INVEST IN HAMILTON

City of Hamilton

LIFE SCIENCES SECTOR STRATEGY

DECEMBER 2021

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Executive Summary

Global growth opportunity

Hamilton is one of Canada's fastest growing life sciences clusters. With more than 30,000 employees,[1] and CAD $5.7 billion in annual economic activity, the life sciences sector is one of the city's largest industries.[2] The largest life sciences employer in the city, Hamilton Health Sciences (HHS), is the second largest hospital network in Ontario and the fourth largest in Canada.[3] Hamilton is also home to McMaster Innovation Park (MIP), which houses over 70 businesses, with a strong plan to add 1.8 million square feet of new office and wet lab space for scaling and established life science companies.

Hamilton's life sciences sector produced a total of 83 new products and services that were commercialized or licensed over the previous five years – such as Fusion Pharmaceutical's targeted alpha therapies, VoxNeuro's Cognitive Health Assessment Management Platform (CHAMP), and SanteSuite's Immunization Management System. The sector is supported by multinational companies with a strong presence in Hamilton, such as the Canadian headquarters of medical technology company Stryker Canada.

Taken together, the life sciences sector includes a more than CAD $4 billion spend in the Hamilton region.[4] To put that in perspective, that's the equivalent of the total GDP that the video game industry contributes to the entire Canadian economy annually.[5]

Life sciences are defined as the sciences concerned with the study of living organisms, including biology, zoology, microbiology, physiology, and related subjects. This sector has a significant impact on people's lives and the ability to create real and meaningful change and opportunities for the advancement of science. Hamilton is strategically positioned to capture a share of the rising foreign direct investment (FDI) in life sciences globally, as well as attract domestic investment opportunities. The time is now for Hamilton to increase national and foreign life sciences investment.

Globally, the life sciences sector is growing rapidly. Since 2010, the sector accounted for more than CAD $294 billion 'greenfield FDI' worldwide — i.e., foreign direct investment where a parent company creates a subsidiary in a new country and builds its operations from the ground up. This can include new production facilities, building new distribution hubs and even offices which require staff talent, research supplies and the like.[6] The onset of the pandemic has accelerated the pace of change and attracted record global investment into the sector – CAD $42.2 billion in 2020 alone, and a record-breaking CAD $34.5 billion worth of venture capital in the first half of 2021.[7] The accelerated

[1] (Invest In Hamilton, n.d.)
[2] (Synapse Life Science Consortium, n.d.)
[3] (Research Info Source, 2020)
[4] (Invest in Hamilton, Life Sciences in Hamilton, n.d.)
[5] (Shankar, 2019)
[6] (Chen, 2020)
[7] (United Nations Conference on Trade and Development, 2020)

pace of change positions Hamilton as a prime location for investment and opportunities to scale-up local businesses.

Focusing on life sciences

Hamilton possesses the potential to lead Canada's national life sciences ecosystem and attract increased national and international. Hamilton's life sciences sector further presents an opportunity to support innovation, economic growth, equity, diversity, and inclusion in the region. The objective of this strategy is to enable sector growth by leveraging Hamilton's successful track record in the life sciences sector, identifying strategic opportunities, and showcasing the city's value proposition.

This strategy offers an actionable roadmap for growing the sector. It builds on Hamilton's past and recent successes in the life sciences sector. Actions to drive the strategy, along with key performance indicators (KPIs) to track results, are included to operationalize the strategy. Each section in this document further defines a key component of the overall strategy. Additional information, including an overview of Hamilton's life sciences sector profile, can be found in Appendix B.

Strategy for growing Hamilton's life sciences sector

Successful strategies start with a clear vision for the future. For Hamilton, this vision is to be Canada's leader in life sciences research and commercialization – with a focus on key subsectors such as nuclear medicine, digital health, infectious diseases, biomanufacturing, and medical devices. This vision draws on Hamilton's long-standing history of research and development which has been supported by key organizations such as McMaster University and Hamilton Health Sciences. Further, this vision focuses on leveraging expertise and opportunities that exist in key subsectors and looks to capitalize on the emergence of key, high potential start-up companies primarily in the Hamilton area.

Based on the current state of Hamilton's life sciences ecosystem, including the local, national, and international landscape, focus is required on the areas (or 'strategic pillars') which present the greatest opportunities for sustained growth. The strategic pillars for growing Hamilton's life sciences sector include: developing resources and programs to enable life sciences companies to scale-up; strengthening and promoting Hamilton's life sciences brand; and developing and undertaking a targeted investment attraction approach.

The strategic pillars are supported by a set of tactical actions aimed at achieving the desired outcome of each pillar and the overarching vision. The strategy will ultimately be led by the City of Hamilton and supported by the Synapse Consortium (Synapse). Synapse, as a not-for-profit regional cluster organization for the life sciences sector in Hamilton, plays a central role in promoting the sector by supporting related initiatives, projects, and the acceleration of commercialized life science

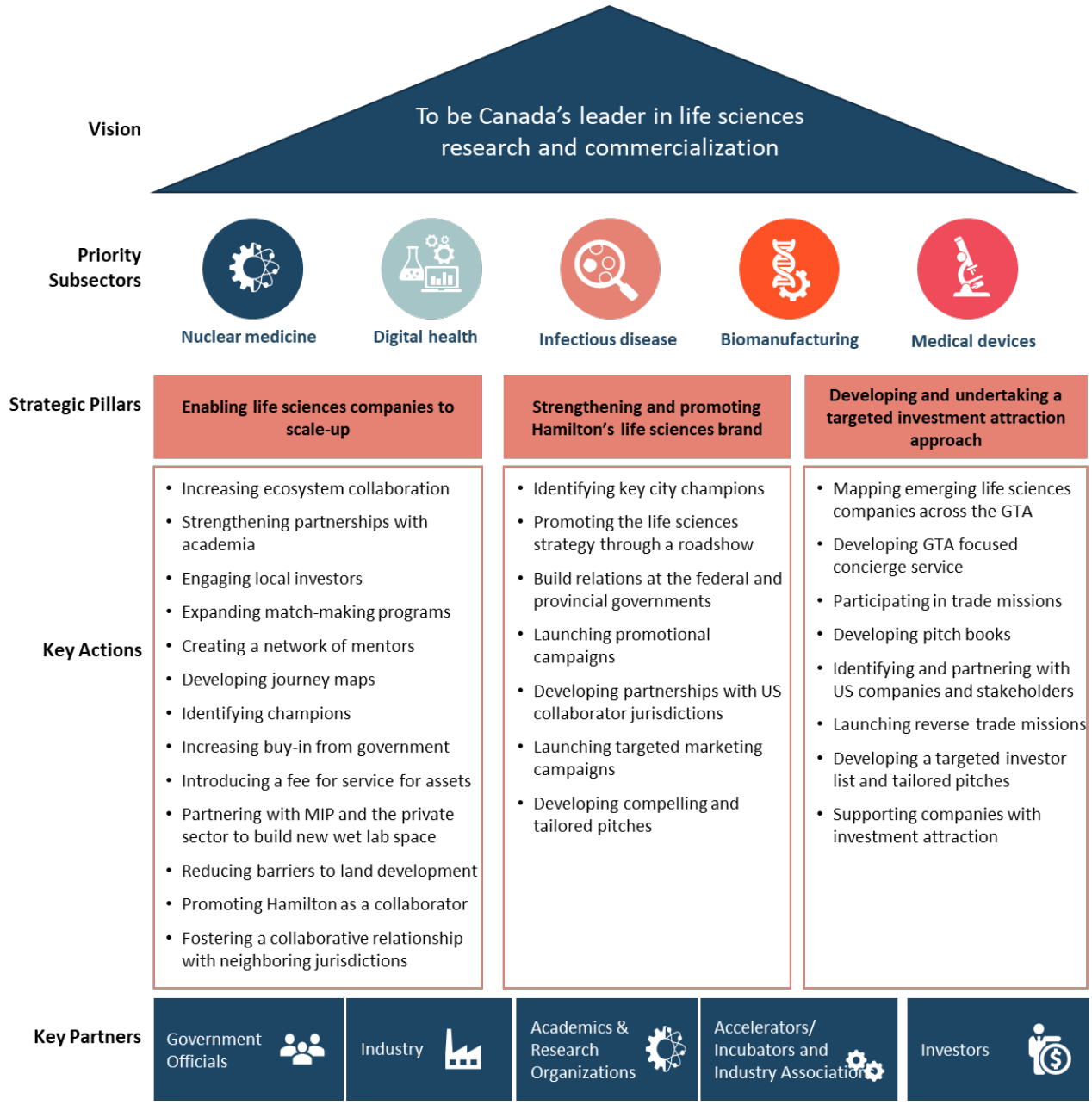
innovation.[8] Synapse partners include Bay Area Health Trust, Hamilton Health Sciences, St. Joseph's Healthcare, Hamilton Chamber of Commerce, Hamilton Economic Development, McMaster University, Mohawk College, McMaster Innovation Park, and Innovation Factory.

The strategy needs to also be supported by key partners in and around the ecosystem to ensure successful execution. These partners include stakeholders across government, industry, academia and research organizations, accelerators/incubators, and industry associations.

Collectively, each of these elements – including the vision, priority subsectors, strategic pillars, key actions, and key actors – comprise the strategy for growing Hamilton's life sciences sector. These elements are presented in *Figure 1* below and are further discussed later in this document.

[8] (Synapse, About Synapse, 2018)

Figure 1: Summary of Hamilton's Life Sciences Strategy

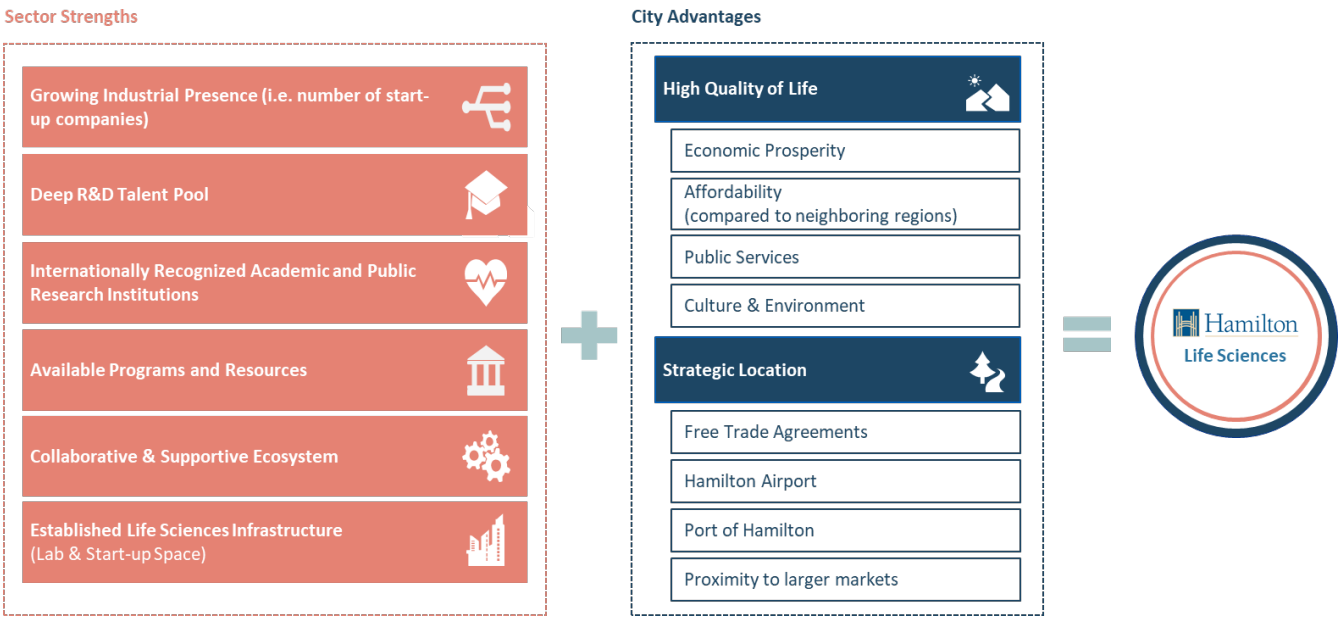


Hamilton's advantages and strengths

Successful sector strategies emphasize competitive advantages and opportunities for growth in local/regional, national, and international markets. Hamilton's life sciences advantages and strengths are summarized in *Figure 2* below. Additionally, highlighting the benefits of living in

Hamilton, alongside opportunities within the life sciences sector is an important part of Hamilton's value proposition.

Figure 2: Hamilton's Advantages and Strengths

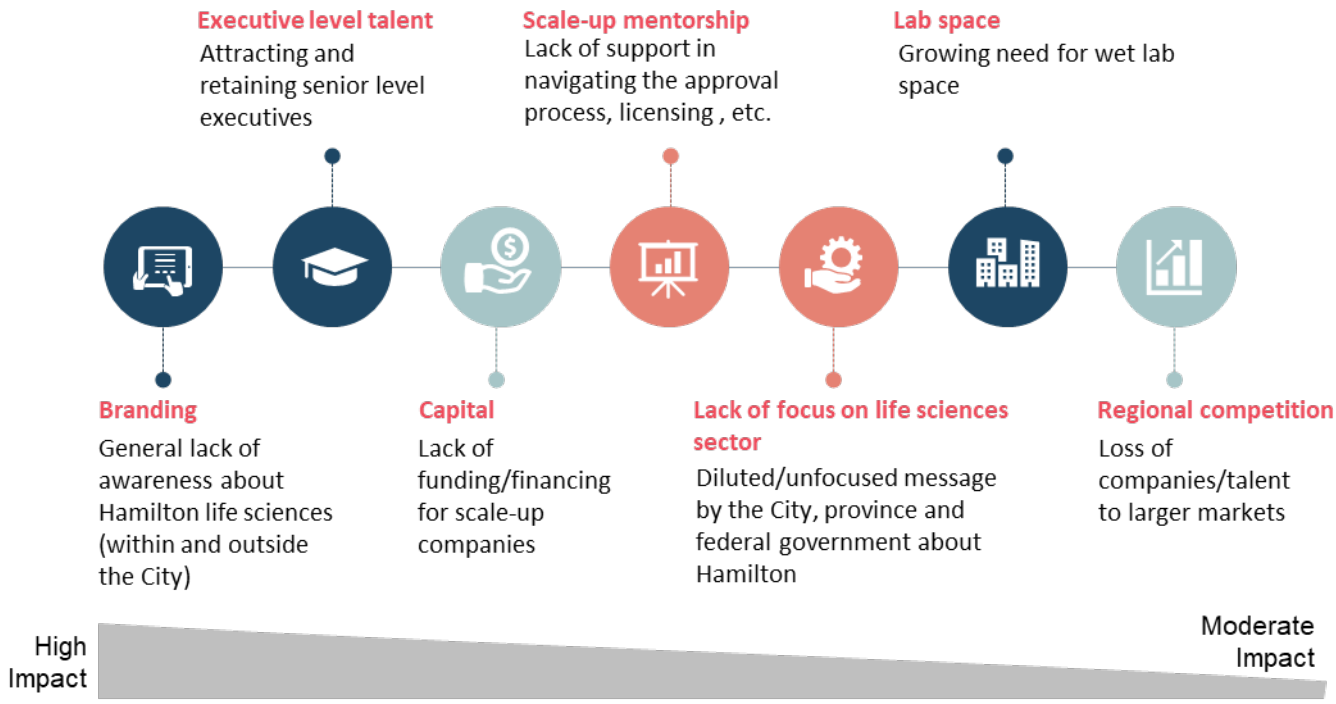


To help ensure differentiation, regions which successfully support sector growth commonly concentrate their efforts and resources on areas where they have unique strengths. This includes focusing on a select number of subsectors where the region has a competitive advantage and where national and international growth opportunities exist in the near and long-term. Based on research, consultation with stakeholders, and analysis, the key subsectors in Hamilton include:

Key challenges creating barriers for accelerated growth

The city undertook a current state assessment of the life sciences sector that included extensive stakeholder consultation and in-depth research and analysis to identify challenges impacting its ability to grow. To enable growth, the city and key partners will need to work and collaborate with key stakeholders to overcome these challenges, including:

Figure 3: Key Challenges Limiting Growth



Unlike other sectors, return on investment in life sciences has a longer time horizon. Between research and development (R&D) timelines, the regulatory approvals process and commercialization, returns on investment can take years to be realized. Thus, the city must account for this longer time horizon when addressing both current and future challenges and opportunities. Long-term commitment to growth is imperative for a sustainable ecosystem to be realized.

As part of the analysis for this strategy, a short, medium, and long-term lens was applied to help ensure successful growth of life sciences sector. To move from strategy to action, the city will need to prioritize its efforts and resources. These priority actions and the actors required to support successful execution are further outlined in the Implementation Roadmap section of this document.

02

Hamilton's Life Sciences Subsectors

Hamilton's Life Sciences Sector is Well Positioned for Growth in Priority Subsectors

The life sciences sector is comprised of key subsectors, each with a unique set of requirements for growth. Some subsectors, such as medical devices and biomanufacturing, rely heavily on infrastructure including factories and distribution networks to get products to market. Other subsectors, including digital health can have a higher reliance on innovative technologies. Given the diversity of subsectors and associated requirements for each, it is important that cities identify their key subsectors to focus their efforts and resources. Each subsector identified below provides an opportunity for the City of Hamilton to draw on its strengths and grow the overarching life sciences ecosystem.

The five key subsectors identified for prioritization are:

These subsectors include areas where Hamilton either has the presence of a strong base to draw from (such as emerging start-ups/scale-ups), or unique assets which can help distinguish the city from key competitors domestically – including Montreal, Toronto, London, Quebec City and Vancouver. Focus was placed on competitor jurisdictions that are often considered by investors when looking to expand into the life sciences sector. These subsectors have potential short-term and long-term growth projections.

