a life sciences powerhouse: ONTARIO

Canada's story

Around the world, competition between life sciences companies is fierce. And so is the competition between jurisdictions wanting to attract the good paying jobs, innovative spirit and R&D that comes along with this important economic sector.

By Michael Stewart

Different jurisdictions, including the UK, have experienced some challenging developments in recent years. GlaxoSmithKline, the UK-based drug company, has reduced the proportion of sales reinvested in R&D for prescription medicines and withdrawn entirely from several therapies, including the closure in Essex of a unit working on depression treatment. AstraZeneca also cut back its UK operations into non-prescription products and Pfizer is winding down its main UK research centre as well. Other jurisdictions are experiencing much of the same.

Bucking this trend has been Ontario, Canada. Ontario is one of North America's premier centres for life sciences, with successful companies involved in pharmaceuticals and bio technology, advanced medical technologies, research and clinical trials, oncology and more.

Key to this success has been the active support of the Government of Ontario, which works to promote investment and trade in this sector, as well as implementing policies attractive to life sciences companies. Complementing these policies is an environment that recognises and embraces the global nature of the life sciences sector – an industry that is no longer limited by geographic borders.

Ontario's life sciences commercialisation strategy

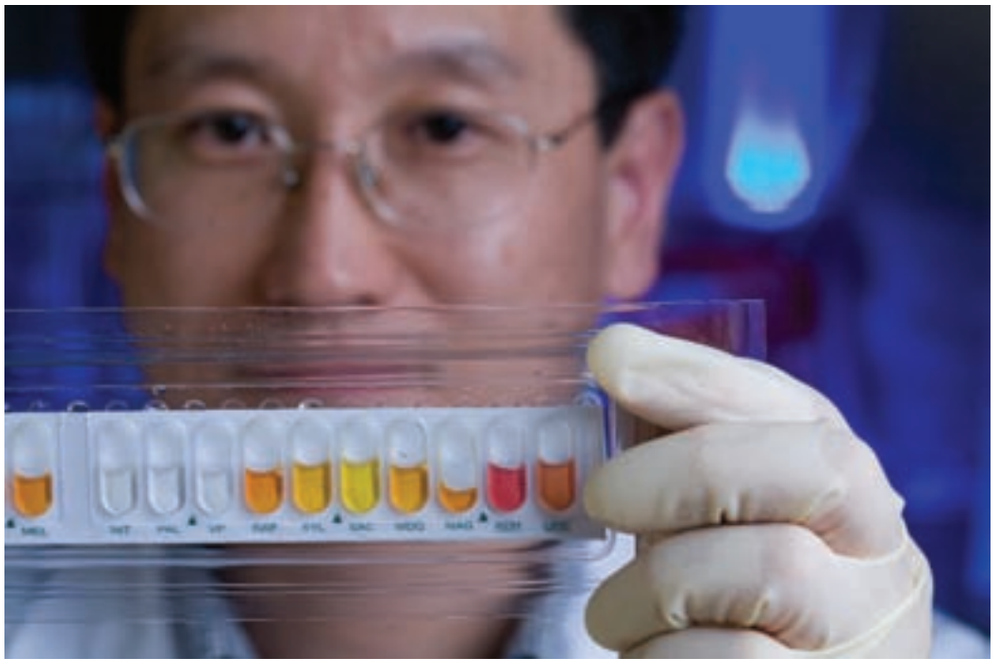
Ontario aims to be the best place in the world to take innovative bio-medical discoveries and turn them into new products and services that resolve unmet patient needs by capitalising on world-class talent, research capacity and collaborative spirit. This will be accomplished by executing a life sciences commercialisation strategy, which has three main goals:

1. To promote even greater collaboration among government, academia and industry.
2. To position Ontario as the 'go-to' place for innovative multinational pharmaceutical and advanced health technologies firms looking to source new technologies and test promising new therapies.
3. To grow the homegrown biotech industry, already the largest in Canada, to the point where it rivals those of leading centres in the US and abroad.

