global-talent-shortage-on-corporations-and-communities/



- The NIH contributed over $84 million to the University of Texas in Austin through research project grants.
- The life sciences industry secured $223 million in VC funding in 2020, accounting for 12.5% of all VC funding in the region.[59]
- The University of Texas UT Horizon Fund is a formative VC fund that seeks investment opportunities in growing companies within the University's start-up ecosystem (accelerators and incubators), supplying over $50 million in committed capital to date.[60]
- The Cancer Prevention Research Institute of Texas (CPRIT), based in Austin, is the country's second-largest taxpayer-funded cancer research organization. CPRIT has awarded 1,070 grants totalling more than $1.67 billion, with approximately $45 million dedicated to academic research grants.

Early-stage commercialization support

Austin Technology Incubator (ATI) is an accelerator located at the University of Texas at Austin and was founded in 1989. ATI was formed by a consortium of university, government, and business leaders when the local government, industry stakeholders, and Austin's Chamber of Commerce funded an experiment to create wealth, generate jobs, diversify Austin's struggling economy, fill office space, and build entrepreneurial infrastructure in Austin. Over the incubator's 33-year history, it has served over 500 companies, raised over $2 billion in funding, and launched over 10 initial public offerings (IPOs). It has evolved into supporting deep tech solutions in healthcare, energy, mobility, water, circular economy, and food and agriculture technology.[61] The start-up incubator of the University of Texas at Austin is regarded by state and federal governments as a "best practices" incubation program.

[59] Austin Chamber of Commerce: Venture Capital investment - https://www.austinchamber.com/economic-development/austin-profile/business-industry/venture-capital-investment
[60] University of Texas: Investment approach - https://www.utsystem.edu/offices/talent-and-innovation/investment
[61] Austin Technology Incubator - https://ati.utexas.edu/

Other primary incubators and accelerators in Austin include:

- Austin Community College Bioscience Incubator
- Capital Factory
- Texas Health Catalyst

These entities assist early-stage companies with business basics, marketing, accounting/financial management, investor and strategic partner linkages, networking activities, affordable lab space, and seed-stage financing.

Cluster management and network

State Level

At the state level, the life sciences industry is looking to leverage significant opportunities to advance and become more competitive with major life sciences hubs. The primary support organizations to establish sector funding priorities, goals and mandates are:

- Texas Healthcare & Bioscience Institute (THBI) - THBI creates public policy initiatives and priorities for Texas's healthcare and life sciences industry. THBI initiatives are set by member organizations comprising industry stakeholders such as biopharmaceutical companies, postsecondary institutions, medical device companies, and economic development entities. Through this membership structure, THBI can provide networking and synergy between stakeholders to address public policy needs effectively. The organization's strategic mandate is to ensure access to innovation, encourage research and development through government incentives, and ensure appropriate funding for higher education and research. The institute works with regional associations (i.e.: BioAustinCTX) to establish funding and policy priorities to support Texas's health and life sciences industries.
- Texas Medical Device Alliance - The organization's strategic mandate is to help create supporting infrastructure to facilitate medical device creation, development, production, and distribution.[62]
- Texas Insight (TXI) - TXI supports the ecosystem by providing strategic research, analysis, and reporting for the Texas Health community. TXI's researchers help individuals, businesses, and associations understand significant public policy issues through reports on public health, advisory council meetings, Medicaid, and the Health and Human Services Commission.

Regional level

- BioAustinCTX - BioAustinCTX is the regional life sciences economic development organization that serves the Central Texas Life Sciences Industry through networking, collaboration, and strategy to advance and grow the entire life sciences community through key industry partners, including the UT-Austin Technology Incubator, ACC Biosciences Incubator, Star Park, Temple Health & Bioscience District, THBI, and the Greater Austin Chamber of Commerce.
- Austin Healthcare Council – The Council works to facilitate collaboration within the ecosystem, educate and establish leadership within the sector, and support the

[62] Texas Medical Device Alliance - https://texmda.org/

entrepreneurial and technology ecosystem to advance the development of better products and services.

- Greater Austin Chamber of Commerce - Austin Chamber of Commerce is a not-for-profit organization that aims to grow the local economy through advocacy, demonstrating the region's comparative advantages and helping local businesses connect to talent. The organization presents a centralized location that highlights:
    - Regional economic performance indicators including population, education, workforce, major employers, cost of living, and quality of life information.
    - The region's key industries highlighting the available talent, early-stage commercialization support (accelerators and incubators), subsector statistics, and postsecondary institutions that support the industry.
    - A log of relocations and expansions to the region, highlighting the company and number of jobs created.
    - A summary of all available state and local taxes and incentives available.

Government legislation/policy

State level

In October 2004, the Texas State Governor announced the launch of a statewide industry cluster initiative to support and sustain the development of globally competitive industries that will form the foundation for the state's future prosperity. The Governor's initiative targets six industries expected to become drivers of high-wage jobs and long-term economic sustainability. One of these six industries highlighted in the initiative is the biotechnology and life sciences sector.[63] Health and life sciences have remained a key industry focus for policy creation in Texas, focusing on enhancing innovation, research capabilities, attraction and relocation of businesses, and improving the capital environment for early-stage companies.

Regional level

Regional initiatives have been instituted in Texas' metropolitan regions, focused on establishing life sciences clusters, which have been positively correlated to driving growth and significant economic development. Industry service organizations led by the Greater Austin Chamber of Commerce and Opportunity Austin's steering committee have prioritized innovation-driven economic development through OA.

The implementation of coordinated strategic initiatives, with involvement from all ecosystem actors, has helped the region identify and prioritize funding for developing, growing, and expanding capabilities within the sector while also focusing on talent attraction and retention initiatives. Notably, tactics focused on advancing public-private research partnerships, commercialization capabilities, advocacy for legislation to improve the capital environment, and support for developments that helped advance innovation and entrepreneurship.

[63] Barwell, Jane. (2006). "The Texas Gulf Coast Biosciences Cluster: Workforce Development and Educational Challenges." https://uh.edu/tech/clist/_documents/texas_gulfcoast_biotechnology_cluster.pdf.

Incentive programming

State level

The Texas business environment encourages foreign investment in the region's health and life sciences industry, with direct taxpayer-funded state and local incentives to recruit businesses that expand or relocate operations to the area and create jobs.