The following provides an overview of each of the identified subsectors. This includes an overview of global and Canadian growth trends and opportunities, and Hamilton's strengths within each subsector.

Nuclear Medicine

Definition

Nuclear medicine refers to procedures that use small amounts of radioactive materials to diagnose and treat patients.[9] Nuclear medicine consists of three different branches: medical isotopes, nuclear imaging, and radiation.

- Medical isotopes – use radioactive substances to diagnose, characterize and treat disease.[10] Two of the most common medical isotopes include:
    - Molybdenum-99 (Mo-99) – Technetium-99m is derived from Mo-99 and accounts for 82% of diagnostic imagining procedures; and
    - Iodine-131 (I-131) – used for diagnosing and treating thyroid cancer and hyperthyroidism.[11]
- Nuclear imaging – similar to x-rays, nuclear imaging enables in-depth examinations into internal organs that cannot be achieved through x-ray by injecting patients with isotopes.[12]
- Radiation therapy – where doses of radiation damage targeted cells so that they can no longer reproduce and are destroyed.[13]

Global Trends

Nuclear medicine is a growing area of life sciences, where it is projected to:

- Reach CAD $9.5 billion by 2026, up from CAD $6.1 billion in 2021 globally;[14] and
- Experience a compound annual growth rate (CAGR) of approximately 9% through to 2026.[15]

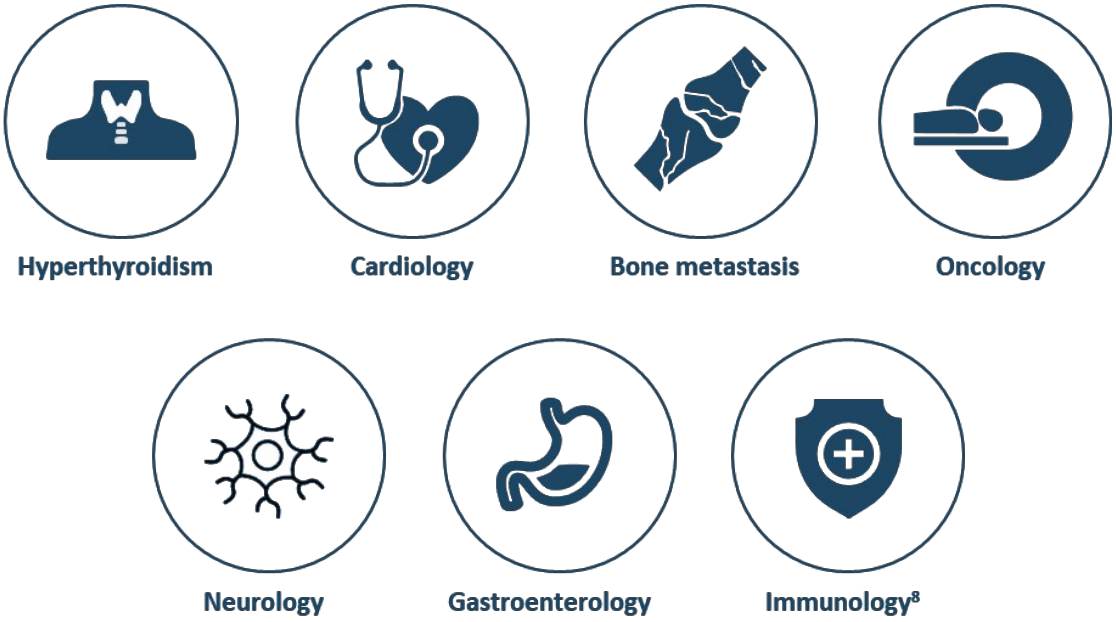
Growth is primarily attributed to an increasing prevalence in treatable ailments due to:

- Aging populations in developed economies; and
- Stronger diagnostic and treatment capacity in emerging economies.[16]

Growth in this subsector poses an opportunity to leverage Hamilton's competitive advantage as the leading life sciences cluster in Canada with nuclear reactor output, research, and diagnostic testing capacity.

[9] (John Hopkins Medicine, 2021)
[10] (Canadian Nuclear Isotope Council (CNIC), n.d.)
[11] (Natural Resources Canada (Government of Canada), 2020)
[12] (John Hopkins Medicine, 2021)
[13] (Natural Resources Canada (Government of Canada), 2020)
[14] (Global News Wire, The global nuclear medicine market, 2021)
[15] (Markets and Markets, 2020)
[16] (Global News Wire, Global Oncology Market Forecast 2023, 2020)

Nuclear medicine can be applied for treatment and diagnostics in the following areas:



The subsector is seeing a shift away from a 'one-size-fits-all' approach, to increasingly focusing on precision/personalized medicine to ensure patients are receiving specific care in relation to their unique biological makeup.[17]

Canadian Trends

Canada is well known internationally for its expertise in nuclear research and technology. Canada's entry into nuclear medicine began in 1951, where the world's first cancer treatment using radiation was conducted in Ontario.[18] Today, Canada is a key supplier of medical isotopes, such as cobalt-60 and iodine-125.[19] Cobalt-60 is used in 70% of cancer therapies that use radiation. Canadian exports of Cobalt-60 have helped provide more affordable cancer care treatments to 10 million individuals worldwide.[20]

Additionally, McMaster University makes notable contributions to Canada's research and medical isotope production. The McMaster Nuclear Reactor, a 5MW multi-purpose reactor, is Canada's most powerful research reactor and the country's only major neutron source.[21]

Hamilton's Strengths

Within Canada, Hamilton is a nuclear medicine epicenter, housing key assets, such as specialized hot cell labs and the reactors, that are capable of producing products and conducting research that are impossible in most other jurisdictions globally. These features leave Hamilton well positioned

[17] (Cardinal Health, 2019)
[18] (Canadian Nuclear Isotope Council (CNIC), n.d.)
[19] (Natural Resources Canada (Government of Canada), 2020)
[20] (Canadian Nuclear Isotope Council (CNIC), n.d.)
[21] (McMaster University, 2021)

to take advantage of subsector growth and bolster its life sciences industry from investments into research and industry.

Hamilton's assets consistently demonstrate leading-edge scientific output, where many of the city's established institutions and programs are focused on research and treatment of patients with unmet needs. This includes the Stem Cell and Cancer Research Institute that is further enhanced by its collaborations and access to the nuclear reactor at McMaster University.

The nuclear reactor is one of only a few global suppliers of iodine-125. The reactor typically produces and exports about 60% of the world's iodine-125 supply[22] – enough for approximately 70,000 treatments per year.[23] Stakeholder interviews frequently cited the nuclear reactor as a major attractor and enabler of life sciences R&D.

Hamilton is an increasingly favoured destination for nuclear therapeutic companies, which have nearly tripled in number since 2016.[24] These companies have continued to experience successful growth over time – the most notable being Fusion Pharmaceuticals Inc. The company, which is located at McMaster Innovation Park, saw the second largest IPO for a Canadian biotechnology start-up, with CAD $271.3 million raised (following a CAD $58.9 million Series A and CAD $134.4 million Series B raise), and is the Canada Pension Plans Investment Board (CPPIB) first direct investment ($20 million) into a Canadian biotechnology firm.[25]

[22] (Canadian Nuclear Association, 2015)
[23] (McMaster University, 2019)
[24] Synapse Data
[25] Synapse Data

Digital Health

Definition

Digital Health refers to the intersection of healthcare and technology. Digital Health encompasses a range of traditional and emerging technologies.

Traditional technologies include:

- Electronic health records – that collect, store, and analyze patient data; and
- Telehealth systems – that remotely connect patients with practitioners.

Emerging technologies include:

- Blockchain – a decentralized database that records the transactions of assets, with applications in healthcare relevant to patient data, clinical trials, healthcare supply chains, etc.;[26]
- Machine Learning (ML) – using machines and algorithms to interpret imaging data and identify suspicious spots or identifying difficult to diagnose diseases;[27]
- Artificial intelligence (AI) – with advanced software capable of diagnosing patients, suggesting treatments plans, and interacting with patients; and
- Extended reality (virtual and augmented reality) – that can provide patients with mental wellness treatments and enable practitioners to perform remote procedures.

Global Trends

Globally, this subsector is seeing significant growth due to strong investor confidence and perceived investment opportunities.[28] The COVID-19 pandemic will intensify subsector growth by demonstrating the benefits of health technologies to both patients and care providers.

- Global market size is estimated to be over CAD $128 billion;[29]
- Global spending on digital health is projected to represent 8% of all healthcare expenditures by 2030, from 3% currently;[30] and
- Funding for digital health companies rose by 72% since 2018, amounting to CAD $17.9 billion invested across 440 deals.

The digital health technologies listed above are revolutionizing the way in which patients are receiving treatment. Digital health services are providing patients with more personalized treatment which is ultimately more effective and improves the overall patient experience. Services such as Electronic Health Records and blockchain collect, store, and analyze patient data, which assists healthcare practitioners with diagnosis as well as enabling them to create tailored treatment

[26] (Badr, 2019)
[27] (Sarkar, 2020)
[28] (Accenture, 2021)
[29] (Popliger & Lakhdar, 2020)
[30] (Bomba, Chan, Heine, Lakhdar, & Popliger, 2020)

plans based on the unique needs of the patient. Widespread patient data collection can also be leveraged to track health trends and explain, influence or predict health related outcomes.

Additionally, digital health services are enabling patients to be more involved in the provision and management of their own treatment. Through self-health monitoring and mobile-based healthcare, patients can track activities related to their healthcare management – from daily exercise to eating habits. Applicable technologies include:

- Wearables that monitor vitals and inform patients through user friendly systems; and
- Assistive devices/systems such as hearables.

The adoption of these technologies has led to an increase in consumer and patient demand for value-added services, improved communication, and better channels of engagement with healthcare providers.[31]

Canadian Trends

The digital health subsector in Canada is experiencing similar trends to those that have been occurring globally.

- The Canadian digital health market is estimated to be valued at around CAD $5.1 billion;[32] and
- Canada has a strong ecosystem of digital health start-ups, which managed to collectively raise over CAD $1.2 billion in venture capital funding in the first half of 2020.[33]

Demand for digital health services in Canada has increased substantially since the COVID-19 pandemic, where a survey conducted by the Canadian Federal Competition Bureau in December 2020 revealed that 72% of Canadians now obtain medical advice from healthcare providers by phone and 42% access websites, mobile applications, or interactive online tools and services. Canadians are increasingly looking to receive treatment from their family doctors and specialists via telephone or virtual means.[34] These trends are further supported by the Government of Canada through investments in programs such as the Canadian Technology Accelerator which helps Canadian businesses focused on life sciences, digital technologies and cleantech.[35]

Hamilton's Strengths

Although Hamilton does not have the same abundance of large innovative multinational companies like Toronto or Montreal, the city offers businesses an environment that is highly conducive to growth. With the recent advancements in digital health technology and accelerated adoption due to the COVID-19 pandemic, businesses aiming to enter this subsector benefit from being located in Hamilton with features such as:

- A strong, diverse talent pipeline with over 28,000 STEM students at McMaster University[36] and Mohawk College[37];
- Talent pool required to support a robust research environment with focused researchers;

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[31] (Capgemini, 2018)
[32] (Popliger & Lakhdar, 2020)
[33] (Popliger & Lakhdar, 2020)
[34] (Government of Canada, Digital Health Services Survey: What We Heard from Canadians, 2021)
[35] (Government of Canada, Digital Health - Canadian Technology Accelerator, 2021)
[36] (McMaster University, 2019)
[37] Data provided by Synapse Consortium

- Resources and infrastructure that supports digital health research (e.g., mHealth & eHealth Development and Innovation Centre (MEDIC) at Mohawk and Centre for Data Science and Digital Health (CREATE) at HHS); and
- An existing ecosystem of innovative start-ups.

The digital health talent pipeline in Hamilton includes graduates specifically trained to work in the digital health subsector through Canada's only graduate program in e-Health at McMaster University. The program is designed to build capacity around digital health informatics. Additionally, Mohawk College offers programs that provide extensive hands-on learning opportunities related to technology that can be applied to digital health.

Further, Hamilton's healthcare ecosystem offers significant opportunity for research collaboration, which has been beneficial to digital health companies and resulted in innovative discoveries. For example, Hamilton-based company Adapsyn uses an algorithm to evaluate potential new drug compounds through meta-analysis of organic materials. Furthermore, the mHealth & eHealth Development and Innovation Centre (MEDIC) at Mohawk College conducts digital health applied research, provides advanced skill development services and leads development of electronic medical records (EMR);[38] while the Centre for Data Science and Digital Health (CREATE) team at HHS was launched in 2020 with experts in artificial intelligence, data sciences and software engineering.[39] SanteSuite, an immunization management system, is a spinoff from technology developed at MEDIC.

Lastly, industry development has been strong with the emergence of start-ups focused on digital health organizations and services. The number of digital health entities in Hamilton has tripled since 2016.[40] As identified through stakeholder interviews, digital health start-ups are focused on areas such as increasing healthcare service delivery efficiency, leveraging digital health as a means of addressing ageing-related challenges and reducing pressures on the healthcare system. There are a number of institutes and labs in addition to the ones listed above, focused on addressing aging-related health issues in Hamilton, including:

- Labarge Centre for Mobility in Aging;
- Canadian Longitudinal Study on Aging;
- Geriatric Education and Research in Aging Sciences Centre;
- Gilbrea Centre for Studies in Aging;
- McMaster Institute for Research on Aging;

Coupled with industry supports within the ecosystem, through local accelerators and incubators, the digital health subsector in Hamilton is well positioned for future growth.

[38] (Mohawk College, mHealth & eHealth Development and Innovation Centre (MEDIC), n.d.)
[39] (Hamilton Health Sciences launches advanced IT group, 2020)
[40] Source: Synapse Data

Infectious Diseases

Definition

Infectious diseases refers to combatting diseases that are spread through direct or indirect contact. Infectious diseases are microscopic organisms such as bacteria, viruses, fungi, or parasites and include a wide range of sicknesses such as:

- COVID-19;
- Chicken pox;
- Diphtheria;
- HIV/AIDS;
- E. coli;
- Lyme disease;
- Pneumonia; and
- Influenza.

Global Trends

Infectious diseases have been and will continue to be an area that is highly prioritized by governments and research institutions all around the world. This subsector is wide-ranging and can include anything from assessing the efficacy of influenza vaccines for patients with different conditions, to reducing the threat of a biological terrorist attack (e.g., the US government's Biological Warfare Defense Program).[41] Spending on infectious diseases has skyrocketed since the COVID-19 pandemic. Global spending on COVID-19 research reached CAD $6.4 billion in January 2021,[42] while spending on COVID-19 vaccines is projected to reach CAD $201.2 billion by 2025 ($67.8 billion in 2021, $65.3 billion projected in 2022, and $29.4 billion projected in 2023).[43] When looking forward, the cost of preventing future pandemics globally is much less than the economic cost of the disruption caused. The economic disruption caused by COVID-19 could cost more than CAD $20.5 trillion. The cost to prevent the next pandemic would mean spending CAD $108.9-$166.6 billion over the next two years, and CAD $25.6 -$64.1 billion annually after that.[44]

Global infectious disease R&D had already been experiencing steady growth before the COVID-19 pandemic. Emerging infectious diseases research spending grew on average by approximately 6.9% annually over the past two decades.[45] G20 countries alone spent over CAD $133.2 billion between 1999 and 2017. This funding was spent on research related to:

- HIV/AIDS (receiving 40.1% of the funding);
- Tuberculosis (6.7%);
- Malaria (5.3%);

[41] (Riedel, 2004)
[42] (OECD, 2021)
[43] (IQVIA Institute, 2021)
[44] (McKinsey & Company, Not the last pandemic: Investing now to reimagine public-health systems, 2021)
[45] (The Elsevier Community, 2020)

- Influenza (4.2%);
- Pneumonia (3.3%);
- Ebola virus (1.1%);
- Zika virus (0.3%); and
- Coronavirus pre-pandemic (0.5%).[46]

Most of the funding was allocated to pre-clinical research studies (receiving 58%), awards and public health research (28%).[47] The primary focus of this R&D includes developing new prevention and control strategies, as well as ensuring the maintenance of research and training infrastructure.

Canadian Trends

Canada is home to globally recognized infectious diseases centres. This includes the Institute for Infection and Immunity, National Collaborating Centre for Infectious Diseases, Canadian Foundation for Infectious Diseases, and various centers within hospital research institutes.

In light of the COVID-19 pandemic, the Government of Canada increased funding supports for infectious disease research. These supports include a CAD $2.4 million grant available to infectious disease researchers from Canadian universities,[48] and a CAD $10 million investment to launch five multidisciplinary infectious disease modelling networks.[49]

Funding for infectious diseases is likely to stay at elevated levels for years following the pandemic, as has been the case for previous outbreaks in recent years (SARS in 2002, H1N1 in 2009, MERS in 2012, Ebola in 2014, and Zika in 2015).[50]

Hamilton's Strengths

Hamilton is a leading jurisdiction in Canada for work related to infectious diseases. The subsector in Hamilton benefits from a large and highly educated talent pool, as well as numerous globally and nationally leading research centres. Hamilton research centres include:

- McMaster Immunology Research Centre – a nationally leading health sciences research centre that specializes in infectious diseases and vaccines, among other research areas. The centre occupies approximately 45,000 square feet of lab space with a biosafety level 3 lab, a GMP facility that develops immunotherapies, and a flow cytometry facility.
- Population Health Research Institute (PHRI)– a world leading research group in large clinical trials and population health studies that is supported by McMaster University and Hamilton Health Sciences.
- Michael G. DeGroote Institute for Infectious Disease Research – a world-leading infectious diseases centre that was established in 2007 and has over 30 principal investigators and 2,000 trainees.