To achieve these goals, Ontario is adopting a strategy of attracting and nurturing scientific excellence, facilitating greater collaboration, addressing financial challenges and improving international marketing and promotion.

The Ontario advantage

Ontario's approach has evolved over the years to remain at the forefront and to remain attractive as a place to work and invest. It is a comprehensive approach involving incentives, low business costs, a powerful research community, extensive global partnerships and a critical mass of companies and talented workers. The following are some of the pillars of Ontario's life sciences industry:



Top ranked R&D tax incentives. Ontario's R&D tax incentives are among the most generous in the world. Factoring in tax credits, a $100 R&D expenditure can be reduced to an after-tax cost of about $56, or $38 for a small business. Also, tax credits can be carried back three years or forward 20 years[1].

Lower business costs. According to KPMG's Competitive Alternatives 2010 report, Canada offers a lower-business cost environment for life sciences companies than the US, Germany, Italy and Japan. Ontario is also North America's most competitive jurisdiction for corporate taxes. The marginal effective tax rate (METR) on new capital investment (provincial and federal combined) fell to 18.6% in 2010 from 32.8% in 2009 and will drop to 16.2% by 2018. Ontario is well connected with extensive, sophisticated and reliable telecom and broadband networks[2].

A research powerhouse. With 25 research and teaching hospitals employing 10,000 scientists, clinical investigators and other researchers, Ontario is one of the largest biomedical research centres in North America. Ontario's universities and teaching hospitals spend almost $2 billion annually on health research, which is roughly 30% of all the health research done across Canada by governments, industry, academics and the non-profit sectors[3].

Ontario has a history of medical breakthroughs that dates back nearly a century to the development of a landmark diphtheria antitoxin, and includes the discovery of insulin, the development of the pacemaker and the world's first hospital-to-hospital telerobotic-assisted surgery. Ontario remains at the forefront of discovery today in several key areas, including cardiology, oncology, neurology, stem cells and regenerative medicine,

Attracting the world's top researchers[21]

ONE OF the world's foremost neuroscientists, Dr Adrian Owen holds Canada's Excellence Research Chair in Cognitive Neuroscience and Imaging. He is addressing one of the most challenging topics in clinical medicine: residual brain function in patients who are non-responsive after suffering a severe brain injury.

In 2011, Dr Owen brought his remarkable research programme – and his entire research team – from Cambridge University in the United Kingdom to the University of Western Ontario. Why Ontario?

"This is the place to be for advanced neuroscience research," Dr Owen says. "The opportunity to work closely with world-class colleagues, with the best equipment available, and to have patients nearby that my work can help, drew me to Ontario. Being located here will make it easier for me to achieve my research objectives – and to push the envelope even further."

imaging, ophthalmology and infectious diseases. Clinical trials and investigational testing are also an area of strength as a result of the centrally managed public healthcare system, which facilitates patient recruitment and tracking, and Ontario's large multi-ethnic population. Multinational pharmaceutical companies invest more than $400 million a year in clinical trials in Ontario. This tradition of bio-medical achievement, grounded in Ontario's unique collaborative research environment, is a major drawing card for the world's best researchers[4].

Recognising that it takes multiple skills to commercialise breakthrough technologies, companies operating in Ontario have the opportunity to acquire the rights to intellectual property developed at Ontario public research centres. The $250 million Emerging Technologies Fund and $50 million Innovation Demonstration Fund help companies accelerate the commercialisation of ground-breaking new products[5].

Exceptional global connections and partnerships. Ontario is home to a growing number of internationally recognised centres of excellence in research, innovation and collaboration, including the International Cancer Genome Consortium at the Ontario Institute for Cancer Research, the new Ontario Brain Institute and clinical trials by the Population Health Research Institute at McMaster University.

Ontario understands global markets. Total international trade by Ontario companies tops $1 billion per day. Ontario has five international airports – Toronto, Hamilton, London, Ottawa and Thunder Bay. The largest, Toronto's Pearson International Airport, offers same-plane service via 75 carriers to 29 Canadian, 50 US and 105 other international destinations.