Tax Incentives

- The state employs a tax structure highlighted by no state income or corporate tax.
- R&D tax incentives help to encourage innovation by giving companies a choice between a franchise tax credit[64] and a sales tax exemption for materials, software, and equipment used for R&D purposes.
- Texas Enterprise Zone Program promotes job creation and investment through state sales and use tax refunds.
- Business Relocation Tax Deduction allows companies that relocate their headquarters to Texas to deduct relocation and moving expenses from their margin when calculating franchise tax liability.

Grants

- The Texas Enterprise Fund - A business incentive fund used as a competitive recruitment tool to attract new business or assist with the substantial expansion of an existing business within Texas. This fund has awarded more than $118 million to life sciences-related companies, creating more than 13,700 jobs in the Texas economy.[65]
- Governor's University Research Initiative (GURI) - Eligible Texas public institutions of higher education attempting to recruit distinguished researchers are eligible for matching grants paid on a cost-reimbursement basis. This incentive goal is to help Texan public higher education institutions recruit distinguished[66] researchers from around the world to Texas to encourage innovative research.[67]
- Skills Development Fund - A program created to assist Texas public community and technical colleges finance customized job training for their local businesses.

Regional level

The city of Austin has aligned its incentives with the strategic goals of the state legislature by implementing a Business Expansion Incentive Program to attract FDI looking to expand to Austin. The Business Expansion Incentive Program is a pay-for-performance program that pays out annually to qualified businesses. The incentive for companies that relocate to Austin includes a 3% wage reimbursement per job created per year up to $1,800 and up to 50% Property Tax reimbursement.

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[64] The franchise tax is a privilege tax imposed on each taxable entity formed or organized in Texas or doing business in Texas. https://comptroller.texas.gov/taxes/franchise/

[65] Office of the Governor: Economic Development & Tourism. (2020). "Texas Biotechnology and Life Sciences." 2020. https://www.thbi.com/gov-2020-biotech-report.pdf.

[66] A "distinguished" researcher is defined as: (1) A Nobel Laureate or the recipient of an equivalent honor, or (2) A member of a national honorific society, such as the National Academy of Sciences, the National Academy of Engineering, the National Academy of Medicine, or an equivalent honorific organization.

[67] GURI overview - https://gov.texas.gov/business/page/guri

Notable health and life sciences company expansion or relocation to Austin from 2016 to 2021:

COMPANY	TYPE OF OPERATION	JOBS CREATED	LOCATION	TYPE OF ACTION
St. David's North Austin Medical Center	Hospital, acute care & rehab	200	Austin	Expanded
DJO Surgical	Orthopedic surgical implants R&D	100	Austin	Expanded
Dell Children's Hospital	Hospital	740	Austin	Expanded
Flex Health	Medical equipment contract mfg.	600	Austin	New
Allergan	Pharmaceutical	200	Austin	Expanded
Babylon	Digital healthcare services	200	Austin	New

Source: https://www.austinchamber.com/economic-development/business-climate/relocations-expansions

Raleigh-Durham-Chapel Hill, NC[68]

Raleigh-Durham-Chapel Hill in North Carolina, known collectively as the "Research Triangle" region, has become a vibrant and expanding health and life sciences cluster within the US. The area serves as a successful case study in transitioning from a declining industrial economy centred around tobacco, textiles, and furniture to a knowledge-based economy leading in pharmaceuticals, banking, technology, and food processing. North Carolina has a highly skilled workforce of 70,000, an extensive portfolio of 790 life sciences companies, an additional 2,500 supporting service providers, and an attractive business environment with low corporate tax rates.[69]

Advanced education and research

The Research Triangle has benefitted from three tier-one research Universities in the region: Duke University, North Carolina State University, and University of North Carolina Chapel Hill. These research universities have contributed to an established workforce pipeline, are active in creating and maintaining industry partnerships, and cultivate an innovative business environment that has seen research success through spin-off companies. In addition to these tier-one research universities, there are nine colleges/universities and nine community colleges in the region.

Recruitment-based development efforts centred on research universities have proven effective in spurring economic development by developing and transferring technology to local industry and stimulating the creation of new businesses in university-centred incubators and science parks. Due to the required capital of technology-intensive companies, it is common to locate their operations near the best universities in particular fields of science and engineering to

[68] All dollar amounts are denoted in USD
[69] North Carolina accelerates success in the life sciences - https://www.ncbiotech.org/transforming-life-science/why-nc

enable their internal research departments to work with top research scientists and recruit promising students.

The Research Triangle Park (RTP) is a 7,000-acre centre of research created by state and local governments in North Carolina to help recruit R&D talent to the region. Unlike Austin, which focuses on organic growth through innovation, the RTP was conceived by government and partners in industry before it was created and centrally planned, rather than an organic process driven by recruiting established companies to North Carolina.[70] The RTP was built to foster innovation and generate economic activity through collaboration between universities, industry, and government. RTP is home to approximately 75% of life sciences companies in North Carolina.

Access and retention of talent

North Carolina is home to one of the most robust talent pipelines in the US for the health and life sciences, as the three different research universities (University of North Carolina at Chapel Hill, Duke University, and North Carolina State University) produce more than 53,000 total graduates annually. Currently, there are 6,900 employees in Raleigh-Durham's life sciences space, an 84% increase since 2010.[71]

North Carolina Biotechnology Center created an Industrial Internship Program to support business and life sciences undergraduates and graduate students seeking life sciences experience. It provides three-month summer internships, which benefit the intern and the life sciences company selected to participate.

Raleigh-Durham is ranked second in the US regarding the ratio of life sciences occupation salary to the local cost of living, trailing only Houston.[72]