Given these features, research centres and the relevant government programs related to infectious diseases that are available, Hamilton is well positioned to leverage the enhanced interest around infectious diseases following the pandemic and attract investment and research initiatives.

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[46] (Head, Brown, Newell, & Scott, 2020)
[47] (Head, Brown, Newell, & Scott, 2020)
[48] (Rodgers, 2021)
[49] (Government of Canada, Government of Canada invests in infectious disease modelling networks, 2021)
[50] (The Elsevier Community, 2020)

Hamilton credibility with working on infectious diseases by demonstrating important R&D abilities during the onset of the COVID-19 pandemic when collaboration between academia and practitioners at St. Joseph's Healthcare, Hamilton. Called McMaster's HealthLabs, this initiative among doctors and scientists to generate scientific data and provide testing and surveillance for infectious diseases.

Hamilton's efforts during the pandemic were made possible in part by the city's large and highly educated talent pool that is supported by departments within McMaster University including:

- Faculty of Health Science, Department of Medicine, Division of Infectious Diseases;
- Department of Pathology and Molecular Medicine;
- Michael G. DeGroote Institute for Infectious Disease Research;
- Department of Biochemistry and Biomedical Sciences;
- Department of Health Research, Evidence, and Impact, and;
- Hamilton Regional Laboratory Medicine Program at Hamilton Health Sciences.

This increased activity in research and the overall talent pool across Hamilton paired with the global trend to find means of reducing and eliminating infectious diseases, presents an opportunity for Hamilton grow the sector and attract investments.

Biomanufacturing

Definition

Biomanufacturing is a process that uses complete living cells or their components (e.g., bacteria, enzymes, chloroplasts) to create products such as vaccines, antibiotics, and monoclonal antibodies. Products are made from either mammalian-based organisms or microbial and other non-mammalian organisms (e.g., plant and insect expression systems).[51]

Global Trends

The biomanufacturing subsector has experienced consistently strong growth over the past 20 years and is forecasted to remain strong into the future.

- Annual global growth has averaged 12% in the last 20 years and is expected to remain at similar levels into the future.[52]
- The subsector is forecasted to reach a value of CAD $54.8 billion globally by 2029.[53]

The US still dominates the international biomanufacturing landscape – with the country seeing over CAD $512 billion in annual drug sales and an approximate capacity of 30% of global manufacturing.[54]

The majority of biomanufacturing is dedicated to mammalian-based organisms – which represents over 70% of worldwide biomanufacturing capacity.[55] The subsector is dominated by a few large processing facilities, where 10 facilities comprise approximately 40% of global capacity and 100 facilities comprise 75%.[56]

The COVID-19 pandemic has increased investment into biomanufacturing from governments, private-sector companies, and nonprofit organizations to boost capacity and launch new products. More than 215 novel and repurposed therapies were in the pipeline for COVID-19 by spring of 2020.[57] Nonetheless, the increased focus on COVID-19 has left non-pandemic related activities unaffected.[58] The COVID-19 pandemic has also prompted biomanufacturing companies to bolster their domestic and regional supply chains as opposed to outsourcing. This comes as a shift in the previously dominated trend of heavily focusing on outsourcing.[59]

Canadian Trends

While the Canadian biomanufacturing subsector demonstrates a strong ability to develop new biologics (i.e., biomanufacturing products), the country lacks the manufacturing capacity to support

[51] (DCAT Value Chain Insights, 2020)
[52] (Rader, Langer, & Jhamb, 2020)
[53] (GlobalNewswire, 2020)
[54] (Nature Biotechnology, 2019)
[55] (DCAT Value Chain Insights, 2020)
[56] (DCAT Value Chain Insights, 2020)
[57] (Rader, Langer, & Jhamb, 2020)
[58] (Rader, Langer, & Jhamb, 2020)
[59] (Rader, Langer, & Jhamb, 2020)

development. The Canadian biologics sector is valued at around CAD $12 billion and projected to grow by 5.8% CAGR through to 2025.[60]

The limited availability of large-scale biomanufacturing facilities in Canada has resulted in only a small number of foreign companies considering Canada as a destination for outsourcing. According to industry surveys conducted by the biomanufacturing consulting firm BioPlan, only 9% of biomanufacturing companies viewed Canada as a likely destination for outsourcing, whereas 25.5% viewed the US as a likely destination.[61]

To help combat this challenge, the Government of Canada is attempting to boost domestic biomanufacturing capacity. In 2021, the federal government launched the Biomanufacturing and Life Sciences Strategy that committed an investment of CAD $2.2 billion over seven years into the subsector.[62] Additionally, since the outbreak of the COVID-19 pandemic, the Government of Canada has invested more than CAD $1.2 billion in 28 COVID-19 domestic biomanufacturing, vaccine and therapeutics projects.[63] While nine of the projects were in Ontario, none were in Hamilton. The Federal Government's increased focus on space and Hamilton's manufacturing history and capabilities present an opportunity for Hamilton to grow its biomanufacturing sector.

Hamilton's Strengths

Hamilton's post-secondary institutions and related programs offer a strong talent pool which can help further build the manufacturing subsector. For example, McMaster University has partnered with Sartorius, a global leader in biomanufacturing, to study ways to improve manufacturing processes of antibody and virus-based treatments.

Biomanufacturers would additionally benefit from building and land costs that are comparatively cheaper than those of Toronto – with the average R&D tangible products facility costing CAD $6.48 per square foot in Hamilton, versus CAD $9.06 per square foot in Toronto.[64]

Hamilton's history as a manufacturing hub also provides unique infrastructure assets that are absent in many other Canadian jurisdictions. Biomanufacturers can utilize these assets either through repurposing or conversion of previous manufacturing assets. This was demonstrated during the COVID-19 pandemic when existing manufacturing capabilities were leveraged to provide critical personal protective equipment (PPE) – such as The Centre of Excellence in Protective Equipment and Materials (CEPEM) which helps Canadian companies with design, research, development and scale up manufacturing.

Lastly, there are efforts currently underway in Hamilton to build out infrastructure that would help meet capacity needs. There has been a growing need and identified gap of more biotechnology infrastructure, including scale-up space. McMaster Innovation Park (MIP) is Canada's premier research and innovation park that supports start-ups, businesses and research through coworking space, with large growth plans.[65] MIP has begun addressing this gap through its announcement of establishing a Bio-Manufacturing Campus (BMC), created in partnership with the Centre for the

[60] (Lier, 2021)
[61] (Lier, 2021)
[62] (Government of Canada, The Government of Canada announces biomanufacturing and life sciences strategy, 2021)
[63] (Government of Canada, Biomanufacturing: Projects underway, 2021)
[64] (KPMG, 2021)
[65] (McMaster Innovation Park, n.d.)

Commercialization of Regenerative Medicine (CCRM). This initiative will create a new facility that specializes in the commercial production of cells and viral vectors that are used for regenerative medicine.[66]

By successfully leveraging and building the qualities listed above, Hamilton has strong potential to attract significant investments and become a national leader in biomanufacturing.

Medical Devices

Definition

Medical devices are equipment used to diagnose, treat, mitigate, or prevent aliments.[67] Medical devices generally require regulatory approval from government agencies (e.g., FDA, Health Canada) before they can be used.

Global Trends

Technological innovation in the medical device subsector is leading to robust growth with strong investor confidence and perceived investment opportunities. Additionally, aging populations and economic expansion in emerging markets are driving growth even further. Emerging markets are especially attractive to medical device manufacturers due to their growth potential and less complex regulatory frameworks.[68]

- The medical devices subsector is projected to grow from CAD $582.7 billion in 2021 to CAD $842.7 billion in 2028, at a CAGR of 5.4%.[69]

As of 2019, the key global business segments of this sector include:

- Diagnostic imaging (e.g., MRI, CT-scan) with 23% of the market;
- Consumables (e.g., syringes, needles, tubing, catheters, adhesives and sealants, etc.) with 17%;
- Patient aids (e.g., hearing aids and pacemakers) with 13%;
- Orthopedic products with 12%;
- Dental products with 8% and
- All other equipment with 28%.[70] [71]

Innovations in the subsector have led to widespread adoptions of numerous new technologies in healthcare. Technologies such as augmented reality and virtual reality are now commonly used in patient care (e.g., remote procedures and mental health treatment) and healthcare training. Biosensors that monitor patients' wellbeing can better predict the possibility of worsening

[66] (Paterson, 2021)
[67] (Government of Canada, Medical devices, 2021)
[68] (Government of Canada, Medical Devices: Industry Profile, 2021)
[69] (Fortune Business Insights, 2020)
[70] (Government of Canada, Medical Devices: Industry Profile, 2021)
[71] Note: the numbers do not add up to 100% due to rounding

conditions and monitor the impact of clinical interventions,[72] while advancements in 3D printing are improving prosthetic limbs and bioprinting of medication and organs.[73]

Canadian Trends

The subsector in Canada is valued at CAD $9.3 billion, about 1.8% of the total global medical devices market.[74] While the national subsector includes innovative small Canadian-owned firms, it is largely dominated by foreign-owned companies.[75] Similar to global markets, Canada's subsector is heavily diversified across a number of different products. Specifically, Canada's medical devices subsector:

- Has the eighth largest market in the world;[76]
- Saw CAD $5.5 billion in exports in 2019;[77]
- Includes 727 businesses in Canada that operate in the subsector;[78] and
- Employees 17,065 individuals.[79]

The Government of Canada also supports the subsector through numerous programs that are available to domestic companies. These programs include the National Research Council's Industrial Research Assistance Program that helps companies develop and commercialize technologies, and the Canadian Scientific Research and Experimental Development tax incentive program that subsidizes firms conducting R&D in Canada, among others.[80]

Hamilton's Strengths

Within Canada, Hamilton has developed a robust medical device subsector capable of becoming a national leader with a large and highly educated talent pool, innovative start-up environment and available existing infrastructure. Programs at McMaster University and Mohawk College help support the development of the skills needed by the subsector, including Mohawk's Medical Device Reprocessing program. Additionally, the Institute for Applied Health Sciences Campus at Mohawk prepares students to become leading health care practitioners. A unique asset is the Centre of Health Care Simulation that provides the opportunity to test and expand our skills in more real-life settings. These programs are increasingly providing start-up/scale-up medical device companies the opportunities to partner with academic and research hospitals such as McMaster University, Mohawk College and Hamilton Health Sciences to commercialize products. Additionally, FedDev Ontario's investment of $6 million to the Innovation Factory to the Southern Ontario Pharmaceutical and Health Innovation Ecosystem (SOPHIE), which is aimed at supporting and developing specialized pharmaceutical and health innovations to scale up companies represents a key win and investment in Hamilton.

Stakeholder discussions also highlighted the existing presence of medical device companies in the city. Specifically, the number of medical device entities in Hamilton has more than tripled since 2016. These companies have the opportunity to leverage existing manufacturing capabilities and

[72] (Medical Design Briefs, 2021)
[73] (Advent Health University, 2020)
[74] (Government of Canada, Medical Devices: Industry Profile, 2021)
[75] (Government of Canada, Medical devices, 2021)
[76] (International Trade Administration, 2021)
[77] (Government of Canada, Medical Devices: Industry Profile, 2021)
[78] (IBIS World, 2020)
[79] (IBIS World, 2020)
[80] (Government of Canada, Medical Devices: Industry Profile, 2021)

distribution networks within Hamilton. For example, Stryker invested CAD $128 million in building their Canadian headquarters in Hamilton to house their 235 local employees.

While COVID-19 disrupted Hamilton's medical devices subsector performance, there is optimism that growth will return and potentially surpass previous levels.

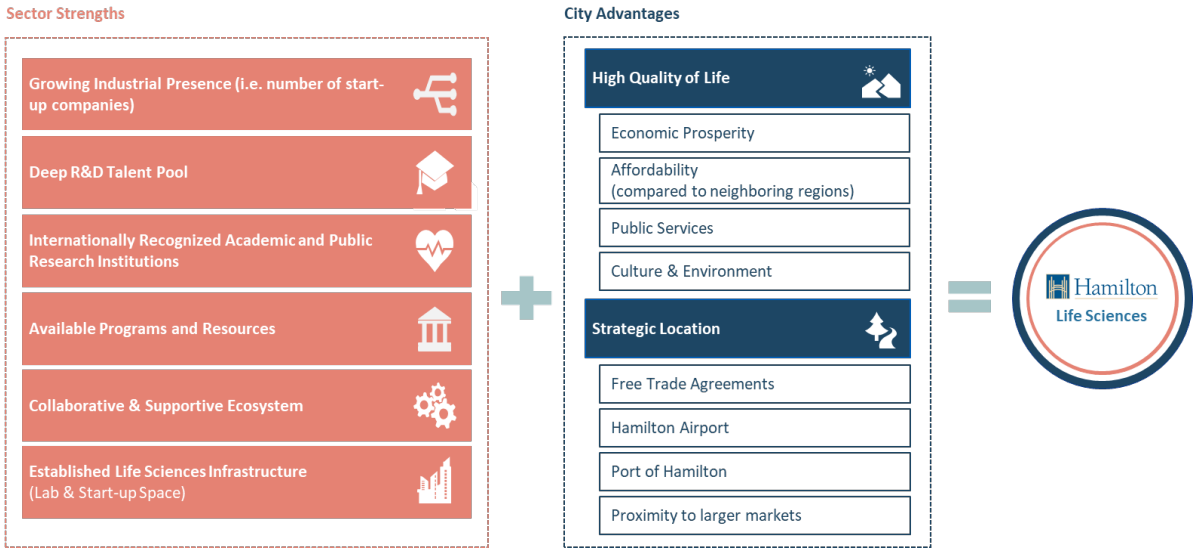
03

Key Strengths in Hamilton's Life Sciences Sector

Key Strengths in Hamilton's Life Sciences Sector Make the City Primed for Investment

Growing Hamilton's life sciences sector and attracting investment will require drawing on the city's life sciences sector strengths and broader advantages. Hamilton's sector strengths include the diversity of the talent pool, wide array of academic professionals, advancements in digital health technology and global company investment. Broader city advantages include a high quality of life and strategic location. Focus is also necessary on areas of competitive advantage to help the city stand out against competing jurisdictions. Further information on Hamilton's life sciences ecosystem can be found in Appendix B.

Figure 4: Hamilton's Strengths



Based on analysis of Hamilton's life sciences sector profile, key subsectors and competitiveness, the following key areas of strength across the life sciences sector were identified:

Growing Industrial Presence

Hamilton has seen notable growth in life sciences start-ups over the last two decades. Supported by a growing number of resources and ecosystem, researchers and entrepreneurs alike are turning their innovations into services and products. Key successes, such as Fusion, Stryker, and Affinity Biologics (or others) are creating critical anchor life sciences companies that can help foster and grow the pool of start-ups.

Deep R&D Talent Pool

Hamilton has a deep talent pool focused on R&D. This is in part the result of STEM and specific programs for life sciences offered at McMaster University, Mohawk College, and Redeemer University. Combined with cutting edge research at HHS and St. Joseph's Healthcare Hamilton (SJHH), and The Research Institute at St. Joe's Hamilton (RSJH), stakeholders highlighted the strong

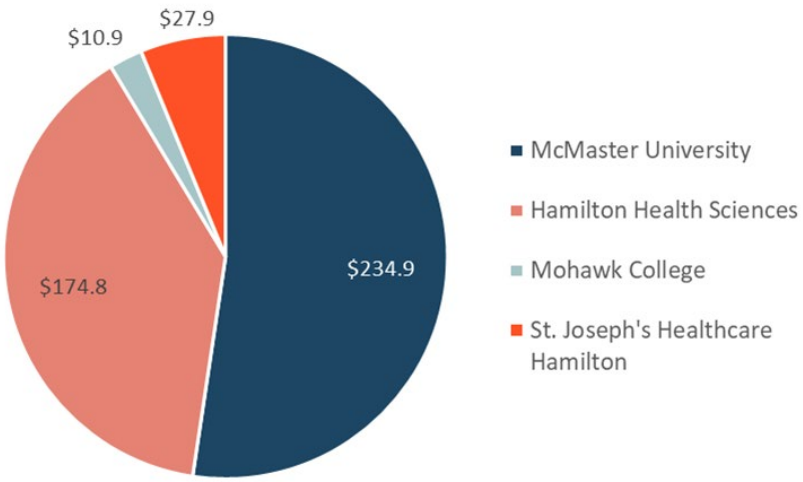
presence of highly skilled researchers which contribute to globally recognized research and innovations. Additionally, programs such as mHealth & eHealth Development and Innovation Centre (MEDIC) at Mohawk and Centre for Data Science and Digital Health (CREATE) at HHS help further build and foster the talent pool.

Internationally Recognized Academic and Research Hospitals

In addition to the presence of a deep talent pool, Hamilton is home to leading academic and research hospitals. These organizations employ leading researchers across the ecosystem, provide necessary programs, funding, and infrastructure to support scientific discovery and commercialization. Research centres include:

- McMaster Immunology Research Centre
- Population Health Research Institute (PHRI)
- Michael G. DeGroote Institute for Infectious Disease Research

Figure 5: 2020 Total Research Spend from Academic and Research Hospitals in Hamilton (in Millions)



As mentioned by stakeholders, Hamilton is seen as being a 'one stop shop' for R&D through a mix of programs and initiatives offered at research hospitals, the volume of clinical trials being performed, and applied research (e.g., testing and prototyping) across the city. Ecosystems with robust value chains have a higher likelihood of success and sustainability. Hamilton's network provides an opportunity to create a relatively seamless value chain from scientific discovery to commercialization to distribution, supporting overall ecosystem growth.

