

# Health care and the innovation agenda:

## Assuring Canada's growth in the life sciences' century

Report from the conference  
Health Innovation, Wealth Creation  
and System Renewal  
November 20<sup>th</sup>, 2003,  
Montreal

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# **Health care and the innovation agenda:**

**Assuring Canada's growth  
in the life sciences' century**

Report from the sixth annual conference  
in the Merck Frosst *Directions for  
Canadian Health Care* series  
November 20<sup>th</sup>, 2003

**Edited by Susan Usher**

# Foreword

## ■ Alain Caillé

Canada's health care system must contribute simultaneously to a number of broad public policy goals, the most important being to provide the Canadian population with access to the most advanced medical services; to promote social solidarity and equity; and to serve as an economic development driver.

The difficult task of balancing these multiple public policy objectives was explored by the 2001 Directions conference report, "Innovation, Health Research and Canada's Prosperity." In the past few years, Canada and its provinces have made significant progress in implementing an innovation platform at the research level. We have maintained and increased university research funding, created a major new agency for funding research at the federal level with the Canadian Institutes for Health Research (CIHR), invested in genomic research, established the Canada Foundation for Innovation, and devised a special \$500 million fund for research hospitals. But there remain significant barriers to the efficient transfer of research that risk negating the gains of this investment. Important issues need to be addressed in our commercialization, regulation and adoption of innovation if we are to see real economic benefit from innovation.

The 2003 Directions conference, "Health Innovation, Wealth Creation and System Renewal," examined the progress made on national health care goals and looked at specific projects encouraging the production, transfer and adoption of fresh ideas in the health care system. Keynote addresses from Henry Friesen, André Marcheterre, Daniel Denis, and David Griller looked at the broad goals that have been set out for health innovation in Canada and at the challenges these present to private companies, universities, and policymakers. Three panels then examined recent initiatives in areas that contribute to meeting innovation goals: the health system, universities, and economic development partnerships.

Canada has made significant progress in the innovation agenda over the past few years. The conference explored what is driving innovation forward, what lessons are being learned, and what barriers remain. Clearly, the next step is to propel participants into action.

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# Executive Summary

Canadians expect our health system to provide access to the most advanced medical services and to promote social equity. This has been asserted through every commission and public consultation held in recent years. However, a third expectation has recently entered the picture: that Canada's health system serve as a driver of economic development. Many provinces have their hopes pegged on the life sciences' sector to keep their economies growing. Provincial and federal governments have supported these ambitions through an innovation agenda focused on increasing research funding in universities, institutes and hospitals.

But however much these efforts contribute to the flow of new ideas, Canada will not see the economic rewards from innovation unless our health care system begins to welcome and drive innovation rather than erect barriers against it. Assuring economic growth in what many are calling the "Life Sciences' Century" requires that health policy and industrial policy work together to create a highly competitive environment for health sciences discovery, commercialization, assessment and use. The conference "Health Innovation, Wealth Creation and System Renewal," held November 20th, 2003 in Montreal, explored what is driving these changes forward, what lessons are being learned and what barriers remain. This report presents the key findings and recommendations from the conference.

## Where does Canada stand today?

The 2001 Speech from the Throne set the goal of Canada becoming, by 2010, one of the top five jurisdictions in terms of R&D intensity (R&D as a percentage of GDP) in North America. Great ambitions are not, unfortunately, matched by current realities. Canada's overall level of innovation capacity is near the bottom of the world's leading economies. R&D intensity, now at 1.9%, would

have to rise to 3.1% to meet the 2010 goal. To achieve that, the public sector would have to double its investment in R&D and the private sector would have to increase investment by 150%.

The burden falls on a very small number of companies in Canada, concentrated in the biopharmaceutical, information technology and communications sectors. These companies would have to increase their revenues by 15% per year and invest 13% of their revenues in R&D in order to achieve the 150% increase in R&D investment by 2010.