Critical mass of companies and talent. Ontario has a broad and innovative life sciences sector. Some 900 companies employ more than 41,500 people in the pharmaceutical, biotech, advanced medical technologies and contract services sectors[6].

Ontario's 44 universities and colleges produce more than 35,000 graduates a year in mathematics, engineering and sciences. Ontario is home to six medical schools including the University of Toronto, one of the largest in North America. Complementing the medical and technical schools are Ontario's business schools, which are ranked among the best in the world by *BusinessWeek*, *Forbes* and the *Wall Street Journal*. Overall, 63% of the population has at least one post-secondary degree or certificate, more than double the average of OECD nations, creating a smart, skilled talent pool for companies to draw from[7].

Ontario is a manufacturing powerhouse, with the people, resources, location and the infrastructure that are essential for success in today's competitive economy – which is why 11 of the world's 20 largest multinational advanced health technology companies have operations there. The contract pharma market is estimated to grow to $40 billion by 2011. The use of strategic outsourcing is becoming an accepted practice to spread the risk of development and lower fixed costs. Ontario has world-class capacity in terms of contract manufacturing services, both for small-molecule and protein-based therapies.

Lifestyle. Ontario, Canada is known for its stunning scenery, safe and friendly communities, high-quality education and healthcare. Ontario offers a unique combination of sophisticated lifestyles, creative opportunities and a comparatively low cost-of living – all of which makes it easier to recruit globally mobile talent. Close to 150 languages are spoken, creating a staffing advantage for companies working with international supply and distribution chains.

With significant assets of talent, infrastructure, leadership and collaboration, Ontario is poised to pull ahead of the pack in the race to capture a significant share of the global life sciences marketplace. With the resources committed to make this vision a

Life sciences in Ontario: a snapshot[8]

Pharmaceuticals and biotechnology
16,500+ employees
125+ companies
revenues of almost $10 billion

R&D expenditures of $1.3 billion+
Advanced Medical Technologies
20,000+ employees
~700 companies
revenues of ~$4 billion

Contract services (research/manufacturing/clinical trials)
5,000+ employees
75+ companies
revenues of $100 million+

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reality firmly in place, there's simply no better place in the world to do business than Ontario.

Pharmaceutical companies growing in Ontario

Roche Canada is investing $190 million over the next five years in a global development site in Mississauga, Ontario. Individuals at this Pharmaceutical Development site, one of six in the world, will manage operations for all stages of global clinical trial research, significantly contributing to the development of highly innovative medicines to benefit patients worldwide. Roche Canada was selected as a global development site, in part, because Ontario offers the environment necessary to support drug discovery and development, including an educated and capable workforce, and a favourable business environment supported by a government that places a high strategic priority on life sciences. This expansion project is supported by a $7.8 million investment from the Ontario Ministry of Economic Development and Trade, and reflects the shared commitment of Roche and the Government of Ontario to build long-term prosperity and international leadership in life sciences and biopharmaceuticals in the province. This new site will further establish Canada's expertise in the support and management of Roche's pharmaceutical development on a global scale. Headquartered in Basel, Switzerland, Roche is a leader in research-focused healthcare with combined strengths in pharmaceuticals and diagnostics. Roche is the world's largest biotech company with truly differentiated medicines in oncology, virology, inflammation, metabolism and CNS. The company is also the world leader in *in vitro* diagnostics, tissue-based cancer diagnostics and is a pioneer in diabetes management[9].

The province of Ontario is helping **Teva Canada Limited**, a leading pharmaceutical company, expand its production at three Ontario plants. Once complete, the new expansion will make Teva Canada's Stouffville, Ontario plant one of the most advanced pharmaceutical plants in North America, meeting stringent Canadian and international regulations. With Ontario's support, the company is expanding the plant and installing state-of-the-art equipment. The upgrades will allow the company to produce one billion more tablets of generic prescription medications per year, compete globally with new specialised generic prescription medications and increase the supply of generic prescription drugs for Ontarians. Teva is one of the largest generic pharmaceutical companies in Canada, manufacturing more than six billion tablets per year for domestic and export markets. Teva Canada's parent company, Israel-based Teva Pharmaceutical Industries Ltd, is the world's largest generic pharmaceutical company[10].