Targeted Entrepreneurship and Commercialization Programs and Resources

Between MILO, MIP, Innovation Factory, and Bay Area Health Trust, The Forge (among others), start -ups located in the city are provided with critical supports to help establish and grow their companies. These programs have often served as a critical lifeline for new entrepreneurs starting their commercialization journey. For more information on these organizations, refer to Appendix B.

Academics and researchers looking to develop their innovative ideas often do not have the business background or acumen required to start and grow a company successfully. The programs help

bridge that gap by providing the necessary know-how and practical guidance – from how to create a business plan, to creating a pitch-book for potential investors.

Collaborative & Supportive Ecosystem

Collaboration and support across Hamilton's life sciences ecosystem was raised by stakeholders as a key differentiator and a unique strength. While some challenges were raised (including siloes between certain organizations), stakeholders noted the invaluable support they received from key stakeholders, support organizations, including Synapse.

With the presence of an emerging number of start-ups, a collaborative and supportive ecosystem is critical for the success of many of these companies. The collaboration included partnerships between industry and academia, and research organizations. Stakeholders highlighted the ability to tap into the support network and access to key officials who could respond or direct their queries to the appropriate places.

Established Life Sciences Infrastructure

With research-intensive organizations present throughout the city, opportunities exist for Hamilton to increase its physical life sciences infrastructure capacity (albeit some challenges exist). Spaces such as MIP are dedicated to growing life sciences companies which spurs interest and investment. MIP owns over 35 acres of developable land with direct highway access and visibility, where ongoing development projects will eventually provide in the future, 2.5 million square feet of commercial laboratory and office space across 11 buildings.[81] MIP is further developing infrastructure in support of sector growth with a focus on companies who have moved beyond the incubation phase.

[81] (Invest in Hamilton, MIP Brochure, 2020)

04

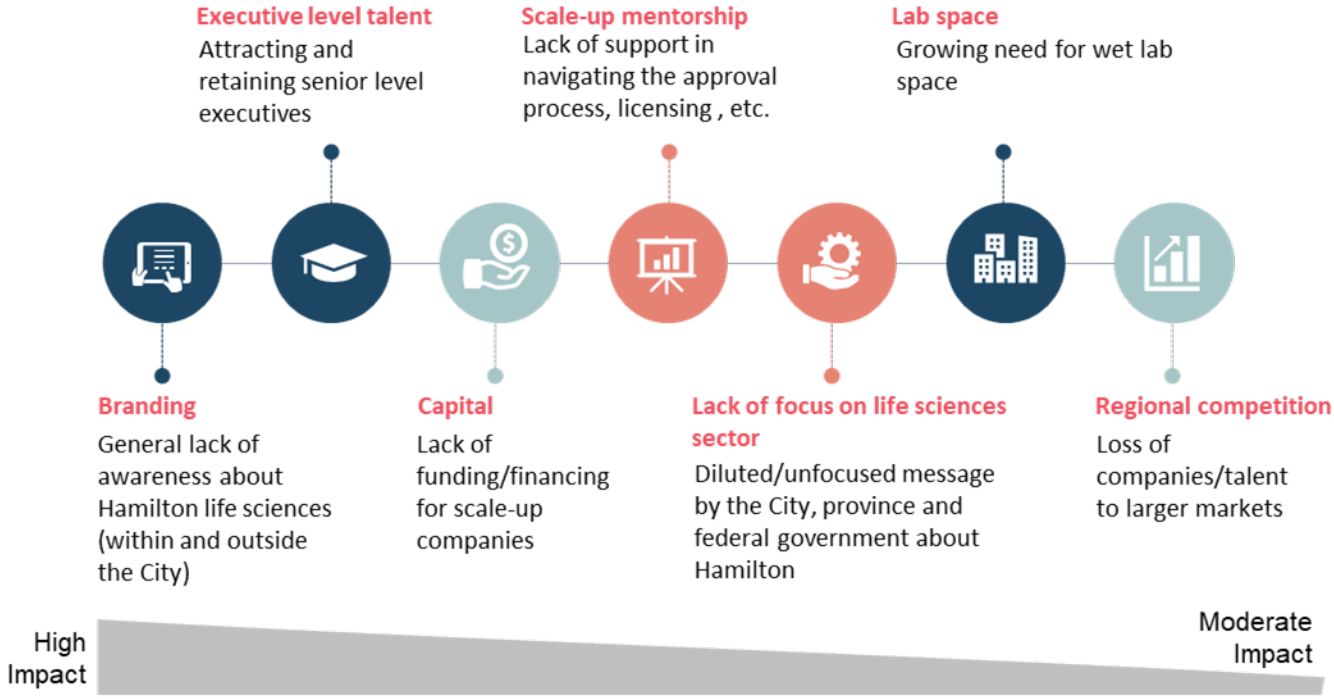
Key Challenges and Opportunities

Key Challenges Need to be Addressed to Enable Sector Growth

Growing Hamilton's life sciences sector requires mitigating local challenges and roadblocks. While generally well positioned for growth, the analysis revealed several key challenges companies face (particularly scale-ups) within the ecosystem and roadblocks limiting investment attraction. Challenges with a high degree of impact are defined as those as the greatest impediment to sector growth.

The key challenges identified through stakeholder discussions and analysis limiting accelerated sector growth include:

Figure 6: Key Challenges Facing Hamilton's Life Sciences Sector



Strengthening Hamilton's life sciences brand

Stakeholders highlighted a general lack of awareness about Hamilton's life sciences sector (within and outside the city). This includes a lack of knowledge about key assets, opportunities for growth and recent wins across the sector. While McMaster University is well known across the region, other assets or recent wins tend to fall under the radar for anyone not directly involved in Hamilton's life sciences sector. This is in part attributed to the persistent association of Hamilton as a 'steel town', and not a city with a growing life sciences sector.

The lack of awareness about Hamilton's life sciences further extends to outside of Canada. Start-up and scale-up companies noted that investors in the United States were unfamiliar with Hamilton, let alone the opportunities that exist within the life sciences sector. This lack of familiarity with the jurisdiction extends beyond the US to global investors who are often unaware of where Hamilton, or even Toronto, is located.

Attracting executive level talent

While Hamilton was observed to have a strong supply of life sciences talent, gaps were identified in the availability of executives and individuals with 5-8 years of experience. This includes individuals with a successful track record and skillsets required to grow start-ups into multi-million-dollar corporations. As companies look to scale-up, experience and executive skillsets are critical to help companies reach the next stage. Hamilton has exceled at attracting top tier talent within the STEM categories and needs to apply the same focus on creating a business environment conducive to attracting future business executives. A challenge for the city will be to create the number of executive level opportunities for business leaders. Challenges surrounding the attraction of executive-level talent were in part attributed to the perceived lack of opportunities across the sector. Should the initial employment opportunity not pan out in the short-term the individual may be needed to once again relocate to another jurisdiction.

Individuals with specialized skills in navigating the regulatory approvals process for life sciences products was also identified as a gap. With a growing number of start-ups in the city, the ability to successfully commercialize life sciences products and gain federal approvals is paramount.

Increasing access to capital

Entrepreneurs identified access to scale-up capital as a primary barrier to growth for start-ups. While not unique to jurisdictions across Canada, start-ups pointed to challenges in accessing capital within the city and Canada more broadly. Entrepreneurs across the city perceived Canadian investors to be more risk averse in their valuations of new companies and innovative products, impeding the ability of Canadian start-ups to raise the required investment for growth. Combined with lower amounts of capital available across the country, starts-ups oftentimes look to the US

when raising capital. This challenge is further compounded by US investors' lack of awareness regarding life sciences opportunities across Hamilton.

Addressing the scale-up mentorship gap

As noted by stakeholders, Hamilton lacks a robust pool of mentors with entrepreneurial expertise in the life sciences sector. This gap is largely the result of a growing ecosystem that has yet to reach a critical mass of successful scale-up companies.

A specific set of skills are needed along each step of the growth journey – from start-up, to successful scale-up. To compensate for a lack of experience, entrepreneurs often look to mentors to help them along the commercialization journey and beyond. With longer product development and licensing timelines in the life sciences sector, knowledgeable mentors that provide meaningful guidance in navigating the process can be the difference between success and failure.

Increasing focus on life sciences sector

Stakeholders noted limited showcasing of the life sciences sector from elected officials at all levels of government when profiling Hamilton. While a few recent wins and success stories (including the recent IPO of Fusion Pharmaceuticals) were identified, Hamilton continues to be closely linked to its industrial history despite life sciences organizations collectively constituting the largest employers in the city.

While the city has been working on profiling the life sciences sector– including through partnerships with Invest in Canada – opportunities exist to further profile the sector. This includes the opportunity to focus efforts on promoting the life sciences sector to key government officials within the provincial and federal governments. When making investment decisions, investors will oftentimes begin their selection process by considering a country, region and ultimately a city. Federal and provincial officials are most commonly the first point of contact for investors. They are then responsible for connecting the investor to municipal relationships to further carry out the deal. If Hamilton is not closely associated with opportunities in life sciences, the city is not likely to be top of mind for government officials who are likely to defer to other cities in their considerations.

Improving access to wet lab space

Through stakeholder discussions, the availability of infrastructure, particularly access to wet lab space was noted. While advancements are being made in artificial intelligence and virtual reality which could help address some of these challenges by providing new methods to test innovative research, in the short and near-term these barriers to access key infrastructure assets present a roadblock to innovation and commercialization.

While an opportunity exists for the private sector to help fill in life science asset infrastructure gaps, inefficiencies within the city's development process were highlighted. Unique requirements associated with the development of life sciences assets, such as regulations surrounding laboratories, lead to additional barriers in approvals. Additionally, there are several barriers that impact the development of business cases for the private sector to undertake the construction, operations, and maintenance of wet labs. This includes uncertainties related to the nature of testing (and the possibility of only having one client); lack of understanding from the public sector about the 'true' cost per-test, and barriers related to turnaround time and logistics.

Mitigating regional competition

While Hamilton's geographic location presents opportunities for growth, including access to larger markets, it also presents challenges. Hamilton is located within the innovation corridor, neighboring Mississauga's 'pill hill' (pharmaceutical companies located in the Mississauga), and Canada's largest city, Toronto. The city faces competition from larger and more well-known cities, all within a 75km radius.

As Hamilton looks to grow its life sciences sector, it needs to distinguish itself against its regional peers to attract investment, while retaining scaling-up companies considering relocation to the neighboring larger market in Toronto.

If addressed, each challenge presents an opportunity to grow an aspect of Hamilton's life sciences ecosystem and bring greater awareness for investment opportunities. For example, addressing brand challenges and increasing awareness about Hamilton's life sciences sector with government officials at the Provincial and Federal levels enables increased opportunities from international investors to be passed along to the city, instead of neighboring jurisdictions. Strategic opportunities and related actions aimed at addressing these challenges and roadblocks are further discussed in section 6 of this document.

05

Hamilton's Life Sciences Value Proposition

Hamilton's Life Sciences Value Proposition

The international investment attraction landscape is fiercely competitive. Cities have a small window of opportunity to capture and keep investor attention. To effectively attract investors, Hamilton will need to have a compelling value proposition that is in-line with market needs and opportunities for growth within the city's key subsectors in life sciences.

A value proposition is a statement that summarizes a promise of value to be delivered to potential customers, users, or investors. The objective of a value proposition is to convey an organization's or jurisdiction's competitive advantage quickly and clearly.

Effective value propositions are:

- Relevant – demonstrating the benefit or need the organization or jurisdiction is addressing.
- Clear – articulating key messaging in a manner that is easy to understand.
- Distinct – highlighting what sets the organization or jurisdiction apart from its competitors.
- Succinct – conveying key messaging quickly to the potential customer or user.

An effective value proposition will help attract investment into Hamilton by highlighting specific opportunities for investors. It will deliver a compelling message about 'what makes Hamilton special'. Insights were leveraged from the sector strategy as well as feedback from the city and key partners to develop Hamilton's life sciences value proposition. Underneath the value proposition, Hamilton has facts and information to support efforts to attract investment and accelerate growth in the life sciences sector.

Figure 7: Hamilton's Life Sciences Value Proposition

Hamilton: Canada's Emerging Leader in Life Sciences Research and Commercialization

Hamilton has a long history of excellence in life sciences research and innovation and today, we're putting that research and innovation to work.

- Through strong collaboration with McMaster University (Canada's most research-intensive university), and world-class academic partners, Hamilton's emerging companies are turning their innovative life sciences ideas and designs into treatment realities.
- Hamilton is leading the way in nuclear medicine, digital health, infectious disease R&D, biomanufacturing and medical devices.
- Entrepreneurs, and growing companies alike are benefiting from the expanding 2.5 million square foot McMaster Innovation Park, and leading clinical trials.

Growing your investment in life sciences? – Hamilton is the place to be.

06

Opportunities for Growth, Investment and Jobs in Life Sciences

Opportunities for Growth, Investment and Jobs in Life Sciences

Based on the state of Hamilton's current life sciences ecosystem, including the local, national and international landscape, focus is required on areas which present the greatest opportunities for growth. The opportunity below outlines the three strategic priority areas Hamilton needs to focus on to enable sustained sector growth and investment attraction. Each strategic priority area seeks to address one of the key challenges outlined previously in this strategy. The strategic priority areas are supported by a small number of associated actions to be undertaken by the city, in partnership with key stakeholders and champions.

To enable successful sector growth, the city will need to:

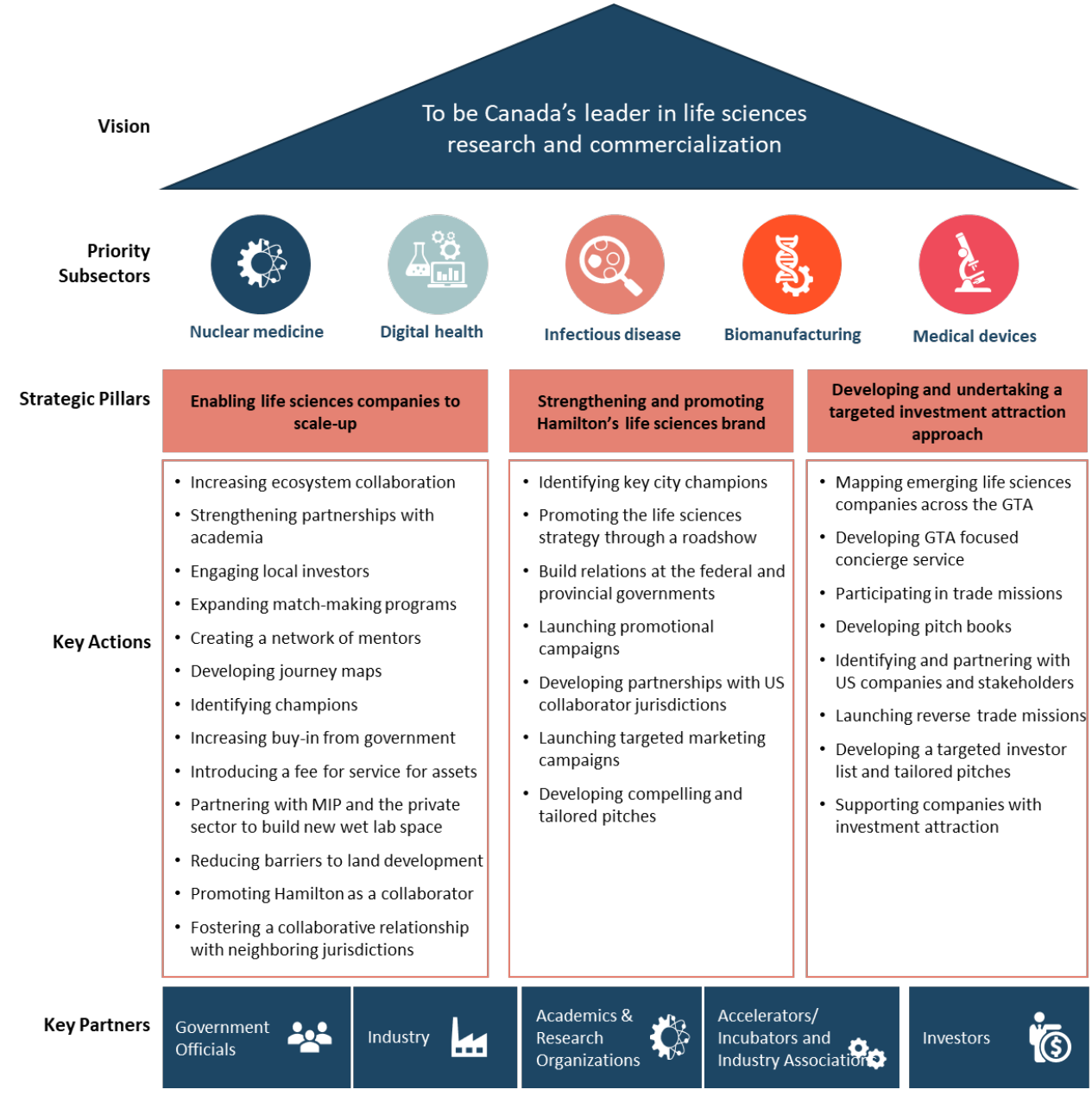
- Address local roadblocks limiting company expansion (i.e., scaling-up) and overall ecosystem growth;
- Introduce strong and focused branding / marketing initiatives; and
- Engage in targeted investment attraction efforts

In order to achieve success, the strategy will need to be assessed on a short, medium- and long-term time horizon.

