

INNOVATIVE COMPANIES  
CREATIVE SOLUTIONS

# VACCINES AND DIAGNOSTICS

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QUEBEC CITY, LEADING THE WAY

# FROM BASIC RESEARCH TO PATIENT TREATMENTS

Æterna Zentaris  
AllergiLab  
PharmaNet Canada  
Asmacure  
BD Diagnostics - GeneOhm  
Chlorion Pharma  
DiagnoCure  
EndoCeutics  
Feldan Bio  
Folia Biotech  
GenePOC  
GlaxoSmithKline Biologicals (GSK Bio)  
GRMO  
Infectio Recherche  
Medicago  
Nordic Life Science Pipeline

## QUEBEC CITY REGION:

A HUB FOR DISCOVERING NEW TREATMENTS,  
VACCINES AND DIAGNOSTIC TOOLS



## BIOPHARMACEUTICAL INDUSTRY SNAPSHOT

**23** companies

**CA\$300 million**  
in annual sales

**2,165** corporate jobs, including

**1,700** in R&D

**7** university hospital research centres

**9** research chairs with  
combined budgets of

**US\$12 million**

**1** complete value chain,  
from research to commercialization

**56 200** Life sciences graduates

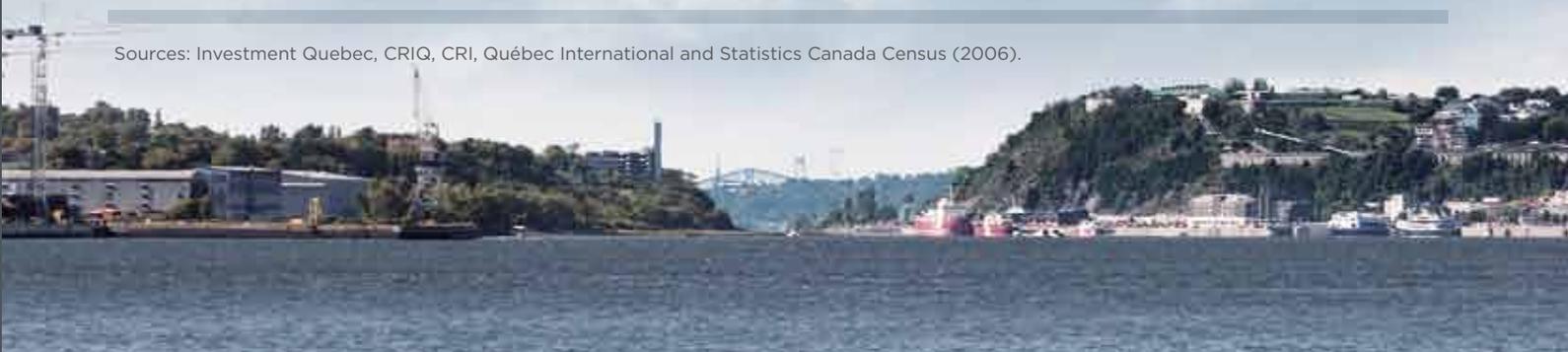
Quebec ranks fourth in North America in terms of the number of biotechnology firms; Quebec City is the second-largest hub in the province.

The world's top 10 pharmaceutical companies all have operations in Quebec. Among them, AstraZeneca, GlaxoSmithKline, Merck Frosst, Pfizer and Sanofi-aventis conduct research in Quebec City.

Successful technology transfers: Æterna Zentaris, PharmaNet Canada, Asmacure, BD Diagnostics - GeneOhm, DiagnoCure, Folia Biotech, GenePOC, GlaxoSmithKline Biologicals, Medicago, EndoCeutics, Chlorion Pharma.

Candidate vaccines:  
HIV/AIDS, H5N1 and H1N1 flu, typhoid fever, hepatitis, leishmaniasis.

Sources: Investment Quebec, CRIQ, CRI, Québec International and Statistics Canada Census (2006).



## HIGH-TECH INDUSTRY

Home to many world-renowned researchers, the Quebec City region is a hotbed of cutting-edge diagnostic and treatment techniques that are revolutionizing 21<sup>st</sup> century medicine: AIDS, bloodborne and sexually transmitted infections, methicillin-resistant *Staphylococcus aureus* (MRSA), HIV, typhoid fever and hepatitis C.

Recognized as a skills hub, the Quebec City region is at the forefront of the industry in terms of developing computerized DNA tests; developing and marketing molecular tests for detecting and managing cancer; and developing vaccines to fight influenza, in addition to vaccines of the future and therapeutic protein biomanufacturing.