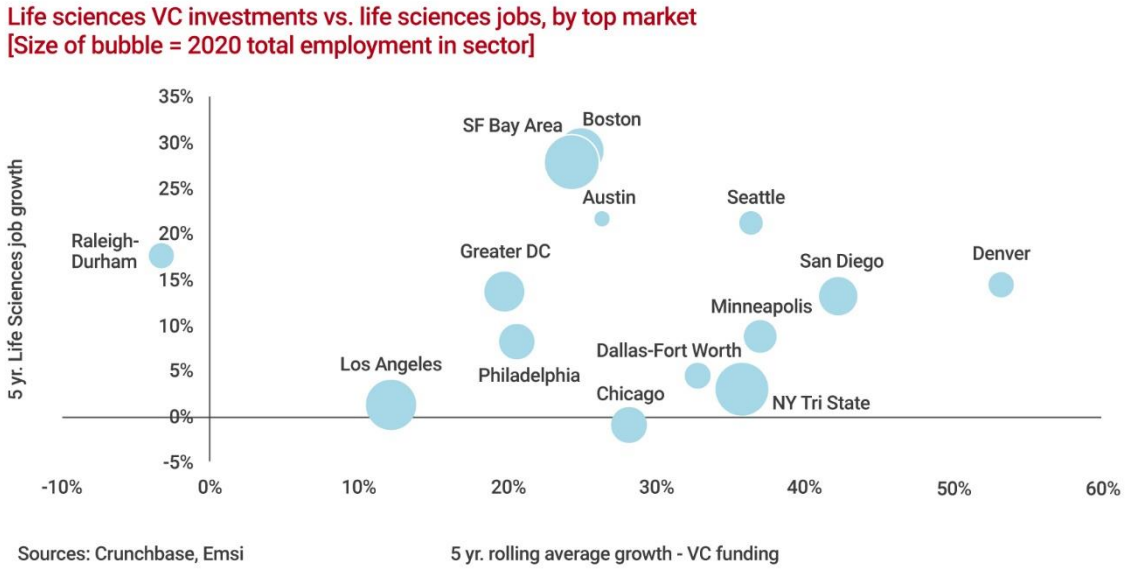
Market	Biochemist	Biomedical engineer	Chemist	Biophysicists	Average	Annual Cost of Living	Ratio of Average Salaries to Cost of Living
Raleigh-Durham	$ 99,496	$ 87,635	$ 76,074	$ 100,461	$ 90,917	$ 50,056	1.82

Source: https://www.cbre.com/en/insights/reports/us-life-sciences-talent-2022

[70] Wessner, C. W., & National Research Council (US) Committee on Competing in the 21st Century: Best Practice in State and Regional Innovation Initiatives (Eds.). (2013). "Best Practices in State and Regional Innovation Initiatives: Competing in the 21st Century." National Academies Press (US).
[71] CBRE 2020 insights - https://www.cushmanwakefield.com/en/united-states/insights/us-articles/2020-03-rdu-the-future-of-life-sciences-is-here
[72] CBRE Research. (2022). "Life Sciences Research Talent 2022." https://cbre.vo.llnwd.net/grgservices/secure/Life-Sciences-Talent-2022.pdf?e=1676484692&h=83a07122a57313ed7cd65908f6f03e4b.

Access to capital

The region has seen volatility in the amount of VC investment secured by the health and life sciences sector in recent years but has seen overall growth in VC investment of 80% since 2016.[73] The funding from the NIH, state-funded programs, and research grants are the primary drivers of revenue streams to support the industry:



- Although the research triangle is the fourth most prominent health and life sciences cluster in the US, it is one of the only clusters to experience a decline in VC funding over a rolling five-year period.
- North Carolina received about $2.4 billion from the NIH in 2021, the fourth highest among all states in the country.
- The life sciences industry secured $415 million in VC funding in 2020, down from $825 in the year prior.[73]
- However, the sector recovered in 2021 with $905 million in VC funding secured, a 118% increase from 2020.[73]
- North Carolina has a diverse group of angel investors and VC firms supporting the state's ecosystem, with 23 VC firms and 11 angel investor organizations supporting growth and emergence of innovative firms in the health and life sciences industry.

Early-stage commercialization support

With three tier-one research universities and the RTP, the region has cultivated a vibrant life sciences sector through its ability to develop and support an innovative business environment.

[73] Friedman, Brianna. (2022). "Life Sciences: Raleigh-Durham, US." Www.savills.ca. May 2022. https://www.savills.ca/research_articles/261115/328473-0.

The area can provide early-stage commercialization support through incubators and accelerators, including:

Alexandria LaunchLabs - The premier start-up platform for early-stage life sciences companies that provides office/laboratory space, shared equipment and lab services with onsite support, short-term leases, the ability to expand into the adjacent AscentLabs space, and engagement with Alexandria's network consisting of industry support and early-stage investors.

BioLabs North Carolina - A downtown Durham co-working facility with open lab space that provides research equipment and access to support services to enable their companies to grow early-stage operations.

First Flight Venture Center – A science, technology, and business incubator in the RTP that provides tailored resources for companies in various business development life cycle stages. Supports early-stage companies with access to office/lab space, mentorship, and assistance with the grant-writing process, and helps to identify and secure non-dilutive funding to enable company growth.