Strategy for growing Hamilton's life sciences sector

As outlined previously, growing Hamilton's life sciences sector will require a focus on the key elements outlined in the below graphic.

Figure 8: Summary of Hamilton's Life Sciences Strategy



Enabling life sciences companies to scale-up.

Hamilton has several long-standing life sciences academic and research hospitals (such as McMaster University), which are key differentiators for the city. Between 2016 to 2021, there were 43 new life science companies established in in the city. In some respects, the life sciences industry in Hamilton is reaching a critical mass for sustainable growth. A core focus of Hamilton's life sciences sector strategy needs to be centered around capitalizing on the emergence of these scale-ups.

Through consultations, local entrepreneurs noted their desire to stay in Hamilton. This was partially associated with the collaborative environment and quality of life. However, their biggest pull to other jurisdictions was the increased ability to grow in larger markets with more life sciences sector supports, such as access and availability of mentors.

Competition for large-scale anchor companies looking to relocate is incredibly fierce within the global marketplace. Between grants, loans, rebates, and 'white glove' investment concierge services, countries utilize all the tools at their disposal to attract multi-national enterprises. Helping local companies expand provides an opportunity for Hamilton to bridge the gap with anchor companies. To do so, the city will need to work with key stakeholders in and around the city to address the key roadblocks currently limiting company expansion.

Table 1: Strategic Opportunities and Actions for Enabling Hamilton Life Sciences Companies to Scale-up

Roadblocks	Strategic opportunities	Actions
Skills	Attracting experienced life sciences talent requires: (i) The availability of multiple employment opportunities within a region. (ii) Competitive compensation and a high quality of life.	• **Increase collaboration** (including information sharing sessions) with accelerators/incubators focused on life sciences across Canada's innovation corridor to promote flow of employment opportunities to potential talent. • **Strengthen partnerships with academia** (including employment liaison officers, researchers with recently obtained large-scale grants) to promote opportunities to recent graduates, mid-level talent and address the mentorship gap within key subsectors.
Capital	Matching companies with potential investors and promoting life sciences opportunities to those outside the region/sector.	• **Explore opportunities to engage local investors** not currently focused on the sector by assessing the broader investor landscape in Hamilton and potential interest in life sciences. • **Expand match-making programs** that are focused on targeted events (e.g., investor 'speed dating'), supported by a robust online platform.
Scale-up mentorship	Leverage virtual platforms to connect Hamilton scale-ups with mentors from across Ontario/Canada to help navigate the regulatory and approvals process, and fill gaps of available Hamilton mentors.	• **Create a network of regional mentors** specifically focused on the regulatory / approvals / licensing process. • **Develop journey maps of the current scale-up process** to identify key pain points and gaps within existing support networks.

Roadblocks	Strategic opportunities	Actions
Stakeholder commitment	Provide key stakeholders – including champions across municipal, provincial, and federal governments – with the same compelling message about opportunities in Hamilton.	• **Identify champions within key stakeholder** groups and arm them with compelling messaging and up-to-date information about wins/opportunities. • **Increase buy-in from government leaders** by promoting Hamilton's value proposition/role as the region's emerging life sciences ecosystem.
Infrastructure	Introduce innovative partnerships (i.e. ad hoc access during off-peak times) between industry/academia/research organizations to bridge the gap of available infrastructure (e.g. wet labs).	• Facilitate the **introduction of a fee for service model** for the usage for underutilized research/academic assets to increase lab space for start – up/ scale ups or generate small amounts of revenue (e.g. Redeemer's labs during the summer months). • **Partner with MIP and the private sector to build new wet lab space** across the city. • **Streamline/reduce barriers** (such as approval timelines and complexity associated with navigating the approvals process) **to the land development** approvals process.
Regional collaboration (instead of competition)	Focus on subsectors and key assets where Hamilton has a distinct value proposition within Canada's innovation corridor. Foster a regional life sciences corridor where each member has a clear role to play and drive strategic collaboration.	• **Promote areas where Hamilton is collaborator** and not a competitor in the innovation corridor – including areas where Hamilton has a distinct advantage in the life sciences value chain (e.g. distribution networks, repurposing manufacturing and chemical processing talent, etc.). • Continue to foster a **collaborative relationship with neighboring jurisdictions** interested in broader regional growth, by highlighting Hamilton's value proposition in the subsectors identified in this strategy.

Strengthening and promoting Hamilton's life sciences brand

The most common roadblock identified by stakeholders is the lack of awareness about the City of Hamilton. This includes an awareness about Hamilton's life sciences sector and as the city as a whole. Within Canada, Hamilton continues to be predominantly associated with its history as a 'steel town'. Those in and around the city are also not often aware of the success and opportunities of the life sciences sector. Outside of Canada, investors are often not familiar with Hamilton or even Southern Ontario.

To successfully attract national and international investment, investors need to be aware of and intrigued by what Hamilton offers. First and foremost, Hamilton's life sciences sector needs to be associated with a strong brand. Pittsburgh for example, has marketed itself as a top US life sciences hub and is often top of mind when thinking of leading sector jurisdictions. Closer to home – although its ecosystem is changing with manufacturers leaving the city, Mississauga has become synonymous with 'pill hill' – a cluster of pharmaceutical and other life sciences companies in Ontario. Hamilton will similarly need to draw on its value proposition of being an ecosystem where a strong history and presence of research is supporting an emergence of innovative companies to build a compelling brand (for further details of Hamilton's life sciences ecosystem, refer to Appendix B). This brand will need to capture and keep investor attention and help local companies get in the door as they look to pitch their products and/or services to investors.

While led by the city, marketing efforts will need to be supported by key champions. For the purposes of the strategy, champions are individuals within and outside of the city committed to promoting Hamilton life sciences and supporting sector growth. Champions should be identified within each stakeholder group – including academia, industry (both established companies and scale-ups), support organizations, and leaders across all levels of government. These champions will help raise the profile to key decision-makers and help ensure the city is top-of-mind when potential opportunities arise. Marketing the life sciences sector will need to be done within the city to ensure all stakeholders support a unified message; across the country to increase national investment opportunities and ensure Hamilton is top-of-mind for Provincial and Federal connectors; in the US as the country continues to be the largest market for Canadian firms; and globally to ensure Hamilton captures on emerging international opportunities. Promoting Hamilton across all of these jurisdictions should be done simultaneously as different champions and campaigns will be required for each group.

Finally, a compelling message should be developed to support each effort. For example, this includes drawing on specific strengths within the subsector of interest, and profiling Hamilton's cost competitiveness for the operating costs which align with the investor's business needs (e.g. facilities costs for biomanufacturing companies). Paramount will be an effective value proposition that highlights opportunities across Hamilton's key subsectors in life sciences.

Table 2: Strategic Opportunities and Actions for Strengthening and Promoting Hamilton's Life Sciences Brand

Roadblocks	Strategic opportunities	Sample actions
Within Hamilton	Build awareness amongst sector champions of Hamilton's life sciences value proposition/brand to effectively promote the city. Accelerate the transition of Hamilton as only being a 'steel town' to a city that is also a 'life sciences hub' to neighboring jurisdictions, and provincial and federal officials.	• **Identify champions** across key stakeholder groups that promote the city's value proposition and key assets. • **Promote the life sciences sector strategy through a roadshow** (which both the value proposition and life sciences brand) across the city.
Across Canada	Promote Hamilton life sciences to government entities federally (e.g. Invest in Canada); and provincially (e.g. Invest Ontario) who are often the first point of contact for international investors.	• **Host a 'Queen's Park' day** with key provincial officials to raise awareness about Hamilton life sciences. • **Host a 'Day on the Hill'** to build awareness of Hamilton's strengths at a federal level, and build Tri-Council awareness of the expertise of Hamilton's post-secondary sector • Identify a **federal champion** who is kept up-to-speed about key wins and opportunities (e.g., high-ranking local MP's such as cabinet ministers).
In the US	Market not only life sciences, but Hamilton as a whole to US investors to raise both city and sector awareness.	• **Launch promotional campaigns** targeted at investors in emerging US life sciences hubs which highlight Hamilton's competitiveness, directly and through participation in trade missions to the US. • Develop **partnerships with emerging US collaborator jurisdictions** (such as Buffalo, Minneapolis, Houston, etc.) within each subsector.

Globally	Focus on targeted outreach (centered around the subsectors) to investors aligned with the city's distinct value proposition.	• Launch a **targeted marketing campaign** such as trade missions and/or key subsector conferences/events. • Develop **compelling and tailored pitches** for each potential investor.

Developing and undertaking a targeted investment attraction approach.

Throughout each step of the process, Hamilton will need to have a tailored approach that builds on the city's value proposition. A 'one-size-fits all' approach is unlikely to garner successful results. As a first step, Hamilton will need to identify which entities are aligned with its value proposition and operate within the city's key subsectors in life sciences. This will help ensure a targeted approach that will increase the chances of successful investment attraction.

Based on this analysis, the city will focus on three primary target groups (including GTA enterprises, US enterprises, and international investors interested in opportunities in Hamilton's subsectors). With increasing real estate costs (both in terms of housing and business space) around the Greater Toronto Area (GTA), an opportunity exists for Hamilton to attract growing companies looking for more affordable options. While Hamilton's costs are increasing, the city continues to be more affordable compared to its peers – with average office space in Hamilton costing an average of CAD $6.48 per square foot (compared to an average of CAD $9.06 per square foot for Toronto). Additionally, average labour costs in Research and Development for the city of Hamilton are CAD $139,655 versus the city of Toronto at CAD $149,905. [82] Entrepreneurs across the GTA often note their desire to stay within area. Hamilton presents an opportunity for these entrepreneurs to do so if they are considering relocation or expansion.

The United States represents approximately 47% of Canada's overall FDI stock. US investors continue to be the primary focus for most life sciences companies and cities considering a foreign investment. The city should continue to prioritize US investors in its attraction efforts. To do so effectively, a targeted approach will be vital, including compelling messaging which distinguishes Hamilton from Canadian and US cities (for more information on Hamilton's competitiveness, please refer to Appendix C). Targeted approaches include tailored messaging and can involve business development initiatives with the potential investor. As shown through the KPMG City Competitiveness Index analysis, Hamilton ranks in the top two for all but one cost factor. As cost factors continue to be one of, if not the primary decision factor for investors, this point will need to be highlighted in any pitch or presentation to US investors. Combined with quality of life benefits and the city's assets (including McMaster Innovation Park), Hamilton has a compelling story to tell.

As with all outreach, global efforts will need to begin with identifying potential investors within the city's key subsectors. Life sciences is a diverse sector comprised of research, manufacturing, technology, etc. Each subsector has a unique set of requirements and opportunities. Focusing on specific benefits available within each subsectors will help the city deliver a message aligned with the specific strategy, needs, interests, and expertise of the potential investor.

[82] (KPMG, 2021).

Table 3: Strategic Opportunities and Actions for Developing and Undertaking a Targeted Investment Attraction Approach

Roadblocks	Strategic opportunities	Actions
GTHA enterprises and other national entities considering investment (e.g. expansion) to Hamilton.	Target growing/expanding companies within the GTA. This includes local start-up/scale-ups wanting to stay in the region that may be facing challenges due to increasing costs in the GTA.	– **Map all emerging life sciences companies** across the GTA within the nuclear medicine, digital health, infectious diseases, biomanufacturing, and medical devices subsectors. – Develop **GTA-focused concierge services** which offers relocation support (including finding office/research space assistance, connections with support organizations, etc.) for companies interested in relocating.
US enterprises considering investment (e.g. expansion) to Hamilton.	Focus on Hamilton's cost competitiveness (relative to peer US cities) when targeting US investors/companies.	– Participate in targeted federal and/or provincial **trade missions** related to life sciences. – Develop **pitch books highlighting Hamilton's cost competitiveness** against US peers. – **Identify and partner with US companies/stakeholders focused on Hamilton's key subsectors** with existing relationships with Hamilton entities to develop the city's distribution channels, value chain and access to US markets.
International investors interested in opportunities in Hamilton's subsectors.	Focus international efforts on companies operating within Hamilton's life sciences subsectors to ensure the city stands out against peer jurisdictions. Efforts need to be targeted and tailored to each pitch.	– Launch **reverse trade missions** for companies operating within Hamilton (i.e., bringing key stakeholders from foreign jurisdictions to Hamilton). – Develop **targeted investors list/tailored pitches**. – **Support companies with investment attraction** bids by providing resources/information (e.g. data and information on operating costs within the city; municipal, provincial, and federal supports including available grants, etc.).

07

Implementation Roadmap

Moving from Strategy to Action Requires Prioritization

A sector strategy needs to be led by a single entity to ensure clarity and accountability. In this case, the lead is the City of Hamilton and associated entities such as Invest in Hamilton. While the city will need to rely on key stakeholders such as Synapse to help grow the sector and attract investment, the city is ultimately responsible for leading initiatives, taking action, and measuring results. Overall, it is important that all stakeholder groups work together to attain a common goal for sector growth. Fragmentation or a lack of collaboration among key stakeholders can result in efficiency-loss and lost investment opportunities as potential investors seek to invest in a market where a comprehensive suite of services or supports are easily accessible.

The tables below provide a high-level implementation roadmap to support the city, as well as key stakeholders from the Synapse consortium (MIP, Innovation Factory, HHS, St. Joseph's Healhcare Hamilton, The Research Institute of St. Joe's Hamilton, McMaster University, Mohawk College, Bay Area Health Trust), in the execution of Hamilton's life sciences sector strategy. The roadmap identifies each of the strategies and actions outlined in the previous section aimed at growing Hamilton's life sciences sector. The roadmap showcases areas that require the city's leadership/support, Synapse's leadership/support, and additional stakeholder (or group) involvement.

The groups listed include the key stakeholders mentioned earlier in the strategy. To support successful execution, the city or Synapse will need to be responsible for leading or supporting each action. Leads are responsible for spearheading the action, are responsible for its success, and coordinate the different groups that are involved. While supporting entities assist in executing each action, they are however not decision makers and do not hold the same level of accountability as a lead. Connectors are focused on bringing together different entities, assets, information, etc.

The actions are associated with a time-horizon that details whether the action will require a short-term commitment (less than six months), a medium-term commitment (six to 24 months), or a long-term commitment (more than two years). Each action is also assigned a priority level (high or low). Following the initial time-horizon, the associated lead should then reevaluate to determine a path forward. The level of priority is determined by the potential impact that the activity has in facilitating growth and attracting investor attention.

Relevant groups that are identified for involvement in the include:

Academia & Research Hospitals

Including universities, colleges, training programs, and research organizations that are focused on life sciences. In Hamilton, these include McMaster University, Mohawk College, Redeemer University, Hamilton Health Sciences (HHS), St. Joseph's Healthcare Hamilton (SJHH), and The Research Institute of St. Joe's Hamilton.

Industry

Includes both established organizations such as medical device and equipment manufacturers, Stryker, and start-up/scale-up companies.

Government

Including all three levels of government (Government of Ontario, Government of Canada, and the City of Hamilton).

Potential investors

Including angel investors, private equity funds, and venture capitalists that provide companies with initial and ongoing financial means to invest in research, development, clinical trials, marketing, and commercialization.

Support organizations

Including the Synapse Consortium, accelerators (Innovation Factory Hamilton Technology Centre, etc.), economic development agencies (Invest Ontario, Invest in Hamilton), and other organizations (Ontario Bioscience Innovation Organization, Hamilton Chamber of Commerce, etc.) that support Hamilton's life sciences sector.