The region serves as a catalyst for industry leaders and innovative firms carving out an enviable position in a high-growth sector. The global vaccine market is expected to top US\$30 billion in 2013, while the in vitro diagnostics market will reach US\$60 billion in 2014.



## DEVELOPING DIAGNOSTIC TOOLS AND VACCINES IN THE QUEBEC CITY REGION:

combining science and expertise  
to turn innovation into a powerful growth driver

Ideal balance between global leaders  
and small and mid-sized firms.

7 high-tech research centres  
serving as industry drivers and technology partners.

State-of-the-art technological infrastructure.

Qualified, stable, dependable and dedicated workforce.

Specialized educational institutions.

Competitive set-up and operating costs.

Business-friendly tax incentives.

Solid partnerships with various levels of government.

Strategic geographic location in North America.



# WORLD-CLASS MANUFACTURING CENTRE

Quebec City enjoys a prime position in the infectiology field, thanks in particular to its three manufacturing facilities: two for vaccines and one for infectious disease diagnostic kits.

- **BD DIAGNOSTIC GENE OHM** has a workforce of 325 employees in Quebec City in the field of molecular diagnostics. This subsidiary of BD (Becton, Dickinson and Co.) manufactures BD GeneOhm™ in vitro PCR diagnostic kits (methicillin-resistant Staphylococcus aureus, StaphSR, Strep B, VanR and C-Diff), which are used to detect and identify a variety of infectious agents and genetic variations in record time. Thanks to a \$60 million investment, the company now has a state-of-the-art R&D centre for its **rapid molecular diagnostic** products targeting nosocomial infections, in addition to a manufacturing facility meeting the highest quality standards established by Health Canada, the US Food and Drug Administration and the CE marking (Europe). In total, BD has invested more than \$700 million in the molecular field since 2006, bringing great benefits to the region. BD is a global **medical technology** leader with 28,000 employees in 50 countries.
- **GLAXOSMITHKLINE BIOLOGICALS (GSK BIO)**, the world's second-largest pharmaceutical company and Canada's leading **flu vaccine** manufacturer, has a state-of-the-art vaccine manufacturing facility in the Quebec City region with a production capacity of 75 million doses per year. The FluViral™ and FluLaval™ seasonal vaccines are produced locally. Since 2007, GSK Bio has invested \$300 million in its regional facilities, enabling it to double its pandemic vaccine production capacity to 33 million doses per month. Already contracted by the Canadian government to produce seasonal flu vaccines, GSK Bio is positioned to ensure Canada's domestic self-sufficiency and to provide rapid supplies in the event of a **pandemic**. GSK Bio is among the top 15 companies for R&D investments in Canada, with more than \$144 million invested in 2009 alone.
- **MEDICAGO** develops effective and affordable **vaccines** using exclusive manufacturing technologies based on plants (Proficia™) and pseudoviral particles. Employing nearly 100 people in Quebec, the company can produce a vaccine **ready for trials one month** after identifying and receiving the pandemic strain's genetic sequences, compared with six months for other methods. In 2008, Philip Morris International became a major Medicago shareholder after acquiring a \$16 million stake in the company. In 2010, Medicago received a \$21 million grant from the US Defense Department to build a new production facility in North Carolina's Research Triangle Park. Medicago is also collaborating with the Infectious Disease Research Institute as part of a vaccine production program aimed at protecting the US in the event of a flu pandemic.





## INFECTIOLOGY RESEARCH: A VIRAL SUCCESS!

Laval University's **INFECTIOLOGY RESEARCH CENTRE** (CRI), affiliated with the CHUQ Research Centre, was founded in 1974 by Dr. Michel G. Bergeron. Serving as an infectiology hub, the CRI is recognized for its productivity and the high priority it places on applications and technology transfers. CRI's researchers have 40 patents granted or pending. For many years, CRI's expertise has extended to the international arena; it is now prepared for galactic glory thanks to its partnership with the Canadian Space Agency! With some 250 scientists on staff, the CRI is Canada's leading infectious disease research group and boasts an impressive track record.

CRI created **Infectio Diagnostic Inc.** (today BD Diagnostics-GeneOhm), which invested CA\$60 million to build a production facility and a research centre in Quebec City. The company manufactures and markets three of the CRI's discoveries (Strep B, MRSA, VanR).

CRI created **Folia Biotech Inc.**, which together with **Dr. Denis Leclerc** unveiled an approach based on the use of a new pharmaceutical adjuvant for developing effective and more cost-effective vaccines for hepatitis C, typhoid fever and flu. PAL technology, a versatile vaccination platform used to develop innovative vaccines against infectious diseases, may also lead to cancer immunotherapy applications.