In June 2011 **Sanofi Pasteur Limited** opened a $101 million vaccine research and development facility at Sanofi Pasteur's Connaught Campus in Toronto, Ontario. This new facility establishes the Connaught Campus as the North American Centre of Excellence in analytical and bioprocessing R&D for Sanofi Pasteur globally. It solidifies the Toronto site as a national strategic asset for the research, development and manufacturing of vaccines that protect public health – in Canada and around the world. The Province of Ontario contributed $13.9

A microchip that detects cancer[20]

IN 2009, University of Toronto researchers created a portable device with a microchip that can accurately diagnose cancer. It was heralded as a landmark medical advance. Prior diagnostic procedures often took days. The chip delivers results in just 30 minutes. It detects the type and severity of cancer by sensing the signature biomarkers that indicate the presence of cancer at the cellular level.

The research team, led by Drs Shana Kelley and Ted Sargent, tested its innovation on prostate cancer and head and neck cancer models. The discovery offers a faster, more cost-effective technology to rapidly diagnose cancers and other infectious diseases. It could also provide more targeted treatments for patients.

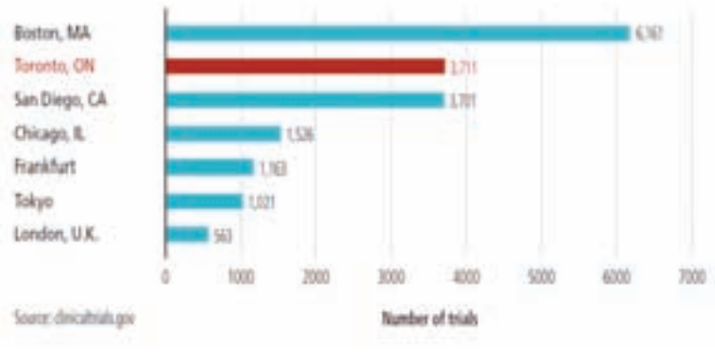
At the University of Toronto (U of T), Dr Shana Kelley, a professor in the Leslie Dan Faculty of Pharmacy and the Faculty of Medicine, and Dr Ted Sargent, U of T's Canada Research Chair in Nanotechnology, display the microchip that detects the type and severity of cancer in just a half hour

million to the project through the Biopharmaceutical Investment Program, part of the Next Generation of Jobs Fund. The Toronto site manufactures many vaccines vital to public health with 94% of its vaccine production being delivered to more than 90 countries around the world. In fact, more than 20% of global sales at Sanofi Pasteur are generated by vaccines manufactured at the Connaught Campus. Sanofi has core strengths in the field of healthcare with seven growth platforms: diabetes solutions, human vaccines, innovative drugs, rare diseases, consumer healthcare, emerging markets and animal health. Sanofi Pasteur, the vaccines division of Sanofi, provides more than one billion doses of vaccine each year, making it possible to immunise more than 500 million people across the globe. A world leader in the vaccine industry, Sanofi Pasteur offers the broadest range of vaccines protecting against 20 infectious diseases.

With support from the government of Ontario, **GlaxoSmithKline Inc** recently announced that it will expand its state-of-the-art advanced manufacturing facility in Mississauga, Ontario. This expansion will help bring new products to market and enable the global supply of the company's dermatological products such as creams, ointments, lotions, and foams – the first capability of its kind in Ontario. The Ontario government will support the expansion with $3.6 million, with GlaxoSmithKline Inc providing more than $30 million towards the project. The expansion of the Mississauga site will enable the production of COREG CR® (carvedilol tablets), RELENZA® (zanamivir dry powder inhalation) and new dermatological products[11].