Canada faces fierce competition for R&D dollars from multinational biopharmaceutical companies. Some of the factors that influence where a company will invest include the productivity of a country's innovation system (which includes public sector investment in R&D), the level of intellectual property protection, the degree of market access and the regulatory system that determines how quickly a product is approved for market. In none of these areas is Canada performing well enough to provide a competitively attractive environment for investment. Patent terms were lengthened in the 1980s and 1990s but, unlike the US, Japan and the European Community, we still do not provide patent term restoration, and considerable loopholes and grey markets exist. Provincial formularies, the key to market access, have grown increasingly restrictive, and delays in regulatory approval have not improved since 1997.

The competition for biopharmaceutical investment is not between Québec and Ontario, but with places like Boston, San Francisco, Research Park Triangle in North Carolina and Biopolis in Singapore. While Québec and Ontario rank third and fourth in North America in numbers of biotech companies, federal and venture capital investment in the Canadian centres is only one tenth that in the US cities. These are the numbers that matter because they are the prelude to sales and real productivity.

# Making the health care system an engine for economic growth

The notion of stewardship for the health system is focused on preserving and protecting. Dr. Henry Friesen proposes we must also include the mandate of growing the asset if we are to pass on a healthy system to future generations. That, he says, is the key to sustainability. Ten percent of our GDP goes to health services, equipment and devices, much of which is now bought from elsewhere. That investment in health could instead be leveraged to help build a Canadian industrial sector larger than the auto sector. An abrupt shift in focus is required away from the exclusive preoccupation health administrators now have on controlling cost and towards recognizing the advantages inherent in our public system and exploiting them for economic gain.

Opportunities exist in every area, from pharmaceuticals to research to health facility design to information technology and medical devices. The investment in the “push” side of innovation must be matched by investment in the “pull” or demand side to increase market opportunities for health products, encourage excellence, and make our health system one that sets the global standard for innovation.

We are part of a global environment and our search for participants who are willing to engage productively in the Canadian environment is not limited to Canadian players. We already see multinationals productive in Canada in the pharmaceutical industry and need to expand discussion with them to create an environment in which they can capitalize on the Canadian advantage.

## A ten-point strategy

Canada currently represents about 2% of global spending on medication but receives only about 1% of biopharmaceutical research spending. We lag behind other industrialized nations, and this lag has widened slightly in the past few years. Canada has a wealth of world-class scientists, as

well as a strong base of companies in the biotechnology and pharmaceutical areas. We have what we need to do more, but we are not achieving the results we should, especially compared to what we see in other countries. SECOR developed a ten-point strategy for improving Canada’s performance in health innovation.

- 1** Continue support for basic research, increasing it at about 15% a year.
- 2** Support biotech startups to avoid throwing a multitude of weak premature infants into the field.
- 3** Clarify and stabilize intellectual property rights in Canada. Too many years are now burned up by regulatory approval delays and grey markets.
- 4** Make our regulatory process more efficient, possibly by improving cooperation with the US FDA.
- 5** Strengthen established Canadian biotech companies with venture capital and facilitate alliances with pharmaceutical companies.
- 6** Clearly delineate generic and pharmaceutical territory.
- 7** Conduct more utilization research to increase productivity in the health care system.
- 8** Eliminate grey markets.
- 9** Improve the coherence of health and industrial policies.
- 10** Forge a new deal with global pharmaceutical firms. Cleaning up our act on other fronts should bring more support for research, clinical trials and post-market clinical research.

## INTRODUCTION

# Science's new century

### ■ Robert Lacroix

*Rector, Université de Montréal*

In an old movie called *The Man in the White Suit*, a scientist invents an indestructible material that is totally stain-resistant. The material could revolutionize the garment industry. But representatives from the large textile firms hear about it and do everything they can to prevent the inventor from patenting his discovery. The new material signals death to their industry, which needs stained and used clothes to survive.

This movie illustrates a world that no longer exists. In the knowledge-based economy, innovation is no longer perceived as a threat to established industry. Instead, it is part and parcel of industrial development, and most enterprises seek to increase the transfer from idea to product.

At present, Canada's overall level of innovation capacity lags behind the world's leading economies. Our innovation performance is improving fast in a small number of areas and we have adopted some powerful tools for promoting medical research. The creation in 2000 of the Canadian Institutes for Health Research (CIHR) is part of a strategy articulated around research and development (R&D) to make Canada a hot bed of medical and pharmaceutical innovation.