CRI created **Infectio Research Inc.**, which develops the Invisible Condom<sup>®</sup>, a phase 3 vaginal microbicide aimed at protecting women against HIV/AIDS and other sexually transmitted infections. In view of the fact that women account for half of the 373 million new cases detected annually, this mode of protection could prove to be a highly effective prevention tool.

**Dr. Guy Boivin** has made a number of major breakthroughs in the diagnostics, pathogenesis and treatment of viral infections. Recognized internationally for his work, he holds the Canada Research Chair on Emerging Viruses and Antiviral Resistance, in addition to heading the Influenza Surveillance Centre and the Pandemic Influenza Virus Surveillance Centre.

**Dr. Marc Ouellette** has combined the study of plant viruses and hepatitis C to provide a better definition of parasites' built-in resistance to antifolates and other anti-parasite medications. Today, he serves as scientific director at the Canadian Institutes of Health Research's Institute of Infection and Immunity.

**Dr. Paul H. Roy** discovered integrons, which have shed new light on bacterial antibiotic resistance, a major issue in infectious disease therapy.

**Dr. Barbara Papadopoulou** develops next-generation vaccines in the fight against HIV/AIDS and leishmaniasis based on genetic engineering technologies.



# SEEK AND YE SHALL FIND!

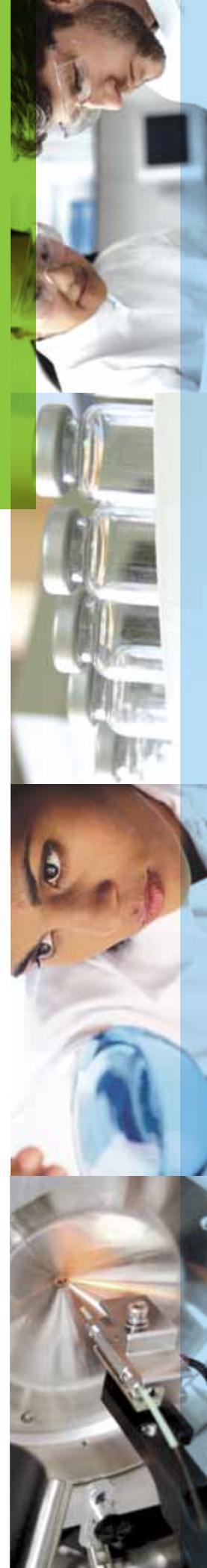
## LIFE SCIENCES: REAPING THE BENEFITS OF INTERDISCIPLINARITY

As a rising star in the vaccine and diagnostic industry, the greater Quebec City region boasts a wealth of additional biopharmaceutical expertise. From flu to hepatitis C, close collaboration between basic and clinical researchers is greatly facilitating the fight against 21<sup>st</sup> century diseases by speeding knowledge transfers and improving patient care and quality of life.

## MADE-IN-QUEBEC

### MEDICAL BREAKTHROUGHS

- Delivery of a flu vaccine ready for trials only one month after the genetic sequences are identified and received, rather than six months using current methods (Proficia™ and PPV).
- Identification of microbes in less than one hour, rather than 48 hours, thanks to integrated on-site diagnostic DNA technology.
- Development of the first real-time PCR tests approved by Health Canada and the US Food and Drug Administration (FDA).
- Detection of group B streptococcus among pregnant women during childbirth aimed at preventing meningitis among newborns (BD GeneOhm™ Strep B Assay).
- Detection of methicillin-resistant Staphylococcus aureus aimed at preventing MRSA in hospitals (BD GeneOhm™ MRSA Assay).
- Discovery of the relationship between abdominal fat and the risk of cardiovascular metabolic complications (regardless of individuals' overall weight), facilitating the identification of type 2 diabetes and cardiovascular disease risks.
- Development of a medication used to treat vaginal atrophy and other menopause-related symptoms (Vaginorm™ by EndoCeutics).
- Vaginal microbicide used to prevent HIV/AIDS and other sexually transmitted diseases among women (Invisible Condom®).
- Development of a diagnostic application removing the need for an initial prostate biopsy in 40% of cases, thanks to the detection of PCA3 RNA expression in the urine (Progenesa™).
- Development of a colorectal cancer staging test indicating the presence of metastases and used to predict the risk of stage II recurrence normally considered low risk (Previstage™ GCC).
- Development of a GCC blood test (GUCY2C) for post-surgical monitoring of colorectal cancer recurrence. This new test is an improvement over current tests, which detect less than 60% of recurrence and have a high false-positive rate.
- Treatment of multiple myeloma and advanced metastatic colorectal cancer (Perifosine®).
- Anti-estrogen therapy for breast cancer treatment.
- Reversible medical castration using LHRH agonists and replacing surgical treatment (\$60 billion in world-wide revenues).
- Initial treatment designed to extend the life of prostate cancer patients (77% survival rate improvement after five years).