Cluster management and network

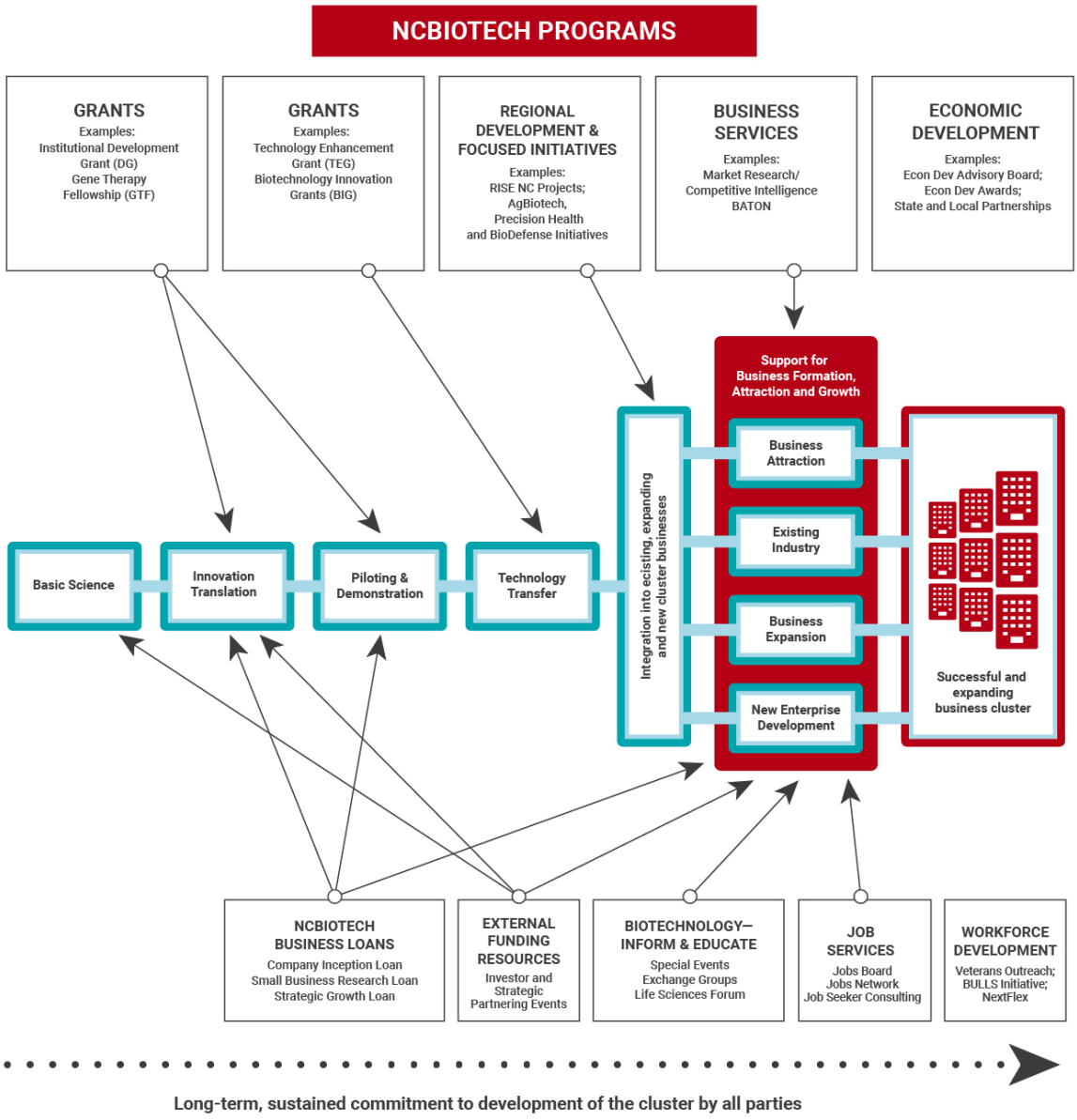
In North Carolina, several support organizations collaborate to highlight the region's intrinsic locational advantage and recruit firms to set up operations in the area.

NCBiotech was the first government-sponsored economic development organization to support the biotechnology sector, established in 1984. NCBiotech has supported the sector's growth with strategic planning, public-private partnerships, education programs, university grants, networking events, and other initiatives.[74] The organization approaches industrial recruitment in the health and life sciences sector over an extended time horizon. The development organization initiates research on biotech companies through industry events and conferences to understand the opportunities around expanding and establishing new operating facilities.[75] NCBiotech has worked and invested deliberately in developing a broad-based life sciences cluster across the state, including rural municipalities, to grow the competencies in the biomanufacturing sector. NCBiotech offers resources and services in a set of five domain areas:

- Funds for commercializing university research and boosting early-stage company development;
- Talent development initiatives and career networking;
- Industry connections to fill gaps;
- Unique spaces to accelerate company growth; and
- Access to high-value information resources.[76]

[74] NCBiotech history - https://www.ncbiotech.org/transforming-life-sciences/about-us/history-biotechnology-north-carolina
[75] Wessner, C. W., & National Research Council (US) Committee on Competing in the 21st Century: Best Practice in State and Regional Innovation Initiatives (Eds.). (2013). "Best Practices in State and Regional Innovation Initiatives: Competing in the 21st Century." National Academies Press (US).
[76] TEConomy Partners, LLC. (2021). 2020 Evidence and Opportunity: Impact of Life Sciences in North Carolina. North Carolina Biotechnology Center.

NCBiotech is a leader in North Carolina's ecosystem, and its role in supporting the health and life sciences cluster can be visualized below:



Source: TECompany Partners, LLC and NCBiotech.

The North Carolina Department of Commerce works with industry stakeholders to educate and market available local resources that can be utilized in outreach efforts to recruit biopharma firms.[77] The Department of Commerce provides reporting data, tools, and reports of KPIs relating to the local economy readily available on its website to help aid in investment and recruiting decisions by industry.

[77] Lowe, N., & Freyer, A. (2015). "A moving target: rethinking industrial recruitment in an era of growing economic uncertainty." Environment And Planning C: Government And Policy, 33(5), 1284-1300. https://doi.org/10.1177/0263774x15612341

BioNetwork is a consortium run by the North Carolina Community College System that offers courses, degree programs, and BioWork certificates for students to become process technicians for a biotechnology, pharmaceutical, or chemical manufacturing company. It is engaged in the early stages of recruitment deals to highlight the State's workforce advantages while continuously working to identify and address skills gaps within the region.

The North Carolina Biosciences Organization (NCBIO) is the trade association for North Carolina's life sciences industry, including companies and research institutions working in the pharmaceutical, diagnostic, medical device, clinical research, and agricultural biotechnology sectors. The association's goal is to advocate for North Carolina's life sciences community through effective policy creation and marketing strategies.

NC BioImpact is an intermediary between North Carolina's University and community college systems and the biotechnology and pharmaceutical industries to meet the growing demands of the sector. The training programs partner closely with the NC Biotechnology Center, NCBIO, the Department of Commerce and industry to form a unique academic, industry, and government collaborative.

Economic Development Partnership of North Carolina is focused on recruiting businesses to the State, supporting existing businesses, facilitating FDI, and creating attractive conditions for small business to get their start. The Economic Development Partnership of North Carolina ranks the state's counties based on economic well-being and performance. This system is the basis for prioritizing state programs to encourage and support economic activity in the underutilized and less prosperous areas of the state.[78]

Golden LEAF is a not-for-profit organization that invests state proceeds from tobacco industry litigation in funding economic development projects by targeting rural areas of the state. The organization found that, unlike most R&D jobs in the health and life sciences sector that tend to cluster around research institutions and parks, biomanufacturing jobs could be dispersed in more rural regions in North Carolina. The organization invested $69 million in a new workforce training initiative to prepare workers for the growing sector, and NCBIO pledged up to $4.5 million from its member companies.[79] This led to the consortium that formed NC BioImpact.

Incentive programming

North Carolina's business environment encourages foreign investment in the region's health and life sciences industry, with direct taxpayer-funded state and local incentives to recruit businesses that foster job development and investment while also providing companies with a low corporate tax rate of 2.5%.