In 2009, **Pfizer** Inc collaborated on a landmark $6 million oncology research project with the Ontario Institute for Cancer Research (OICR) and the Ontario Cancer Institute (OCI) to discover and validate new targets for the diagnosis, prognosis and treatment of colorectal cancer. These research institutions are global leaders in genomics and cancer stem cell research aimed at finding a cure for cancer. The scientists will use genomic and molecular pathology approaches and develop a large clinical biobank to identify molecular signatures in colorectal cancer. These molecular signatures will be used to accelerate the development of biomarkers for early detection, monitoring and treatment of cancer. Pfizer Global Research and Development will contribute $6 million over three years. The OICR and OCI scientists will leverage existing Ontario Government support that has been provided to OICR and other organisations to build and utilise state-of-the-art research infrastructure such as equipment and tissue banks. The government of Ontario invested an additional $900,000 in this initiative through its Biopharmaceutical Investment Program, part of the government's Next Generation of Jobs Fund[12].

Toronto: A major clinical trials centre 2005-2009[17]



Breaking new ground: Ontario: a clinical trials powerhouse

Ontario has built a respected life sciences industry where multi-nationals and home-grown companies

Ontario institute for cancer research (OICR)[22]

OICR IS an independent, not-for-profit corporation funded by the Government of Ontario and other sources. Since its launch in 2005, Ontario has invested $380 million in the Institute.

Researchers pursue multi-disciplinary research in cancer prevention, early detection, diagnosis and treatment. They collaborate across institutions to investigate the major research questions of our time. For example, Dr Tom Hudson, the Institute's President and Scientific Director, is studying genome variation that affects the progress of a cancer.

OICR invests more than $150 million each year in translational research to move new discoveries from the bench to practical applications for patients. The Institute is also working to develop personalisedmedicine for cancer patients. Key to this effort is the development of reliable biomarkers, which requires strong collaborative multi-disciplinary and translational research capabilities. Investments here include:

- A $22-million initiative to support the co-ordination of imaging platforms, technology pipelines and research across several institutions, led by Drs Aaron Fenster and Martin Yaffe.
- A co-ordinated initiative to develop molecular imaging probes, led by Dr John Valliant.

have established themselves as proven leaders in innovation. In 2009 alone, multi-national pharmaceutical companies invested $280 million on clinical trials in Ontario[13].

The pace of medical discovery is accelerating, increasing the pressure on life sciences researchers to complete clinical trials quickly, efficiently and with the high quality data that regulators demand. In Ontario, life sciences leaders continue to break new ground every day. They are finding the solutions needed to answer some of the world's most elusive medical questions. The province's vibrant life sciences sector, through clinical trials, is helping healthcare leaders bring life-saving solutions to global markets. These solutions provide positive patient outcomes, affordable medicines, shorter hospital stays and high quality jobs[14].

In fact, Ontario has long been a destination of choice for major international clinical trials sponsored by multi-national pharmaceutical companies, publicly funded research institutions and universities, and small/medium life science and medical device companies. More than 5,200 clinical trials are under way in Ontario at any given time. These include trials for treatment of allergies, cardiovascular disease, cancer, imaging, inflammatory bowel disease, urology, rheumatology, organ transplants and a host of others[15].

Top five reasons to conduct clinical trials in Ontario[16]

1. A globally competitive testing environment. Major international medical authorities recognise the validity of data from Ontario clinical trials. Ontario has well-established clinical trials networks and contract research organisations highly experienced in managing clinical trials across Canada and around the world. Staff are trained in Good Clinical Practices (GCP) and the workforce is one of the best educated in the world. In fact, 61% of Ontario's workforce has completed post-secondary education, the highest percentage among G7 nations.

2. World-class clinical research talent. Ontario's researchers are recognised for their expertise in designing and managing complex clinical trials. Ontario's legacy of biomedical discovery inspires and attracts the world's best researchers. It is grounded in Ontario's unique collaborative research environment. Ontario's internationally recognised investigators are studying viruses that kill cancer cells, new diagnostics and therapies in neuroscience, autoimmunity and other therapies related to diabetes, high impact cardiovascular interventions and much more.