## DRIVEN BY CURIOSITY

The Quebec City region is home to major state-of-the-art research centres (cardiology, genomics, infectiology, immunology, obesity, oncology, neurosciences, biophotonics, nutraceuticals and functional foods), including the following:

- **CHUQ RESEARCH CENTRE (CRCHUQ)** - The CRCHUQ is Canada's largest biomedical university research centre and has gained an international reputation, thanks to the high-quality work of its researchers and its ultramodern facilities. The world's first molecular endocrinology lab was founded there in the early 1980s. [www.crchuq.ulaval.ca](http://www.crchuq.ulaval.ca)
- **INFECTIOLOGY RESEARCH CENTRE (CRI)** - The CRI is Canada's leading infectious diseases research centre and the fifth largest in the world. The CRI boasts a multi-disciplinary team of more than 250 scientists from 20 countries. [www.cri.ulaval.ca](http://www.cri.ulaval.ca)
- **QUEBEC CITY UNIVERSITY INSTITUTE OF CARDIOLOGY AND PNEUMOLOGY RESEARCH CENTRE (CRIUCPQ)** - A world leader in the areas of obesity and cardiovascular/respiratory complications. The CRIUCPQ is the only facility in Canada, and one of the few in the world, that undertakes research in all three of these areas. [www.criucpq.ulaval.ca](http://www.criucpq.ulaval.ca)
- **NUTRACEUTICAL AND FUNCTIONAL FOOD INSTITUTE (INAF)** - At the INAF, biochemists, food engineers, nutritionists, doctors and pharmacologists use food products to prevent disease. Quebec City is home to the largest concentration of food science and technology professors/researchers in the country. [www.inaf.ulaval.ca](http://www.inaf.ulaval.ca)
- **NATIONAL OPTICS INSTITUTE (INO)** - The INO is Canada's largest applied optics/photonics research centre. Its expertise covers a wide range of biomedical disciplines, including biophotonics, applied spectroscopy, 3D sensors, fibre sensors, special optical fibres and laser micro-machining. [www.ino.ca](http://www.ino.ca)



## RESEARCH SERVING SCIENCE AND INDUSTRY

- Largest concentration of researchers per capita in Canada.
- 6,000 researchers and associates.
- 400 laboratories, groups, consortiums, institutes and R&D centres.
- In 2010, Laval University held 630 active patents.
- Nearly one-third of the working population in the Quebec City region is employed in the science and technology sector

Sources: Quebec Statistics Institute (ISQ), Statistics Canada and Québec International.



## QUEBEC CITY REGION: IMPORTANT DECISION-MAKING CENTRE

As the political capital of Quebec, the Quebec City region plays a key role in health-related decisions at the institutional and public health levels. Headquartered in Quebec City, the provincial Department of Health and Social Services (MSSS) oversees nearly \$3 billion in annual expenditures on products and services.

In the spring of 2007, the Government of Quebec unveiled its Drug Policy, which recognizes the importance of innovation in the pharmaceutical industry and is aimed at spurring development. As the first socio-economic initiative of its kind in North America, the Drug Policy sets out an integrated strategy based on improved access to prescription drugs.

The region is also home to the Quebec National Public Health Institute (INSPQ). A major expertise and reference centre, the INSPQ plays a leading role by proposing strategies and initiatives designed to improve public health and well-being. The INSPQ also advises government authorities on public health decisions, including the Quebec Immunization Program. In addition, the INSPQ provides a solid scientific foundation for vaccination programs and ensures support services for the vaccination information system, the documentation of side effects and the evaluation and organization of vaccination services.