Competitive Incentives

- JDIG is a performance-based incentive program that provides grants to new and expanding companies to offset some of the cost of locating or expanding a facility in the state. Grant payments use a formula-based approach that considers the new taxes generated by the new jobs created within the region. A portion of those newly generated

[78] County development tier designations - https://edpnc.com/incentives/county-development-tier-designations/
[79] History of Biotechnology in North Carolina - https://www.ncbiotech.org/transforming-life-sciences/about-us/history-biotechnology-north-carolina#panel4

funds are reimbursed to the successful company for the limited term of the grant and is dependent on the company achieving its performance targets.[80]

- The One North Carolina Fund (OneNC) is a grant program that allows the Governor to respond quickly to competitive job-creation projects. Grants depend on the number of jobs created, level of investment, project location, economic impact, and the project's importance to the state and region.
- The One North Carolina Small Business Program helps fund North Carolina businesses in capital-intensive, high-risk science, technology, engineering, and math industries. This Technology fund is designed to match the Phase I federal Small Business Innovation Research or Small Business Technology Transfer grant.
- Workforce grants often connect businesses with training resources that upskill their employees to better respond to industry needs. This training helps companies to compete and succeed while offering new opportunities for employees to advance.
- R&D Tax Credits are 3.25% of qualified research expenses; this tax credit is enhanced to 20% of those expenses for research performed with North Carolina universities.

Toronto, ON[81]

The Toronto, Ontario region is home to one of Canada's largest and most mature health and life sciences clusters. The sector contributes more than $2 billion annually to the region's economy and employs over 30,000 employees.[82] The cluster is anchored by the MaRS Discovery District in downtown Toronto, a research park and health innovation hub comprised of Canada's largest concentration of hospitals, research institutes, business incubators, VC organizations, and the University of Toronto.

Advanced education and research

Universities and academic research hospitals drive innovation and facilitate an essential talent pipeline. Most health and life sciences companies outsource many of their R&D functions to these research institutions to cost share the pursuit of discovery and innovation. The greater Toronto region is well situated to absorb this demand for research institutions as four of Canada's top 15 scientific research universities are in the area. The University of Toronto leads the U15 with the most research funding of any Canadian university. It also supports Canada's most prominent medical faculties and medical research institutions. McMaster, Western, and Waterloo universities are some of Canada's most respected medical and life sciences postsecondary institutions. Additionally, these universities have historically been among the most consistent U15 Group of Canadian Research Universities in converting innovative research into commercialization opportunities.

[80] Job Development Investment Grant - https://www.nccommerce.com/grants-incentives/competitive-incentives/job-development-investment-grant
[81] All dollar amounts are denoted in CAD
[82] Toronto life sciences sector- https://www.toronto.ca/business-economy/industry-sector-support/life-sciences/

Number Of University Start-Up Companies Formed (Actual)

INSTITUTION	2010	2011	2012	2013	2014	2015	Average
U of Toronto	18	23	17	12	20	17	18
McMaster U	0	1	2	2	3	4	2
U of Western Ont.	3	2	3	6	0	0	2
U of Waterloo	5	4	9	11	12	15	9
U of Alberta	4	4	1	5	5	5	4
U of Calgary	2	1	1	1	4	8	3

Source: Association of University Technology Managers

The University of Toronto has been the most successful at spinning off high-potential IP. The university averaged 18 start-ups from 2010 to 2015, two to three times more companies than other leading Canadian research universities over that period. This is due to the significant presence of accelerators/incubators to provide early-stage commercialization support to start-ups, as the University is ranked in the top ten university-managed incubators globally.[83] Access to capital, public-private partnerships (i.e.: JLABS) and transparent technology transfer policies and practices also encourage the commercialization of breakthrough innovation within the region.

In addition, the region is home to five of Canada's top 10 academic research hospitals and research networks, including:

- University Health Network (UHN) – North America's largest hospital network consists of four patient care centres, a leading learning institute, and the site of leading-edge research and training for health professionals. UHN is the top-ranked research hospital, with over $489 million invested in research, or 20% of the hospital's total annual expenditure.
- The Hospital for Sick Children (SickKids) – Affiliated with the University of Toronto, SickKids is one of the world's leading pediatric healthcare centres and ranked Canada's second most research-intensive hospital, with over $280 million invested in research annually.
- Hamilton Health Sciences – A network of seven hospitals in the Hamilton region that ranks fourth in research spending, with over $170 million invested annually.
- London Health/St. Joseph's – A network of hospitals and, collectively, one of Canada's leading and largest acute-care teaching hospitals that invests over $120 million in research annually.
- Sunnybrook Health Sciences Centre – An academic health science centre and home to Canada's largest trauma centre that invests over $107 million in research each year.

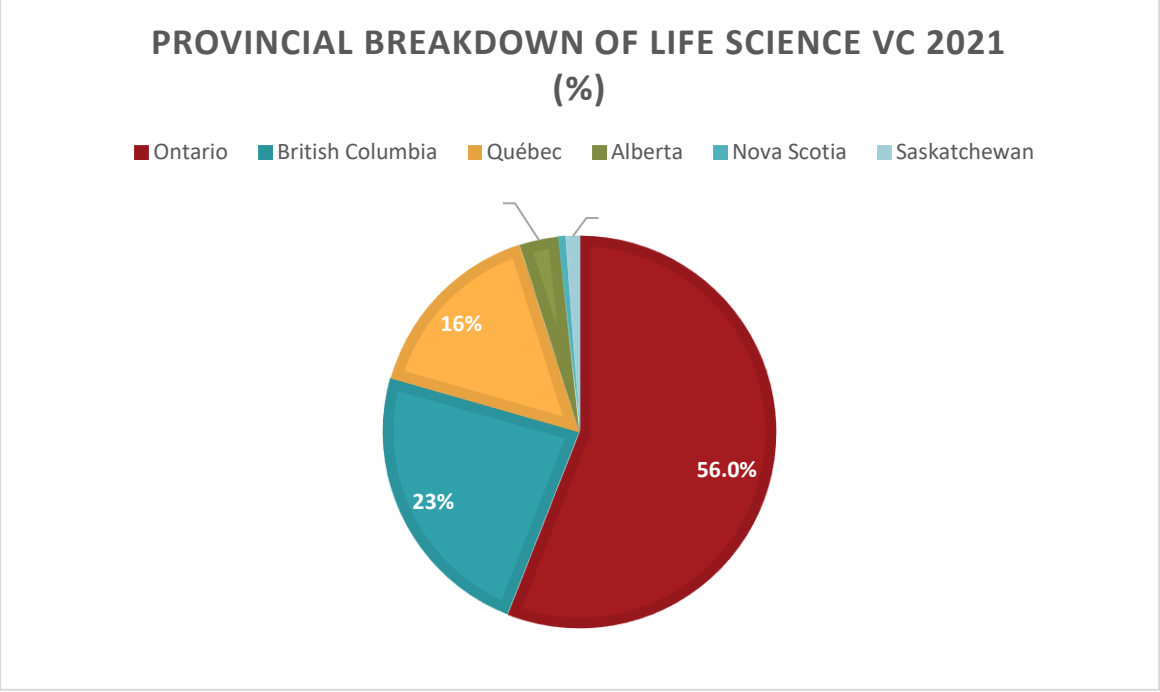
[83] University of Toronto startups - https://entrepreneurs.utoronto.ca/our-startups/u-of-t-startups/