3. Access to a public healthcare system and diverse patient populations. Ontario offers resources that help healthcare leaders accelerate their clinical trials. The province has a centrally managed public healthcare system. This makes it easy to access a

International Cancer Genome Consortium (ICGC)[23]

ONTARIO IS currently co-ordinating a global effort to investigate the links between genetics and cancer.

The province is investing $40 million over 10 years in the International Cancer Genome Consortium, through the Ontario Institute for Cancer Research (OICR). Dr. Tom Hudson, President and Scientific Director of OICR, was instrumental in the creation of the Consortium. Its goal: to co-ordinate a global effort to unlock the genome of the 50 most common cancer tumours that plague humanity.

This project will generate 25,000 times more data than the Human Genome Project. Funding organisations in Asia, Australia, Europe and North America have already committed funds for 38 project teams to study more than 16,000 tumour genes.

Not only has Ontario been chosen as the world headquarters of this global effort, one of the largest scientific projects in history, it has also been tasked to serve as the global data centre. In essence, the province will create the largest health informatics database in history. This information will lead to better ways of diagnosing, treating and preventing cancer, a disease that strikes almost 13 million people a year worldwide.

population of more than 13 million that is demographically and ethnically diverse, a critical advantage that can accelerate understanding of the trial drug's impact on different population subgroups. This enables more efficient drug development and helps ensure safe and effective medical products for a broader range of users.

4. Highly competitive costs and generous R&D tax incentives. Clinical trials costs here are 8% below costs in San Diego and 11% below Boston, for example. Also, the province has established a number of funding programmes. Ontario's R&D tax credits are considered to be among the most generous in the industrialised world.

5. Strong government support for clinical trials. Ontario is constantly working to improve both funding support and service delivery. Ontario's 2010 Life Sciences Commercialization Strategy committed an additional $17 million to establish a province-wide co-ordinating framework for clinical trials that will streamline ethics reviews and administrative processes for the province's multi-centre clinical trials. Ontario continues to invest significantly in modernising its clinical trials framework. The result: increased patient recruitment, reduced trial start-up times and a stronger value proposition for investors.

In short, Ontario laboratories continue to generate new breakthroughs in cardiology, oncology, neurology, stem cells and regenerative medicine, imaging, ophthalmology, infectious diseases and other areas. This tradition of biomedical discovery inspires and attracts the world's best researchers. It is grounded in Ontario's unique collaborative research environment. To help ensure that Ontario continues to recruit and retain star scientists, the province has established a number of funding programmes. Currently, Ontario invests more than $500 million annually in basic and translational life sciences R&D[18]. Programs include:

- The Ontario Research Fund. This $730 million programme supports the operational and capital costs of doing innovative research in Ontario.
- The Early Researcher Awards. This award provides up to $100,000 to help promising and recently appointed Ontario researchers build their research teams.
- The Post-Doctoral Fellowship programme. This programme provides two-year fellowships worth $100,000 to outstanding scientists at Ontario's research institutions[19].

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Ontario has the people and the resources that today's leaders in life sciences need to efficiently test their promising innovations.

Bringing innovative ideas to market: Ontario Network of Excellence

The Ontario Network of Excellence (ONE) is a network of 14 regional innovation centres across the province that helps local entrepreneurs bring innovative ideas to market. Funded by the Government of Ontario, ONE is a coherent and effective network that co-ordinates all of Ontario's programmes and services available to support entrepreneurs. The Network's programmes and services address the needs of technology-based researchers, entrepreneurs and business leaders by determining which resources best match the company, its products, goals and stage of company development. Services offered include educational programmes, advisory services, expert coaching and mentorship.

An example of one such member is MaRS; a commercialisation centre which connects and enables active collaboration between the communities of science, business and capital to accelerate the innovation process and amplify the economic and social impact of important new ideas and discoveries. Located in the heart of Toronto, MaRS's goal is to accelerate the commercialisation of breakthrough discoveries by giving entrepreneurs access to a broad range of experts, including experienced entrepreneurs, researchers, academics, businesspeople, government representatives and investors, who can help sell an idea and grow a business worldwide. DDW

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