# A BOOMING INDUSTRY

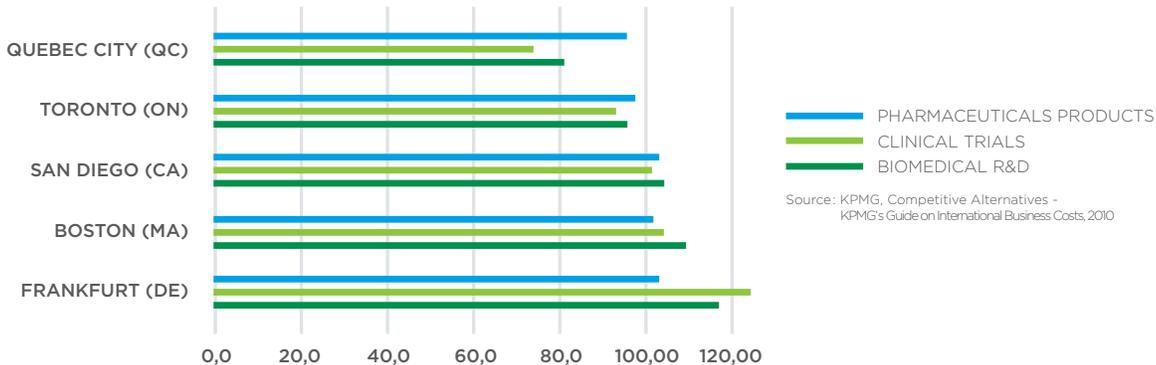
Backed by Québec International, the region's pre-eminent regional economic development agency, vaccine and diagnostic industry stakeholders ensure sector growth and development by sharing cutting-edge information on best practices, business opportunities, technology transfers and training/specialized worker needs with research centres and companies participating in a community of interest.

## COMPETITIVE OPERATING COSTS

Quebec City is the most competitive place for doing business in Canada, compared with other similarly-sized regions. It ranks first in North America in terms of operating costs, which are lower than the averages for US cities in the areas of clinical trials (27% lower), biomedical R&D (20% lower) and pharmaceutical product manufacturing (6% lower).

### COMPARISON OF LOCATION SENSITIVE COSTS

Index: United States = 100

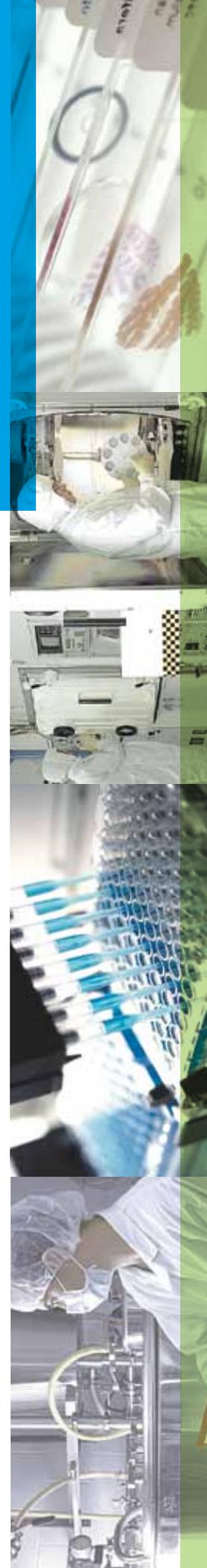
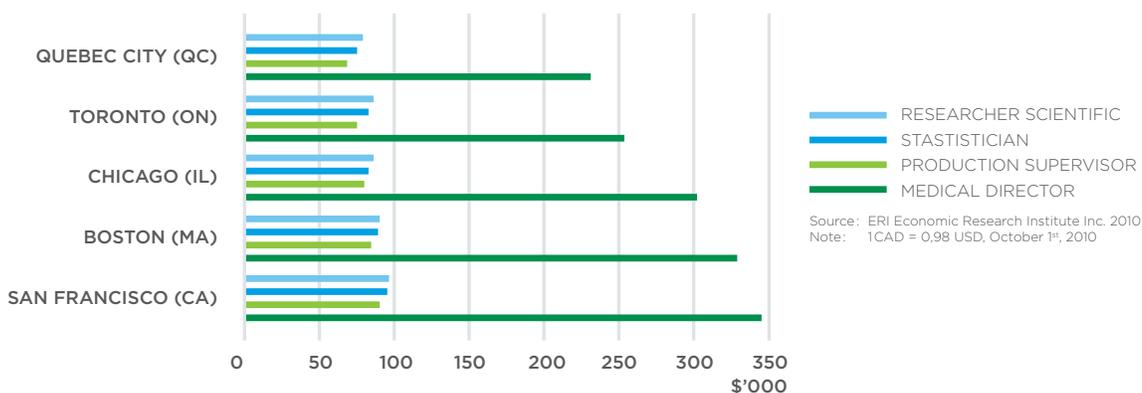


## COMPETITIVE LABOUR COSTS

The province of Quebec is internationally recognized for its stable, high-quality workforce. The Quebec City region compares favourably in terms of labour costs.

### COMPARISON OF WORKERS' TOTAL COMPENSATION

Based on Average Salary in US\$



# THE QUEBEC CITY REGION

LEADING THE WAY

“Quebec City is a unique location for us since it has everything we need to compete effectively in the business world, including a qualified and stable workforce for research and vaccine production, various business-friendly tax incentives and low set-up and operating costs.”

Paul Lucas, President and CEO,  
GlaxoSmithKline Canada

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