Rank	Hospital/Hospital Network	Research Spending		Research Intensity	
2020		2020 ($000)	% Change (2019-20)	$ Spent per Researcher ($000)	Research Spending as a % of Total Hospital Spending
1	University Health Network (UHN)	489,966	20%	611	20%
2	Hospital for Sick Children	281,939	11%	734	28%
4	Hamilton Health Sciences	171,115	-7%	376	11%
8	London Health Sciences Centre/St. Joseph's Health Care London	121,888	3%	619	7%
10	Sunnybrook Health Sciences Centre	107,616	5%	312	9%

Source: https://researchinfosource.com/top-40-research-hospitals/2021/list

Access to capital

The province has cultivated the most robust VC sector in Canada, facilitating access to sustainable funding for the province's health and life sciences sector. The industry has been able to leverage venture capital to support SMEs' development and commercialization potential.



Source: Pitchbook Data, Inc. based on deals from Jan 01, 2016, to Dec 31, 2021. Excludes failed/cancelled deals.

Ontario received over half (56%) of all Canada's VC investment in health and life sciences, totalling $1.12 billion in 2021. This is attributable to the province's strong VC sector, including life sciences-specific firms like Genesys Capital and Lumira Ventures, and an innovative

environment that provides a consistent pipeline of high-potential early-stage companies that can secure funding.

Life Sciences Innovation Program (LSIP) – As part of Ontario's "Taking life sciences to the next level" strategy, the province aims to launch a new $15 million, early-stage fund to help address the funding challenges life sciences companies face in advancing ideas and prototypes from the lab to the marketplace. Designed to make early-stage investments less risky to investors, the Life Sciences Innovation Program will attract private-sector funds to help scale local solutions for global markets. The program aims to become a co-investment fund that will finance up to $500,000 for IP that demonstrates real-world demand or projects to solve specific challenges faced in the provincial hospitals and health sector. The aim is to bridge the commercialization gap and allow companies to progress to a point where they become attractive to private-sector VC.

Similar to Alberta's formation of the AEC, Ontario created the Ontario Capital Growth Corporation. This VC agency promotes the development of the VC sector in the province by making funding available for high-potential technology companies within the region.

Early-stage commercialization support

The Toronto region has a robust ecosystem of over 20 accelerators and incubators that foster innovation through early-stage commercialization support. These supports, coupled with a solid academic and research base, make Toronto one of the top cities in North America for the health and life sciences sector, combining research with clinical and business expertise to deliver new diagnostics and therapies. Some examples of the leading accelerators and incubators in the region include:

- MaRS Investment Accelerator Fund (IAF) – The IAF helps foster innovation and strengthen Ontario-based businesses in the technology, cleantech, and life sciences sectors. It offers two types of funding, from $250,000 to $500,000, and tailored resources for each applicant.
- JLABS – Johnson & Johnson opened the first JLABS outside of the US in downtown Toronto within the MaRS Discovery District. The business incubator provides lab space, access to an international investor community, mentorship from industry experts, and partnership opportunities through research collaborations.

Government legislation/policy

The Government of Ontario has outlined a comprehensive strategy called "Taking life sciences to the next level" to continue to evolve the province's health and life sciences sector and grow the biomanufacturing and life sciences industry by targeting an increase of 85,000 jobs in the life sciences sector by 2030. The province plans to implement this strategy in two phases: Phase one aims to build up the life sciences sector through increasing manufacturing capacity and supply chains and improving the manufacturing readiness of SMEs. The second phase seeks to build the industry into a global leader in next-generation life sciences technology.[10]

The strategy has set four benchmarks it hopes to achieve by 2030 to address long-standing barriers to growth:

- Grow Ontario's biomanufacturing footprint – The province aims to grow and diversify Ontario's biomanufacturing sector through securing FDI investment, promoting the region's cluster to outside markets, and reducing the regulation and red tape to increase competitiveness.
- Build domestic supply chain resiliency in PPE and critical medical supplies – The province will invest in local production to improve emergency preparedness and be better equipped to handle future pandemic situations.
- Boost the commercialization capacity of Ontario companies and start-ups – Through improving access to capital, improving entrepreneurs' business acumen, and promoting cluster partnerships, the province aims to strengthen the sector's ability to convert research and ideas into commercialization success.
- Adopt Ontario innovations to improve healthcare in Ontario – The province aims to achieve this goal through modernization of the province's supply chain and early adoption of local innovation and technologies across Ontario's healthcare system.

Incentive programming

Ontario's business environment encourages development and attracts FDI into the region's health and life sciences industry, with direct incentives and grants to promote growth and innovation.

Tax Incentives

- Ontario Business Research Institute Tax Credit – Eligible corporations can claim a 20% refundable tax credit for qualified expenditures on scientific research and experimental development.
- Ontario Innovation Tax Credit – Eligible corporations can claim a refundable tax credit of 8% on scientific research and experimental development expenditures performed in Ontario.
- Ontario Research and Development Tax Credit – Eligible corporations can claim a non-refundable tax credit of 3.5% on eligible scientific research and experimental development expenditures.
- Regional Opportunities Investment Tax Credit – Provides a 10% refundable Corporate Income Tax credit for corporations that invest more than $50,000 to construct, renovate, or acquire eligible commercial and industrial buildings in these regions. This credit is aimed to support business investment and growth through expansion and relocation to the area from job-creating companies.[84]
- Ontario Centres of Excellence (OCE) Smart Seed Program – Supports Ontario-based start-up companies by funding 50% up to $60,000 in seed-stage funding to help bridge the commercialization gap.