Table 4: Hamilton Life Sciences Strategy Implementation Roadmap

Roadblock	Action	City of Hamilton role	Synapse role	Groups Involved	<6 months	6-24 months	>24 months	Priority
Strategic Initiatives: Hamilton company expansion (i.e. scaling up) and overall ecosystem growth								
Skills	**Increase collaboration** (including information sharing sessions) with accelerators / incubators focused on life sciences across Canada's innovation corridor to promote flow of employment opportunities to potential talent.	Connector	Lead	Industry, Academia, Government				Medium
	Strengthen partnerships with academia (including employment liaison officers, researchers with recently obtained large-scale grants) to promote opportunities to recent graduates and mid-level talent within key subsectors.	Support	Lead	Academia, Support Organizations				Medium
Capital	**Explore opportunities to engage local investors** not currently focused on the sector by assessing the broader investor landscape in Hamilton and potential interest in life sciences.	Lead	Support	Industry, Academia				High

Roadblock	Action	City of Hamilton role	Synapse role	Groups Involved	<6 months	6-24 months	>24 months	Priority
	Expand match-making programs that are focused on targeted events (e.g. investor 'speed dating'), supported by a robust online platform.	Lead	Connector	Industry, Potential Investors				Medium
Scale-up Mentorship	**Create a network of regional mentors** specifically focused on the regulatory / approvals / licensing process.	Connector	Lead	Support Organizations, Industry				Medium
	Develop journey maps of the current scale-up process to identify key pain points and gaps within existing support networks.	Support	Lead	Support Organizations				High
Stakeholder Commitment	**Identify champions** within key stakeholder groups and arm them with compelling messaging and up-to-date information about wins / opportunities.	Lead	Support	Support Organizations, Government, Industry, Academia, Potential Investors				High
	Increase buy-in from government leaders by promoting Hamilton's value proposition / role as the region's emerging life sciences ecosystem.	Lead	Support	Government				High

Roadblock	Action	City of Hamilton role	Synapse role	Groups Involved	<6 months	6-24 months	>24 months	Priority
Infrastructure	Facilitate the **introduction of a fee for service model** for the usage for underutilized research/academic assets to increase lab space for start – up/ scale ups or generate small amounts of revenue (e.g. Redeemer's labs during the summer months).	Lead	Connector	Academia, Industry (specifically start-ups/scale-ups)				Medium
	Partner with MIP and the private sector to build new wet lab space across the city.	Lead	Support	Industry, Provincial Government, Federal Government				Medium
	Streamline / reduce barriers (such as approval timelines and complexity associated with navigating the approvals process) **to the land development** approvals process.	Lead	Connector	Industry				Medium
Regional competition (instead of collaboration)	**Promote areas where Hamilton is collaborator** and not a competitor in the innovation corridor – including areas where Hamilton has a distinct advantage in the life sciences value chain (e.g. distribution networks, etc.).	Lead	Support	Municipalities and economic development agencies across Southern Ontario				Medium

Roadblock	Action	City of Hamilton role	Synapse role	Groups Involved	<6 months	6-24 months	>24 months	Priority
	Continue to foster a **collaborative relationship with neighboring jurisdictions** interested in broader regional growth, by highlighting Hamilton's value proposition in the subsectors identified in this strategy.	Lead	Support	Municipalities and economic development agencies across Southern Ontario				Medium
Branding and Marketing Efforts								
Within Hamilton	**Identify champions** across key stakeholder groups that promote the city's value proposition and key assets.	Lead	Support	All				High
	Promote the life sciences sector strategy through a roadshow (which both the value proposition and life sciences brand) across the city.	Lead	Support	Industry, Support Organizations				High
Across Canada	**Host 'Queen's Park' information day** with key provincial officials to raise awareness about Hamilton life sciences.	Lead	Connector	Industry, Provincial Government				High
	Host a 'Day on the Hill' to build awareness of Hamilton's strengths at a federal level.	Lead	Connector	Industry, Federal Government				High

Roadblock	Action	City of Hamilton role	Synapse role	Groups Involved	<6 months	6-24 months	>24 months	Priority
	Identify a federal champion who is kept up-to-speed about key wins and opportunities (e.g., high-ranking local MP's such as cabinet ministers).	Lead	Support	Federal Government				High
In the US	**Launch promotional campaigns** targeted at investors in emerging US life sciences hubs which highlight Hamilton's competitiveness, directly and through participation in trade missions to the US.	Lead	Support	Industry				High
	Develop **partnerships with emerging US collaborator jurisdictions** (such as Buffalo, Minneapolis, Houston, etc.) within each subsector.	Lead	Support	Industry, Academia and Research Organizations				Medium
Globally	Launch a **targeted marketing campaign** such as trade missions and/or key subsector conferences / events.	Lead	Support	Industry				Medium
	Develop compelling and **tailored pitches** for each potential investor.	Lead	Support	Industry				High

Roadblock	Action	City of Hamilton role	Synapse role	Groups Involved	<6 months	6-24 months	>24 months	Priority
				Targeted Investment Attraction Efforts				
GTA enterprises and other national entities considering investment (e.g. expansion) to Hamilton.	**Map all emerging life sciences companies** across the GTA within the nuclear medicine, digital health, infectious diseases, biomanufacturing, and medical devises subsectors.	Lead	Support	Support Organizations				High
	Develop **GTA-focused concierge services** which offers relocation support (including assistance in finding office / research space, connections with key support organizations, etc.) for companies interested in relocating to facilitate re-location / expansion efforts.	Lead	Support	Invest in Hamilton, Invest in Ontario				Medium
US enterprises considering investment (e.g. expansion) to Hamilton.	Participate in targeted federal and/or provincial **trade missions** related to life sciences.	Lead	Support	Invest in Hamilton				Medium
	Develop **pitch books highlighting Hamilton's cost competitiveness** against US peers.	Lead	Support	Invest in Hamilton				High

Roadblock	Action	City of Hamilton role	Synapse role	Groups Involved	<6 months	6-24 months	>24 months	Priority
	Identify and partner with US companies / stakeholders focused on Hamilton's key subsectors with existing relationships with Hamilton entities to help develop the city's distribution channels, value chain and access to US markets.	Lead	Support	Industry, Academia and Research Organizations				Medium
International investors interested in opportunities in Hamilton's subsectors.	Launch **reverse trade missions** for companies operating within Hamilton's subsectors.	Lead	Support	Industry, Academia and Research Organizations				Medium
	Develop a **targeted investor list and tailored pitches**.	Lead	Support	Industry				High
	Support companies with investment attraction or expansion bids by providing resources / information (e.g. data and information related to operating costs within the city; municipal, provincial, and federal supports including available grants, etc.).	Lead	Support	Industry				High

Undertaking the above activities will position Hamilton's life sciences ecosystem for future growth and increased investment attraction. The city, with its partners, will play an important role in developing specific action plans within each of the areas to drive collaboration, growth, investment, and jobs in Hamilton's life sciences sector.

08

Key Performance Indicators

Key Performance Indicators Will Determine Success and the Path Forward

To support the city in measuring the success of the life sciences strategy, a total of 11 key performance indicators (KPIs) relevant to Hamilton's life science sector have been identified. These indicators are intended to monitor local sector performance. Their objective is to provide the city with an evidence-based look into areas of strength and gaps that may require higher intervention levels to remedy.

Outlined below, the performance indicators focus on private-sector companies (e.g., number of companies, revenue generated, investment, etc.), innovation (e.g., R&D spending, number of patents created), life sciences facility space (e.g., lab, research, office and manufacturing space) and talent (e.g., number of jobs, number of students). The below table also outlines how each indicator can be measured (e.g. if it is to be measured year over year (Y/Y)), the source of information and data to support the assessment, and its relevance to the life science sector. Each indicator should be measured to help provide a look at the entire ecosystem.

Table 5: Hamilton Life Sciences Key Performance Indicators

Performance Indicator	Attribute Measured	Source of Information	Source of Data
Total revenue from local entities in the Hamilton life sciences ecosystem.	Economic activity	Survey	Synapse annual survey
Venture capital investment in Hamilton's life sciences sector (book value).	Funding / financing	Survey	Synapse annual survey
Number of life sciences companies with a physical presence in the Greater Hamilton Area.	Industry presence / growth (Y/Y)	Survey / company lists maintained by Synapse and Invest in Hamilton	Synapse annual survey
Life sciences facility space in square feet.	Infrastructure	Government	City of Hamilton / Invest in Hamilton / Synapse annual survey
Annual investment (capex, opex, payroll) by Hamilton life sciences sector organization companies ($).	Investment	Government	City of Hamilton / Invest in Hamilton / Synapse annual survey
Number of Hamilton full-time employees employed by international companies operating in the sector (Y/Y).	Labour / talent	Survey	City of Hamilton / Invest in Hamilton, Synapse annual survey
Number of annual undergraduate / graduate / postgraduates in STEM at Hamilton Universities/Colleges.	Labour / talent	Academia	McMaster, Mohawk, Redeemer

Median income for life sciences jobs in Hamilton.	Labour / talent	Survey	Synapse annual survey
Number of life sciences jobs in Hamilton.	Labour / talent	Survey	Synapse annual survey
Number of patents created by Hamilton life sciences companies per calendar year as a result of research in Hamilton area.	R&D activity	Government / Academia	Patent-level / IP information from Government / McMaster / Mohawk
Total spending on R&D (% of operating budget) from life sciences organizations in Hamilton.	R&D activity	Survey	Synapse annual survey

Appendix A

Project Overview

Project Overview

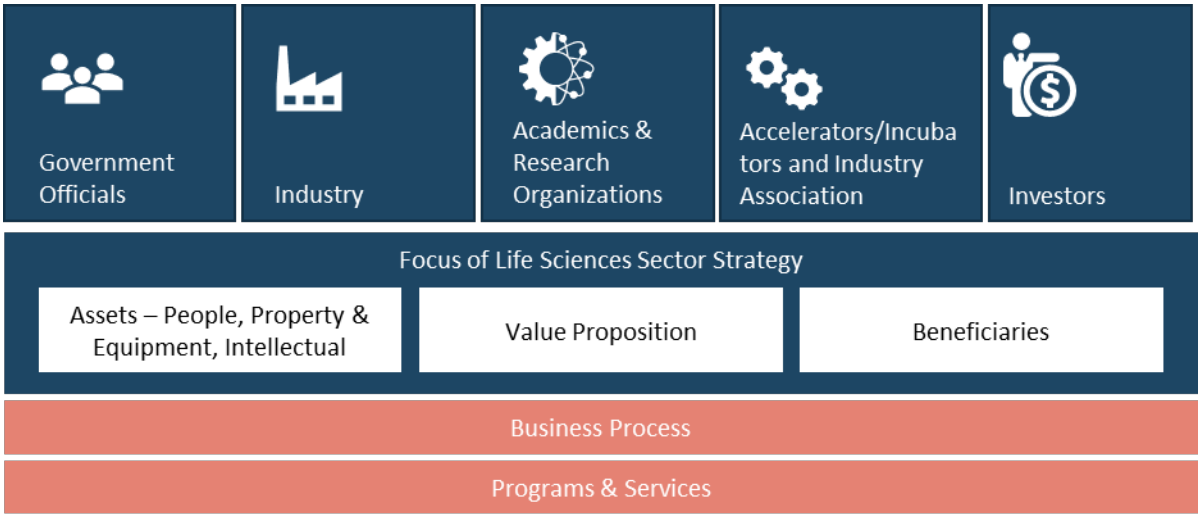
The City of Hamilton, in partnership with Synapse Life Sciences Consortium, engaged KPMG to support the development of a life sciences sector strategy. The goal of the strategy is to create a plan aimed at growing the sector and attracting investment to Hamilton.

A sector strategy is a call to action — a framework to outline the direction and priorities to achieve accelerated growth. It helps provide a framework for the sector's participants to link public investments with private sector expertise and innovation. Done right, it inspires further collaboration and alignment to attract domestic and international investment.

Successful sector strategies leverage key strengths and address roadblocks. This includes supporting and promoting subsectors with a competitive advantage that present current and future opportunities for growth. As the investment attraction landscape continues to become increasingly competitive, cities need to further develop value propositions that gain and retain investor attention. These value propositions need to be clear, distinct, succinct, and compelling. They need to effectively convey what makes the specific sector and Hamilton *unique*.

Ultimately, effective sector strategies mobilize the entire ecosystem in moving towards the same goal while delivering the same message — a message built on key assets and a strong value proposition.

Figure 10: Key Components of the Life Sciences Ecosystem



The sector strategy for Hamilton's life sciences sector was developed over three phases.

Phase 1: Current state assessment of Hamilton's life sciences sector – the assessment focused on describing strengths and challenges, identifying roadblocks, and uncovering competitive advantages. This phase also explored global trends.

Phase 2: Strategy development – this included potential opportunities to address key roadblocks and an implementation roadmap that outlines the short, medium, and long-term priorities for the city and key stakeholders across the ecosystem.

Phase 3: Final Strategy – this document outlines the key findings and strategies for sector growth.

Figure 11: Definition of Life Sciences

For the purposes of this strategy, life sciences include the fields of biotechnology, pharmaceuticals, biomedical technologies, healthcare technologies, biomedical devices, digital health technologies, biomanufacturing, and research products and services.

The findings of this strategy are a result of desktop research, engagement with KPMG subject matter experts ranging from KPI development to strategy development, and extensive consultations with key stakeholders across the Hamilton life sciences ecosystem. Representatives from across industry; academia and research organizations; accelerators/incubators and industry associations; all three levels of government; and funders/financers were engaged. To support assessment of Hamilton relative to comparative jurisdictions, the city used KPMG's City Competitiveness Index. The online tool compares cost factors most relevant for investors in cities across the world and provides insights related to competitiveness.

Appendix B

Hamilton's Life Sciences Sector Profile

Hamilton's Life Sciences Sector Profile

Hamilton's life sciences ecosystem has a strong foundation with:

- A robust R&D presence with more than 40 health research institutes and centres;
- World-renowned academic and research hospitals, with the number one most research-intensive university and the fourth most research-intensive college in the country;
- Skilled labour;
- Infrastructure; and
- Canada's second largest hospital network.

The ecosystem is supported by a growing industrial base comprised of for-profit entities, including an increasing number of life sciences start-ups.

Ontario is seventh in terms of life sciences employment and eighth in the number of life sciences establishments in North America.[83] In Hamilton, life science entities are the largest employer with more than 39,000 professionals working collaboratively across life science disciplines. [84] Overall, the local ecosystem contributes to Ontario's highly skilled, knowledge-based economy through continued research and educational efforts and a growing number of start-ups, small businesses, and established companies.

Hamilton's large infrastructure capacity supports successful product evaluations, diagnostic testing, and clinical trials. Laboratories are located at each acute care site across the city.[85] Significant clinical trial capabilities and a large population sample enable testing and evaluation of diversity of products, services, and technologies both in a laboratory and clinical setting. For instance, Population Health Research Institution (PHRI) — an award-winning joint institute of McMaster University and Hamilton Health Sciences — leads large-scale international clinical trials in cardiovascular disease, diabetes, kidney and lung disease, brain health and cancer. The clinical trials led by PHRI include 1.5 million participants across 102 countries.[86]

Through discussions, stakeholders continually emphasized Hamilton's reputation as a 'one stop shop for R&D'. The city's focus on research hospitals, clinical trials and applied research (e.g., testing, prototyping) provides the building blocks for life sciences activity, which helps enable commercial success. Meaningful collaboration further helps support innovation across industry, academic and research hospitals within the city.

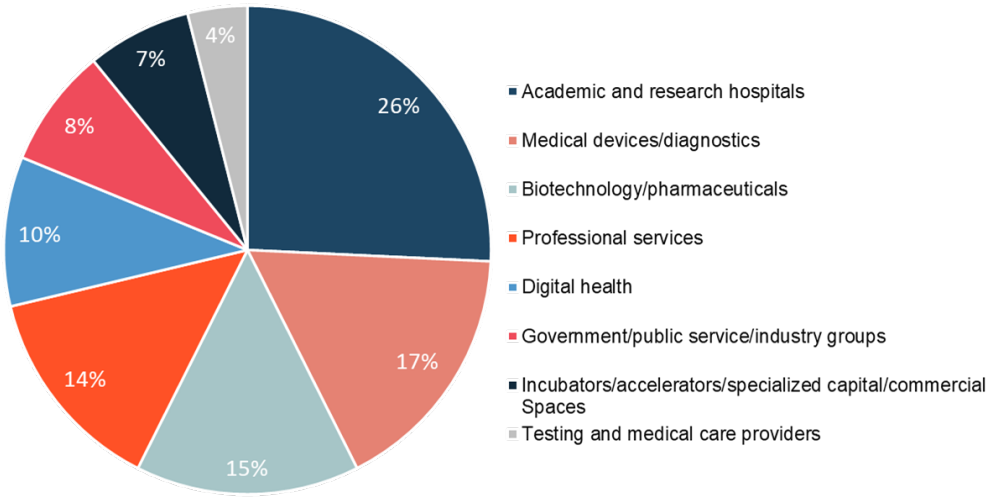
Industry Presence

Hamilton's life sciences ecosystem comprises over 150 organizations.[87] As presented in the chart below, these organizations most commonly focus on research, medical devices and diagnostics, and

[83] Synapse Survey
[84] (Invest In Hamilton, n.d.)
[85] (Hamilton Health Sciences, Hamilton Regional Laboratory Medicine Program, 2021)
[86] (PHRI, n.d.)
[87] Based on available Synapse survey data

biotechnology and pharmaceuticals. The ecosystem's composition presented in *Figure 11* is based on Synapse's annual survey which identifies the profiles individual entities that are supporting and fueling Hamilton's life sciences ecosystem.

Figure 12: Overview of Hamilton's Life Sciences Ecosystem (Based on Primary Area of Focus Per Entity)



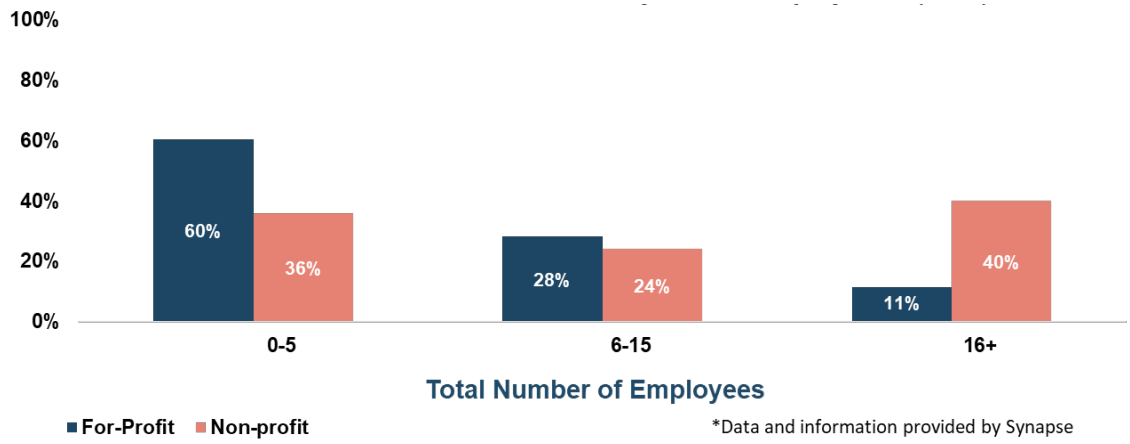
*Source: Information provided by Synapse

Other commercial activities include (but are not limited to) the fields of digital health technologies, diagnostic testing centres, medical labs, and organizations and institutions focused on the various stages of research, development, technology transfer and commercialization.

Currently, a notable portion of these organizations are small and medium size enterprises. Of the organizations surveyed, approximately 47% employ between 1-5 employees, and 25% employ between 6-15.[88] While a significant portion of organizations have between 1-15 employees, Hamilton does have a presence of anchor (or large-scale) life sciences companies, such as Stryker. The company invested CAD $128.1 million in building their Canadian headquarters in Hamilton, which houses 235 employees. *Figure 12* below illustrates the composition of employment size for Hamilton life sciences entities.

[88] Synapse Life Sciences Consortium survey data

Figure 13: Hamilton Life Sciences Sector Entities by Size of Employment (2021)



Industry presence in the life sciences sector has grown steadily. Between 2016 to 2021, 43 new companies have been established in the city. Most of this growth took place in the biotechnology, pharmaceuticals, medical device, diagnostic and digital health subsectors respectively.[89] A significant number of these start-ups have developed out of local academic or research hospitals such as McMaster University, largely due to its commercialization support programs.

A strong collaborative spirit within Hamilton has been well-documented and noted through stakeholder discussions as a significant strength supporting the growing presence of start-ups in the city. This spirit is attributed to Hamilton's history of academic discoveries through collective efforts. Additionally, the city's talent pool, accelerators, and life sciences support programs (such as Synapse, Innovation Factory, Bay Area Health Trust, etc.), and capacity for clinical trials and testing within Hamilton further enable start-up establishment and growth.

The pandemic has not stopped activity within Hamilton's life science ecosystem. Organizations and companies continue to grow. For example, SteriRight was Canada's first company to design and offer a suite of services including N95 mask reprocessing.[90] In addition, the pandemic required emergency response from a production perspective. Large demands led to a need for the industry to pivot from advanced manufacturing to life sciences-related product manufacturing. This proven capability could be further explored as a long-term opportunity.

Academia and Research Hospital Organizations

The City of Hamilton has major academic and research hospitals, many of whom are nationally and internationally recognized, including:

- McMaster University;
- Mohawk College;
- Redeemer University;
- Hamilton Health Sciences (HHS);

[89] Synapse Life Sciences Consortium Data
[90] Synapse Life Sciences Consortium Data

- St. Joseph's Healthcare Hamilton (SJHH); and,
- The Research Institute of St. Joe's Hamilton (RSJH).

Hamilton's academic and research hospitals have a strong focus on life sciences, including specialized programs designed to provide specialized skilled labour for the sector. The city's three secondary academic and research hospitals (McMaster University, Mohawk College, and Redeemer University) have a combined total of over 28,000 STEM students.[91] [92]

Collaboration between academic, research and healthcare institutions has helped create an environment that enables graduates to successfully commercialize innovative healthcare products and services. For example, HHS' collaboration with McMaster University has resulted in the commercialization of research and establishment of new life sciences companies. This includes Reliq Health Technologies – a company focused on developing innovative mobile health and telemedicine solutions which has worked with HHS and McMaster to scale-up.[93] Additionally, partnerships between academic and research hospitals further support collaboration and ecosystem growth. This includes a collaboration between Mohawk College and McMaster University called the Institute for Applied Health Sciences which is a multi-million simulated hospital and long-term care centre that enables real-world experiences for more than 2,000 students a year.

Individually, each organization has a unique role to play within the ecosystem, including:

McMaster University

McMaster University is the most research-intensive university in Canada with a total sponsored research income of CAD $371.6 million.[94] The University brings in more industry-led research dollars than any other university in the country. It has earned an international reputation as a centre of excellence for teaching, learning, innovation, and creativity within life sciences. As part of one of the largest and most sophisticated hospital networks in the country, McMaster University is a strong contributor of R&D and global leader in innovative discoveries in areas such as clinical epidemiology, immuno-oncology, and nuclear medicine. The University is the primary source of skilled talent for the region and is increasingly focused on supporting entrepreneurship and commercialization.

McMaster University has 5 hectares of incubation space. Over the past five years, the University has supported 36 new inventions and innovations that have successfully been commercialized or licensed, with an additional 97 inventions identified as having commercialization potential. The institution's unique and complex scientific research and testing equipment contribute to broad research and development programs at the University. This helps provide local companies opportunities to commercialize the products. Access to testing facilities and equipment helps provide significant business development opportunities for new and emerging companies.

[91] (McMaster University, 2019)

[92] Data provided by Synapse

[93] (Synapse, Reliq Health Technologies Inc., 2016)

[94] (University, 2020)

Mohawk College

Mohawk College is Canada's fourth most research-intensive college in Canada, with CAD $10.9 million in annual sponsored.[95] Through the applied research department IDEAWORKS, Mohawk supports dozens of partners, from SMEs to global multinationals, to explore new and emerging technologies and to commercialize new products.

In recent years, the College has prioritized health service innovation through efforts such as the Apps for Health initiative and the creation of the mHealth & eHealth Development and Innovation Centre (MEDIC). MEDIC is Canada's only Technology Access Centre focused on digital health.[96] Every year, MEDIC partners with dozens of companies to develop advanced digital health solutions for a global market. Additionally, MEDIC, along with other partners (Gevity, Smile CDR, Ontario MD, and Canada Health Infoway), hosts the annual FHIR North conference which is the only Canadian Digital Health conference. FHIR North, which stands for fast health interoperability resources, is an internationally recognized event that is focused on building awareness, knowledge, and experience around the Health Level Seven (HL7) FHIR healthcare interoperability standards in Canada.[97] Mohawk is also active in biotechnology and health care education, training hundreds of learners in 29 programs, through the Healthcare Simulation Centre at the Institute for Applied Health Studies.

In addition to undergraduate programs within the life sciences related programs, the College has several programs aimed at supporting students with R&D and product commercialization, including:

- mHealth & eHealth Development and Innovation Centre (MEDIC); and
- Medical Technologies Innovation Centre
- IDEAWORKS.

Redeemer University

Redeemer is a Christian-based liberal arts and science university. Redeemer has approximately 800 undergraduate students annually.[98] Over the last few years, the University indicated an interest from students in life sciences and related programs. To continue to meet market needs, in 2018 the University invested CAD $400,000 into upgrading its health and life sciences labs.[99] The University provides students with supports to enter the marketplace including internships, coops and career readiness programs. The University recently launched the Centre for Experiential Learning and Careers (CELC) to help students attain employment in their desired field.

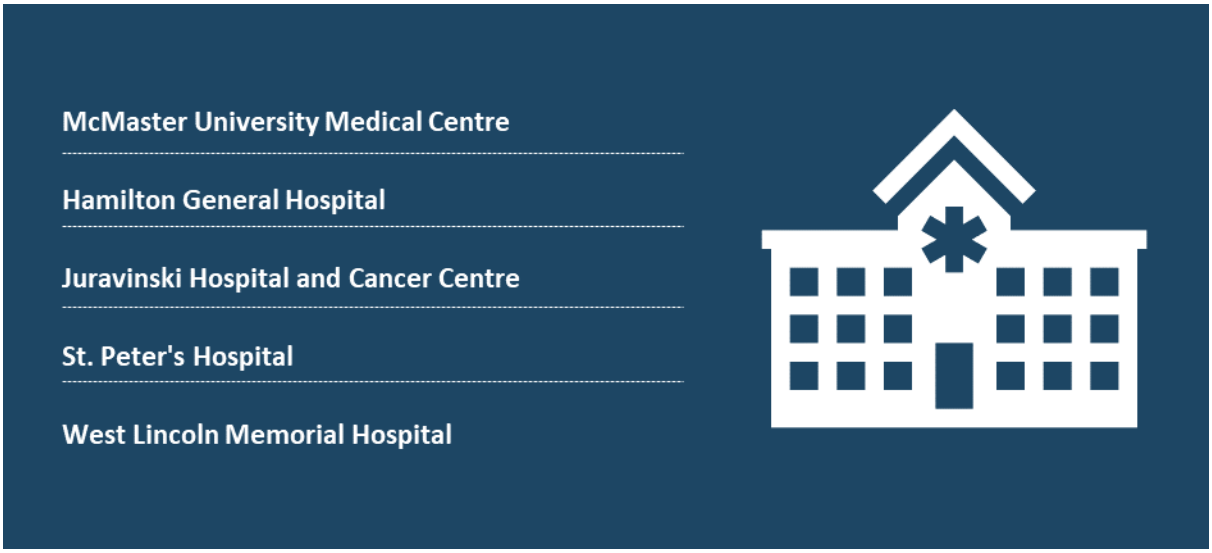
Hamilton Health Sciences (HHS)

HHS operates a family of hospitals and facilities serving the City of Hamilton and the surrounding region. The organization is a strong contributor of research, innovation, and development. It is the

[95] Synapse Data
[96] (Synapse Life Science Consortium, n.d.)
[97] (Mohawk College, About FHIR, 2021)
[98] (Redeemer University, 2019 At a Glance - Redeemer University, 2019)
[99] (Redeemer University, Redeemer expands and upgrades health and life sciences labs, 2018)

largest employer in the Hamilton region and is considered one of the top research hospitals in Canada.[100] HHS is the 2nd largest hospital network in Ontario, spending CAD $174.8 million on innovative research in 2020.

HHS operates five hospital sites, including:



HHS supports the life sciences ecosystem through discoveries in medicine and life science innovations. Over the previous five years, HHS' R&D efforts have led to 32 new inventions and innovations that have been successfully commercialized or licensed with an additional 9 inventions that have demonstrated commercialization potential.[101]

Additionally, HHS supports over 450 researchers and their research teams across life science subsectors. These researchers and their research teams have enrolled over a million participants in clinical research trials at 1500 sites in 90 different countries. The organization is also one of Canada's largest biobanks, holding over 3 million samples.[102]

A jointly owned program between SJHH and HHS, the Hamilton Regional Laboratory Medicine Program (HRLMP), which delivers laboratory medicine services. The program has more than 700 staff including 50 medical and scientific staff with cross appointments from McMaster University. The program focuses on coordinating research studies for physicians, health professionals and researchers from across Hamilton Health Sciences and St. Joseph's Healthcare Hamilton.

St. Joseph's Healthcare Hamilton (SJHH)

SJHH is an academic and research hospitals with a national reputation for outstanding patient care and innovative medical and surgical treatments. The hospital is particularly well known for

[100] (Hamilton Health Sciences, Hamilton Health Sciences holds strong as a top Canadian research hospital, 2020)

[101] Synapse

[102] Information provided by Hamilton Health Sciences

excellence in respiratory care, kidney and urinary care, mental health and addictions, surgical services, cancer surgery and women's and infants' care.[103]

SJHH supports over 200 researchers and their research teams across life science subsectors and has the ability to facilitate product testing and evaluation. SJHH has over 77,000 square feet in lab space and supported 285 new clinical research projects in 2020. In 2020, St. Joseph's researchers conducted CAD $26.9 million innovative research activity.[104]

The Research Institute of St. Joseph's Healthcare Hamilton acts as platform for clinical practice research in respiratory health, mental health and addiction, biostatistics, imaging, kidney and genitourinary, on site and off site in collaboration with partners. Stakeholder interviews indicated that the collaborative setting of clinicians working along with in-house expertise has helped advance healthcare in hospitals and within primary care settings. This collaboration is viewed as a major benefit to the hospital and Hamilton's ecosystem overall.

SJHH's R&D efforts have supported 3 new inventions and innovations that have led to successful commercialization or licensing. An additional 4 innovations have been identified to have commercialization potential.

Talent

Hamilton is home to a deep talent pool. This is in large part attributed to the research-intensive academic and research hospitals noted above. The strong focus on research has supplied the ecosystem and surrounding region with a steady flow of high-quality technical talent.

McMaster University had a total of 19,063 students enrolled in life sciences and related fields in 2020, representing 55% of the total undergraduate student population. Similarly, Mohawk College saw total of 6,172 students enrolled in life sciences and related fields in 2020, making up approximately 23% of the total undergraduate student population.[105] In 2021, Redeemer University had over 400 students enrolled in life sciences related fields. In addition to new talent, over 30,000 employees work in the life sciences sector. This includes a total of over 1,400 life sciences focused researchers. [106]

Support Organizations

Support services provided by incubators and accelerators are an important element in helping to grow early stage start-up and scale-up companies. In addition to academic and research hospitals, there are several resources available to businesses and entrepreneurs to support commercial activity in Hamilton. These supports are offered through the following organizations and programs:

Bay Area Health Trust (BAHT) is a Hamilton based company that operates life science businesses and invests in growth-oriented opportunities with the goal of returning value to its beneficiaries. For example, in anticipation of global shortages of COVID-19 testing supplies, Dr. David Bulir, a

[103] (St. Joseph's Healthcare Hamilton, About Us, n.d.)
[104] (St. Joseph's Healthcare Hamilton, The Research Institute, 2019)
[105] Synapse Life Sciences Consortium Data
[106] (Invest In Hamilton, n.d.)

researcher from McMaster University developed McMaster Molecular Medium (MMM). MMM a temperature-stable storage medium that can maintain coronavirus specimens for up to 14 days, significantly longer than standard transport media.

Figure 14: BAHT Recent Commercial Successes

McMaster Molecular Medium (MMM) – is a ready-to-use, temperature-stable sample collection and storage medium that inactivates and stabilizes coronavirus specimens from the collection site to the laboratory. Bay Area Health Trust has an exclusive licensing agreement for MMM with McMaster University. Developed by researchers from St. Joseph's Healthcare, Hamilton's Disease Diagnostics and Development Group, MMM will enable labs to safely increase their COVID-19 testing capacity and therefore return results faster.

Hamilton Chamber of Commerce is an advocacy organization focused on the business interests of Hamilton organizations. The Chamber played a notable role supporting the initial cluster development of Hamilton's life sciences ecosystem. Currently, the organization supports the ecosystem by strengthening Hamilton's narrative and branding, attracting new residents, increasing tourism, expanding the city's aesthetics and culinary offerings, and leveraging the strengths of the region.

Innovation Factory is dedicated to assisting Ontario-based start-up and scale-up businesses by providing advisory services, training, mentorship, and strategic connections. Support is available in areas such as product development, access to funding, intellectual property, and operational analysis.[107]

The Forge is a business incubator funded by McMaster University, serving novel and scalable start-ups in the Hamilton, Greater Toronto and Niagara Regions. Launched in 2015, the incubator supports entrepreneurs to develop their business ideas from ideation and validation to growth.[108]

Life Sciences Ontario is a dedicated industry association for Ontario's emerging biotechnology sector. The association fosters commercial success for Ontario's life sciences sector through advocacy and education, and promoting the industry locally, nationally, and internationally.

McMaster Innovation Park (MIP) is a research and innovation campus comprised of start-ups, scale-up businesses, and researchers. MIP offers a collaborative space for academia and industry to focus on furthering their initiatives. MIP also offers programs aimed at supporting start-ups and scale-ups. For example, Conferences @ MIP aims to provide 11,000 square feet of modern, versatile meeting and conference facilities to fit business and event needs. MIP plans to add 1.8 million square feet of new office and wet lab space for scaling and established life science companies. While

[107] (Innovation Factory, 2021)
[108] (The Forge, 2021)

originating out of McMaster University, MIP is not directly associated with the University, operating as a separate for-profit organization.[109]

Ontario Bioscience Innovation Organization (OBIO) is a not-for-profit, membership-based organization engaged in strategy, programming, policy development and advocacy to further the commercialization of Ontario's life science companies. OBIO led the Ontario Bioscience Economic Strategy Team in 2011. Currently, the organization advances its goals through collaborative partnerships with industry, the investment community, academia, patients, and government.

Synapse Life Science Consortium is a life science focused advocacy organization. Synapse brings together 8 key anchor institutions, 40 research institutes and centres, 34,600 life science professional and 34,649 employees, including almost 63,000 researchers.[110] Synapse provides a series of programs related to networking and assistance on companies' commercialization journeys.

Figure 15: Synapse Life Science Competition

In partnership with Innovation Factory, Synapse hosts Ontario's premier life science pitch competition. The competition is designed to help commercialize innovative life sciences products and services and move them out of the lab and into the market. This includes pairing up life sciences innovators with business and entrepreneurship students.

Funding and Financing

The municipal, provincial, and federal governments all provide funding programs and other incentives aimed at growing and supporting Hamilton's life sciences organizations. Examples of government initiatives include:

- The Government of Canada's Scientific Research and Experimental Development (SR&ED) tax incentive program, which encourages Canadian businesses in any sector to conduct R&D in Canada through income tax deductions, investment tax credits, and refunds. The program provides over CAD $3 billion in incentives to over 20,000 claimants annually.[111]
- The Ontario Centre of Innovation (OCI) IP voucher program, which supports collaboration between academia and industry to solve industry problems and drive the commercialization of intellectual property. The program provides investment support and has so far contributed CAD $360 million to collaborative R&D projects.[112]
- FedDev Ontario's investment of CAD $6 million to Innovation Factory (in partnership with Synapse) to launch the Southern Ontario Pharmaceutical and Health Innovation Ecosystem (SOPHIE), aimed at supporting and developing specialized pharmaceutical and health innovations to scale up companies.

[109] Source: Synapse Life Sciences Consortium Data

[110] Synapse Life Sciences Consortium Data

[111] (Government of Canada, Medical Devices: Industry Profile, 2021)

[112] (Ontario Centre of Innovation, How Academic-Industry Collaboration Maximizes Innovation, n.d.)