[84] Government of Ontario. (2023). "Tax Credits and Benefits by Topic | Ontario.ca." Www.ontario.ca. January 2023. https://www.ontario.ca/page/tax-credits-and-benefits-topic#section-9.

Recommendations

Based on the current state of the Edmonton region life sciences and healthcare cluster, our review of leading practices, insights from other experiences, objectives of the Edmonton region, and opportunity assessment for maximum impact, we have developed the following recommendations to further enhance the opportunities, growth, financial, economic, and marketplace results, and to optimize the overall impact of the life sciences and healthcare cluster in the Edmonton region.

Our recommendations are organized using the major elements of successful life sciences and healthcare clusters:

Advanced education and research

1. Work with research organizations to optimize consistent and transparent technology transfer policies and practices across all Edmonton region participants to increase consistency, speed, and effectiveness in partnering, alliance, and licensing transactions in the Edmonton region ecosystem. Technology transfer practices at the University of Toronto and University of Waterloo would provide best practices that could be leveraged.
2. Ensure all public support and facilitation entities can support researchers, entrepreneurs, and companies in transferring research into companies through partnering, alliance, licensing, sales, financing, and other mechanisms.
3. Develop a centralized and effectively equipped innovation incubator/accelerator with low-cost rent and equipment suitable for life sciences research (e.g.: wet labs, environments for safe handling of viruses and hazardous materials).
4. Develop a memorandum of understanding between the technology transfer organizations and AHS to:
    a. Support the commercialization of innovative ideas, technologies, and opportunities in the healthcare system.
    b. Find ways to mine the rich data that results from having one healthcare region with robust depth, number, and longitudinal data available regarding treatments and disease insights. Develop the policies, procedures, and systems to aggregate, organize, interrogate, and develop insights from the data that could be mined from bioinformatics, digital health, and clinical development perspectives.

Access and retention of talent

1. Provide personal income tax incentives for the benefit of highly qualified senior executives, including entrepreneurs and investors. Quebec has successfully implemented a tax holiday from provincial personal income tax for foreign researchers or experts to assist employers who have trouble hiring people with the required scientific research and experimental development competencies. The tax holiday measure for foreign researchers is intended for companies located in Quebec performing SR&ED and having signed an employment contract with a foreign researcher that:

- Holds a second-cycle university degree recognized in Quebec in the field of pure and applied sciences or a related field;
- Does not reside in Quebec or Canada immediately before taking up employment with the eligible employer; and
- Exclusively or almost exclusively and continuously carries out SR&ED activities within the Québec enterprise.
- The foreign researcher that meets the above requirements is eligible for a tax holiday, with an exemption rate of 100% for the first two years, and this amount is reduced by 25% for each preceding year for a maximum of up to five years. [85]

2. Create an industry-sponsored training and education board to develop the appropriate infrastructure for identifying and meeting training and educational needs in the region's emerging health and life sciences cluster.
3. Form a regional council of biotechnology educators to collaborate on biotechnology educational activities, including needs assessment and program planning to reduce overlaps and burdens on the industry.
4. Develop approaches for gathering and disseminating accurate labour market, occupational skills, and educational, training, and graduate retention data to the academic community.
5. Continue to support the work of the C100.[86] and A100.[87] in networking with crucial US hubs such as San Francisco, New York City and Boston to develop networks with industry leaders who can provide mentoring and advice on Edmonton region opportunities.

Access to capital

1. Work with Alberta Enterprise Corp to develop a business case in support of provincial funding for life sciences VCs in the region.
2. Reintroduce the Alberta Investor Tax Credit program, which offered a 30% tax credit to investors in Alberta small businesses, which could help increase the amount of capital available to early-stage companies in the health and life sciences sector by helping to offset investor risk.
3. Partner with other Canadian-based VCs to establish a seed and VC fund presence in the Edmonton region.
4. Develop closer ties (relationships, regular meetings, etc.) with key seed and VC funders in the United States, especially in leading life sciences clusters such as San Francisco, Boston, and New York City.
5. Ensure consistent and coordinated networking opportunities for entrepreneurs to showcase their technologies, companies, and ideas to potential investors, larger companies, and industry support organizations in the Edmonton region, Canada, and to the more significant global life sciences clusters.

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[85] Tax holiday for foreign researchers https://www.economie.gouv.qc.ca/bibliotheques/programmes/mesures-fiscales/conge-fiscal-pour-chercheurs-etrangers/

[86] C100 is a privately-funded, not-for-profit member association for its members across Canada and globally, to enhance the global Canadian tech dispersion to support, inspire, and advance Canadian entrepreneurship. https://www.thec100.org/

[87] A100 is a non-profit, member-driven organization that volunteers time and resources to help grow the next generation of tech and innovation leaders. A100 members expand networks, connect people and share experiences to help drive lasting economic diversification. https://thea100.org/

6. Support Edmonton organizations that raise charitable funding for life sciences research, especially in the commercialization of the research that is funded and the development of venture philanthropy organizations and processes to further attract funding for Edmonton region research.

Early-stage commercialization support

1. Develop and operationalize a dedicated physical incubator/accelerator focused on healthcare and life sciences. Subsidized specialty-built labs and office space with the appropriate equipment, tools, and networking opportunities are key success factors in other leading life sciences clusters. The MaRS Discovery District in Toronto and Innovation District in Austin can serve as best practices to be leveraged.
2. Develop relationships with major health and life sciences companies and attract major corporate innovation centres. This is important for Edmonton region to stay competitive with leading life sciences clusters that are having notable success in attracting research centres of major biopharmaceutical, medical devices, diagnostic, and digital health companies to collaborate with their universities and not-for-profit research centres. Programs such as JLABS at MaRS Discovery District in Toronto and Zoetis Incubator Research Lab at the CSU Research Innovation Center in Denver are leading examples that could be levered.

Cluster management and network

1. Optimize the strategies, goals and working relationships between all the organizations that support cluster development in the Edmonton region, including: Alberta Pharmaceutical Innovation, Health Cities, Alberta Innovates, Edmonton Innovates, the University of Alberta, PrairiesCan, and BioAlberta.
2. Develop a clear plan of roles and responsibilities, coordination strategy, communication plan, and service plan to streamline the ability of entrepreneurs, investors, and companies to obtain relevant support from the optimal service organizations. An output of these activities should be a cluster strategy supported by governments, Edmonton Global, support organizations, companies, entrepreneurs, and investors. Cluster coordination strategies implemented by NCBiotech in North Carolina could serve as a best practice in cluster management.
3. Create or adopt a network organization responsible for coordinating the cluster strategy, management, and growth for the Edmonton region.
4. Develop a network of hospitals that can coordinate clinical trial sites in the Edmonton region to attract pharmaceutical, biotechnology, medical device, digital health, and tool companies to the Edmonton region for running their clinical trials.
5. Ensure the cluster management strategy includes all other recommendations from this report and the existing organizations supporting the life sciences industry in the region.

Government legislation/policy

1. Encouraging the development and implementation of a comprehensive health and life sciences strategy from the provincial government would help facilitate investment by creating investor confidence based on the government's commitment to the sector. The successful implementation of the Texas Industry Cluster Initiative[9] or Ontario's "Taking

life sciences to the next level" strategy[10] could serve as a framework for Alberta to adopt.
2. Provide structures, policies, and processes to create fast-track access for Edmonton region companies to work with AHS as a support organization in developing, testing, and commercializing home-grown technologies.
3. Work with life sciences companies to support them in the development of high-need, urgent solutions in priority areas including vaccine development and manufacturing, and diseases/conditions that have a significant negative impact on our population, such as cancer, cardiovascular disease, diabetes, organ transplantation, viruses, and neurological conditions (e.g.: Alzheimer's, Parkinson's, etc.)

Incentive programming

1. A complete study of all available federal and provincial funding should be undertaken and updated to ensure that entrepreneurs and companies know all relevant programs and incentives.
2. Support incentives that have assisted in the creation, attraction and sustained growth of life sciences and healthcare clusters, including:
    a. Enhance awareness and visibility of the provincial Investment and Growth Fund to increase the province's ability to recruit relocation and expansion of job-creating companies within the region. The Texas Enterprise Fund and JDIG in North Carolina are leading examples of how this incentive has benefited the health and life sciences sector.
    b. Implement provincial grants for public institutions of higher education attempting to recruit distinguished researchers to incentivize more innovative research to be conducted within the region. The Governor's University Research Initiative offered in Texas is a leading example of how this grant could be implemented.
    c. Reintroduce the provincial portion of the SR&ED tax credits for research and development expenditures. This tax credit was ended in 2020 in favour of the Innovation Employment Grant, which is targeted at SMEs and not at large multi-national life sciences companies that might consider expanding in Alberta.
    d. Voucher programs to support R&D and investment in the patenting process have shown success in Alberta and the UK[88]. In these programs, the entrepreneur or company receives a voucher, which provides funding to a service provider, such as a researcher or a patent attorney, to fund services associated with the patenting process.

Integration with Alberta Health Services

1. Increase the integration of researchers, entrepreneurs, companies, and investors with AHS to:
    a. Increase the commercialization of technologies developed at AHS sites and by AHS employees.

[88] Nationwide innovation voucher program in the UK. Kleine, M., Heite, J., & Huber, L. (2022). "Subsidized R&D collaboration: The causal effect of innovation vouchers on innovation outcomes." Research Policy, 51(6), 104515. https://doi.org/10.1016/j.respol.2022.104515

b. Increase the research, development, and commercialization level in collaboration with AHS to generate additional commercial opportunities.
c. Optimize and facilitate the ability of companies to conduct clinical trials at AHS sites across the Edmonton region.
d. Facilitate the process by which local entrepreneurs can partner, sell, or commercialize their products and services to AHS.

Appendix A: Jurisdictional Scan

Location	Greater metropolitan area population	Primary industry focus	Higher education institutions	Number of life sciences companies	Current workforce	VC invested
Houston, Texas	Houston-The Woodlands-Sugar Land metropolitan area population: 7,150,000	A hub for medical device manufacturing, pharmaceuticals, and health research.	The Houston region is home to more than 20 universities and colleges, including three Tier 1 universities.	1,760+ life sciences companies in the region	Approximately 31,000	$518.4 million USD (2021)
Austin, Texas	Austin-Round Rock-Georgetown metropolitan area population: 2,290,000	Medical device/diagnostics, Contract Research Organizations, and pharmaceuticals.	20 colleges and universities provide life sciences-related and healthcare education in the Austin region.	280+ life sciences companies in the region	Approximately 16,000	$223.24 million USD (2020)
Raleigh-Durham, North Carolina	Raleigh-Cary metro population: 1,420,000 Durham-Chapel Hill Metropolitan population: 644,367	Medical device/diagnostics, Contract Research Organizations, and pharmaceuticals.	16 colleges and universities provide life sciences-related and healthcare education in the region.	600+ life sciences companies in the region	Approximately 34,000	$586 million USD (2021)
Minneapolis, Minnesota	Minneapolis-St. Paul-Bloomington metropolitan area population: 3,650,000	Medical device and diagnostics	36 colleges and universities provide life sciences-related and healthcare education in the region.	750+ life sciences companies in the region	Approximately 44,000	$437 million USD (2021)
Seattle, Washington	Seattle-Tacoma-Bellevue metro area population: 4,010,000	Medical device manufacturers, digital health companies and pharmaceutical firms.	10 colleges and universities provide life sciences-related and healthcare education in the region.	150+ life sciences companies in the region.	Approximately 13,000	$898 million USD (2021)
Denver, Colorado	Denver-Aurora-Lakewood metropolitan area population: 2,999,000	Medical device and diagnostics, pharmaceuticals, and biotechnology companies.	11 colleges and universities provide life sciences-related and healthcare education in the region.	880+ life sciences companies in the region.	Approximately 25,000	$332 million USD (2021)
Toronto, Ontario	Census Metropolitan Area (CMA) of Toronto: 6,202,225	Pharmaceuticals manufacturing, medical and diagnostic laboratories.	Nine colleges and universities provide life sciences-related and healthcare education in the region.	580+ life sciences companies in the region.	Approximately 30,000	$1.123 billion CAD (2021) was invested in health and life sciences in Ontario
Montreal, Quebec	Census Metropolitan Area (CMA) of Montreal: 4,098,927 (2016)	Pharmaceuticals, biotechnology, Medtech, artificial intelligence and digital health.	11 colleges and universities provide life sciences-related and healthcare education in the region.	650+ life sciences companies in the region.	Approximately 56,000	$314 million CAD was invested in health and life sciences in Quebec (2021)

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Additionally, we have also relied upon other publicly available information, including documents noted throughout the body of the Report.