- NGen, a not-for-profit organization that matches manufacturing companies with new technologies to drive economic possibilities and generate new commercial opportunities for advanced manufacturing in Canada. To date, the organization has supported 105 projects valued at a total of CAD $437 million which have contributed to the creation of 835 jobs.
- The Ontario Centre of Innovation (OCI) Market Readiness Co-Investment Fund, that supports early-stage companies in Ontario raising pre-seed and seed investments. The program funds 20 companies with investment of CAD $125,000 or CAD $250,000 annually.[113]
- The OBIO Business Development Skills Program, which grants up to CAD $100,000 in funding to private health science companies in Ontario.[114]
- Mitacs Accelerate Entrepreneur funds student and postdoctoral entrepreneurs to further develop the research or technology at the core of a start-up business.[115]

Other types of financing available to Hamilton start-up/scale-ups include investments through angel investors, private equity funds, and venture capitalists. These stakeholders provide companies with initial and ongoing financial means to invest in research, development, clinical trials, marketing, and commercialization. Investors have varying levels of influence on the direction and pace of development for companies, especially those in earlier and start-up stages.

Hamilton's Quality of Life

Situated on Lake Ontario and along the Niagara Escarpment, Hamilton offers residents a high quality of life, including access to outdoor activities with vast hiking trails, relative affordability, world-class academic and research hospitals, a thriving art scene and a diversified economy. These factors help ensure that Hamilton is a desirable and prosperous place to live, which is especially important for attracting the highly skilled talent required for a robust life sciences sector. Highlighting the benefits of living in Hamilton, alongside opportunities within the life sciences sector is an important part of Hamilton's value proposition.

Economic Prosperity

- Hamilton has a workforce of approximately 400,000.
- The Conference Board of Canada recently ranked Hamilton as the top city nationwide for economic diversity.
- Hamilton is seeing an increasing rate of building developments – with the city issuing over CAD $2 billion worth of building permits by the end of 2021[116].

Affordability

- As of October 2021, the average selling price of a house in Hamilton was approximately CAD $836 thousand, compared to an average of CAD $1.1 million in Toronto.

[113] (Ontario Centre of Innovation, Market Readiness: Investment Criteria, 2021)
[114] (Ontario Bioscience Innovation Organization, 2021)
[115] (Mitacs Accelerate Entrepreneur, 2021)
[116] (Municipal Information Network, 2021)

- Restaurant prices and groceries are more than 20% less expensive than Toronto.
- The city has more affordable real estate with the average R&D tangible products facility costing CAD $6.48 per square foot in Hamilton, and CAD $9.06 per square foot in Toronto.

Public Service

- Hamilton Immigration Partnership Council (HIPC) helps new immigrants settle in the city.
- The city has a cluster of health institutions which have helped raised Hamilton's life expectancy rates.

Transportation

- Hamilton has an extensive regional public transit hub linked to the provincial GO Transit system.
- One-third of all commuter trips are less than 5km, making the city walkable and bikeable.
- There are over 200km of bike lanes across Hamilton.
- The average commuting duration is 26 minutes shorter than Toronto.

Culture & Environment

- Residents can enjoy natural assets such as Lake Ontario and the Niagara Escarpment.
- The city has a vibrant arts and nightlife community.
- Hamilton is home to professional sports teams and programs.
- There are continued beautification efforts across Hamilton, specifically in the city's downtown, waterfront, and Pier 8 development.

Location-specific attributes

Hamilton's geographic location is considered a major advantage. The city is in the centre of the most densely populated corridor of economic activity in Canada. Its location provides businesses and organizations with easy access to a network of highways, international rail lines, John C. Munro Hamilton International Airport, and the Hamilton-Oshawa Port Authority (HOPA). The city is within close range of key major urban markets in Canada and the United States. The city is within an hour's drive of 9 million people and is an hour away from the US border. These advantages are outlined in *Figure 15* below.

Figure 16: Overview of Hamilton's Location-Specific Attributes and Free Trade Agreements

Appendix C

Hamilton's Competitiveness

Hamilton's Competitiveness

Cities that rank highly among their peers for operating, business and intangible factor costs are well positioned to garner domestic and foreign investment.[117] Business environment factors such as the size of experienced workforce, new inflows of talent, information technology infrastructure, utility and infrastructure are critical for attracting investment. Intangible factors such as the regulatory environment and the ease of doing business or employing workers, innovation and intellectual property laws, and quality of life are advantages that investors focus on when relocating or establishing a business.[118]

The KPMG City Competitiveness Index (Index) was utilized to assess Hamilton's competitiveness within the life sciences sector.[119] The Index models cost and non-cost data for each location based on a set of operations parameters that were developed based on industry consultations and analysis to reflect the average business operation in the sector. For the purposes of the analysis the model for research and development (tangible products) was used. This model includes applied research in fields dedicated to developing tangible products within life sciences. Example operations for R&D (tangible products) include medical device R&D, and biomedical R&D. The cost and non-cost factors that were assessed include utilities costs, tax costs, facilities costs, labour costs, business environment factors, and intangible factors.

Hamilton was compared to four Canadian and five US cities which have established/emerging life sciences sectors and/or are comparable to Hamilton. Focus was placed on competitor jurisdictions or key life science hubs that are often considered by investors when considering investment or expansion in the life sciences sector.

Table 6: List of Canadian and US Cities Compared to Hamilton

Canadian City Comparison	US City Comparison
London	Boston
Toronto	Houston
Hamilton	Minneapolis
Quebec City	Pittsburgh
Montreal	Raleigh

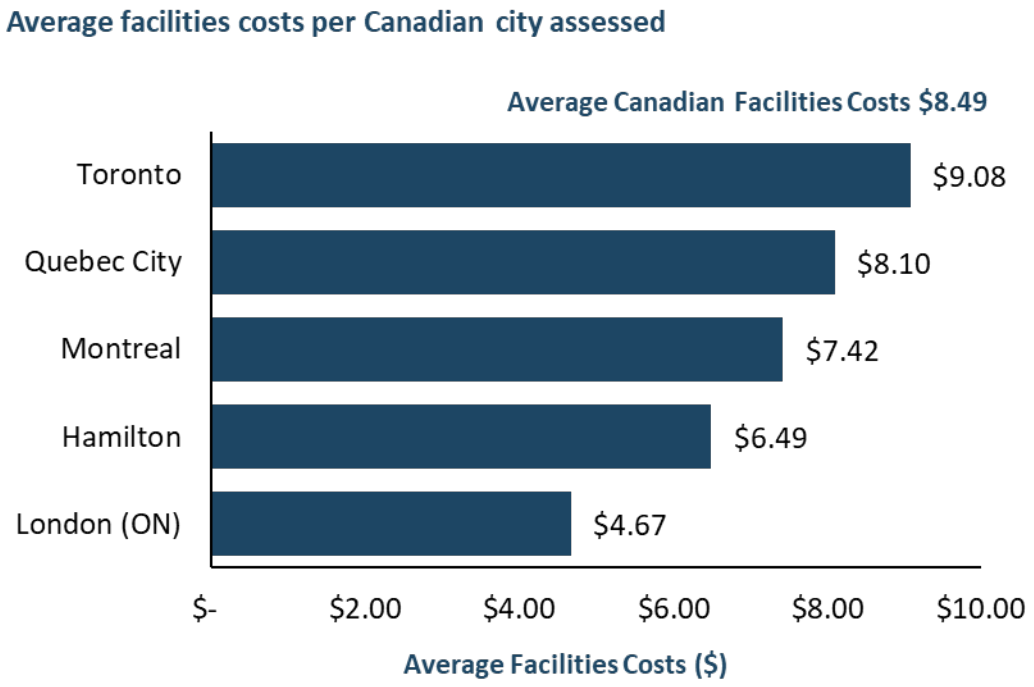
For details regarding the competitiveness analysis, please visit: https://citycompetitivenessindex.kpmg.ca

[117] (KPMG, 2021)
[118] (KPMG, 2021)
[119] (KPMG, 2021)

Canadian City Comparison Highlights

When compared to four Canadian jurisdictions with life sciences hubs, Hamilton's competitiveness for cost and non-cost factors was strong. Hamilton's top performance was for facilities costs, ranking 2nd among the peers with an average of CAD $6.48 per square foot (compared to an average of CAD $9.06 square foot for Toronto) and an average labour cost ranking that was tied for second at CAD $139,836.

Figure 17: Average Facilities Costs ($CAD) for Select Canadian Cities



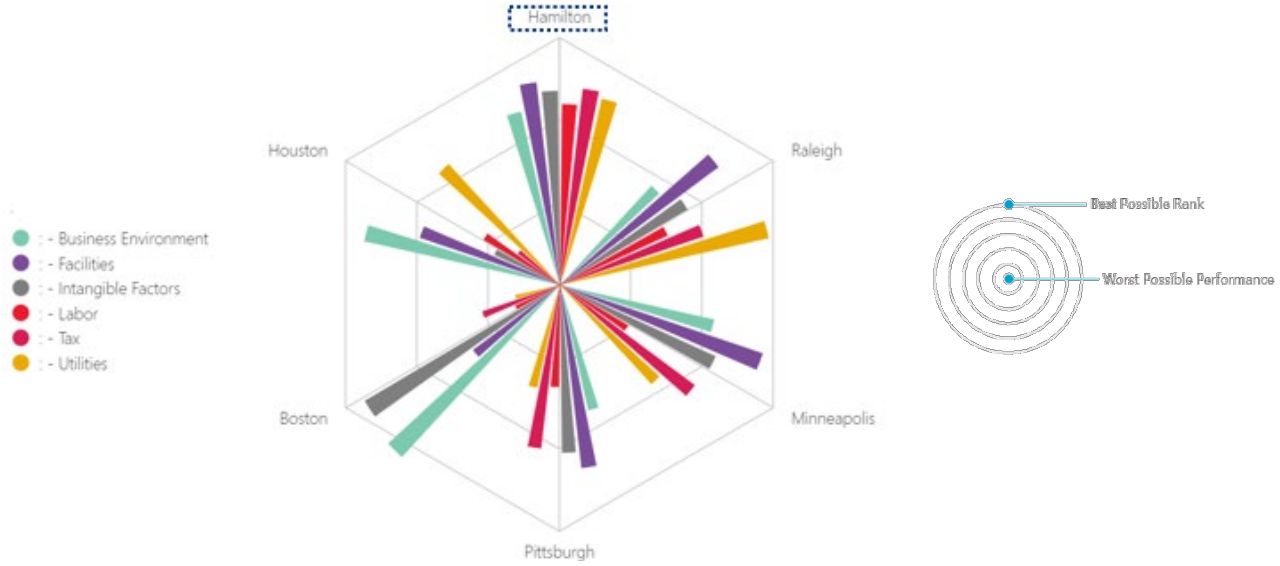
Source: (KPMG, 2021)

US City Comparison Highlights

Hamilton outperformed American counterparts for labour and tax costs. These advantages are shown in *Figure 16,* which provides a comparison of the estimated cost factors associated with operating an equivalent facility in each city, where longer bars represent more competitive costs.[120]

[120] KPMG City Competitiveness Index

Figure 17: Hamilton's Competitiveness Compared to Select US Cities

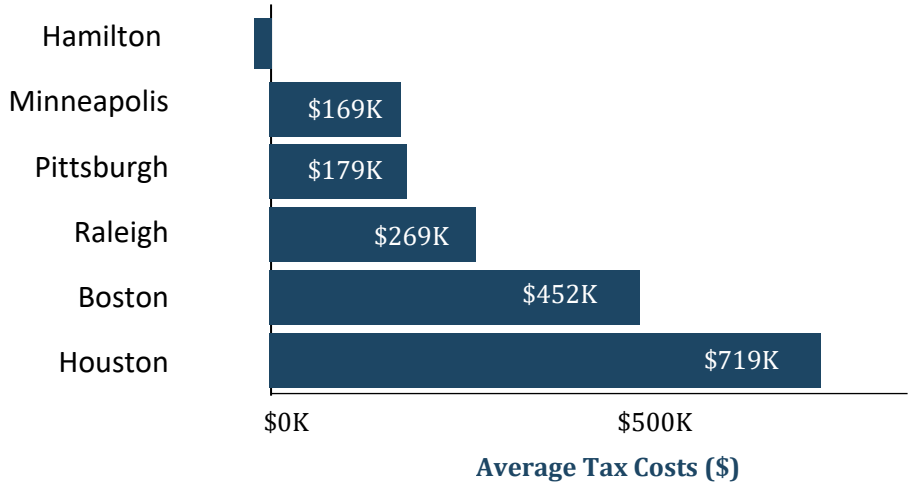


Source: KPMG City Competitiveness Index, 2021

When compared to five US jurisdictions with established life science hubs, Hamilton's competitiveness for key cost and non-cost factors was very strong. Hamilton scored in the top two for most factors.

When compared to US peers, Hamilton is the only jurisdiction with negative tax costs. This may be attributed to the incentive programs in place, and Canada having among the most favourable research and development tax incentives in the world.

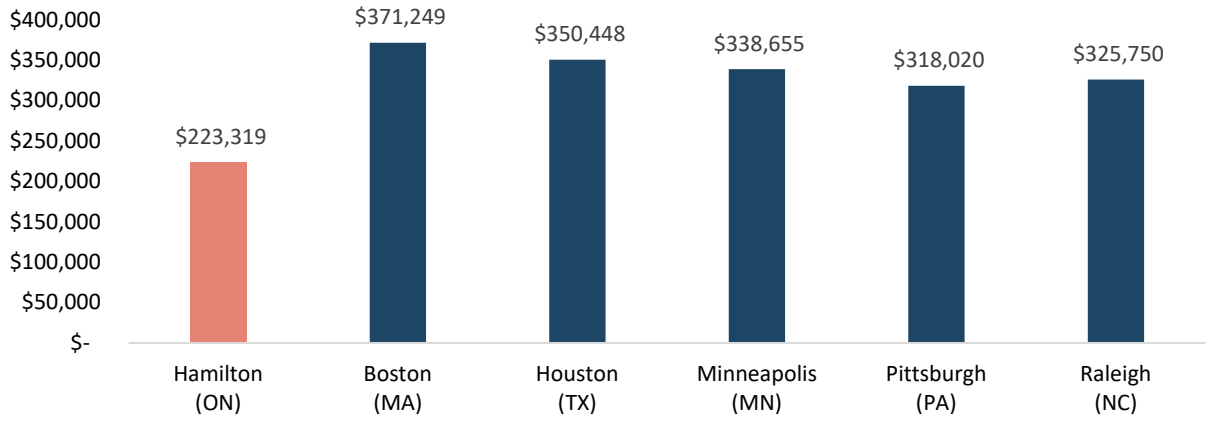
Figure 18: Average Tax Costs for Research and Development Operations with Tangible Products for Hamilton and Select US Cities



Source: KPMG Analysis, 2021

When comparing total compensation levels for Research and Development Director positions in Hamilton with those in select US jurisdictions, Hamilton's labour costs are notably lower – with an average total compensation of CAD $98,757 in Hamilton compared to an average total compensation of CAD $407,195 in Pittsburg. Meaning Hamilton is 30% more competitive than the US city with the lowest labour costs.[121]

Figure 19: Total Compensation for Research and Development Director for Hamilton vs Select US Cities

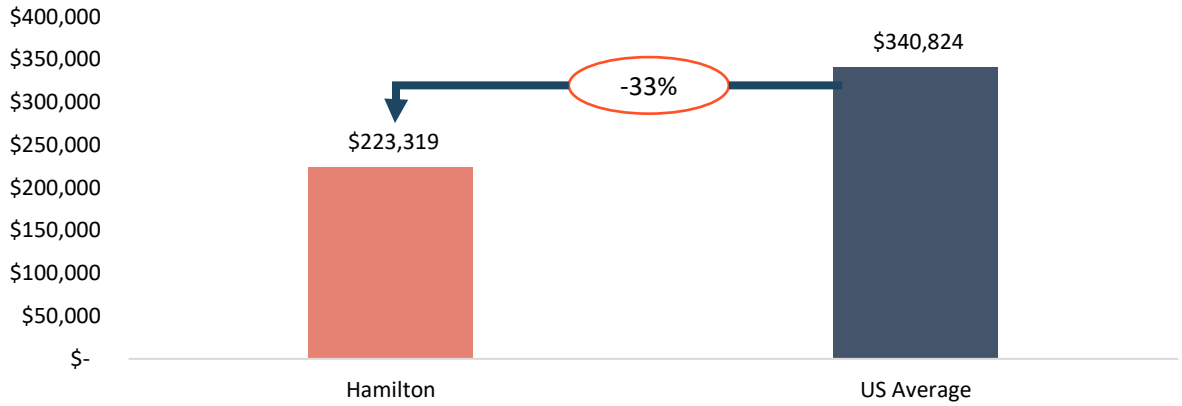


Source: KPMG City Competitiveness Index, 2021

[121] KPMG City Competitiveness Index, 2021

On average, Hamilton labour costs are 33% less expensive than in the select US cities assessed.[122]

Figure 20: Total Compensation for Research and Development Director for Hamilton vs US Average



Source: KPMG City Competitiveness Index, 2021

[122] KPMG City Competitiveness Index, 2021

Appendix D

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Century Therapeutics

City of Hamilton

Equation Angels - Angel One Chapter

HaloHealth

Hamilton Health Sciences

Hamilton Regional Laboratory Medicine Program

Industrial Research Assistance Program (IRAP Ontario)

Innovation Factory

Invest in Canada

Ironstone Product Development

Life Sciences Ontario

Mariner Endosurgery

McMaster Innovation Park

McMaster University

Michael G. DeGroote Health Innovation, Commercialization and Entrepreneurship

Mohawk College

National Research Council Canada

Ontario Centre of Innovation

Ontario Ministry of Economic Development, Job Creation and Trade

Population Health Research Institute

Redeemer University

St. Joseph's Health System

Stryker

ToeFX

VoxNeuro

Appendix E

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