The great innovations of tomorrow will be in the life sciences. "Life" will be for the coming era what "matter" was to the last, and the components of life will be to biomedical science what atoms were to physics and chemistry in the 20th century. Mastery of the secret code of life will lead to fields of exploration so vast that it is still difficult to envisage their limits.

In medicine, genetics and molecular biology will have a major impact on diagnostic and therapeutic methods, and will profoundly change the nature of care offered to the sick. What medicine in the 20th century did for populations, largely through vaccination, medicine in the 21st century will do with targeted therapies made for individuals: cellular therapies for leukemia, molecular therapies for the production of anti-cancer agents, genetic therapies in the treatment of congenital illness.

Universities do not have a monopoly on innovation but are key players in the innovation process. Many of the discoveries that nourish globalization today first came to light in a university lab. Canadian universities account for more than a quarter of all R&D activity across Canada. They are a source of innovation for Canadian firms and are being called upon to deliver ever more high calibre individuals to the business sector. The portion of university research financed by industry has more than doubled in 10 years, and the federal government has made university research the launching pad for its innovation strategy.

Medicine has received the lion's share of these investments. At the Université de Montréal, almost half of research funds go to medical and biomedical

research. The last strategic plan for innovation and health research issued by the CIHR underlined the importance of research partners, and asserted that the success of the Institutes depends on “a global approach that brings together the members of the health research enterprise, including those who finance research, those who undertake it, and those who use the results.” Universities and industry have a key role to play in this global approach. They need to consolidate the links forged over the past few years, and to reduce the lag-time between scientific discoveries and clinical application.

The innovation agenda will develop new fields of science and ways of practicing medicine, as well as fresh partnerships involving all players in the medical field. Innovation will create more flexible therapeutic approaches, better drugs, and less intensive health care. As clinical medicine is an ideal location for innovative research, the university hospital will be the cornerstone of this new approach. Currently, however, Canadian hospitals are taken up by clinical activities and patient care. They lack the time, money and space to accomplish their scientific function. Around 90% of activities in health sciences centres directly involve care. In order to change this state of affairs and maximize their innovative potential, hospitals must become enormous laboratories equipped to provide highly specialized care to the population, train researchers and professionals, and direct research in rewarding medical fields. The university hospital of the 21st century should not be a simple care dispensary. In order to offer high quality services, it needs to serve as a platform for researchers’ work in medical, biomedical, and pharmaceutical areas while fulfilling a triple vocation that is clinical, academic and scientific.

The best way to contribute to the innovation strategy is to give university health centres the means to carry out this triple vocation. More innovative cities and institutions are already seeing a fertile synergy taking root between universities and industry. Think of Boston’s Wyatt Institute or Toronto’s Medical and Related Sciences (MARS) Discovery District. Increasingly across North America, industry is seeking to develop alongside university health centres for reasons beneficial to both.

If we are to truly cook up something better and new, the ingredients are already there, bubbling away in the dynamic between university, hospital and industry. That’s where the medicine of tomorrow is. We cannot invent healthy men, women and children, but we can invent the tools that will help us to rid the world of the diseases afflicting humanity. Canadian universities and industry are well positioned to create innovative therapies that can make a difference.

### CHAPTER 1

# Aligning Canada's health and economic agendas

#### ■ Dr. Henry Friesen

*Chair, Genome Canada*

Three years ago, the late Honourable Ron Duhamel, then Minister of Western Economic Diversification, put the question: could Canada's health system be an engine for economic growth? If so, how would it work?

Many Canadians have been trying to answer that question ever since. In the interim, a number of important studies of the Canadian health care system have been conducted. Most prominent was the Romanow report, which convincingly established that Canadians value a publicly funded health system and see themselves and their governments as stewards of that system. This notion of stewardship is centred on preserving and protecting the system.

But there is another aspect of stewardship, and that is the responsibility to grow the asset we have and to pass on more than we received. Growing the asset requires that we see the health sector in a whole new way: not just as a provider of health for Canadians, but as a generator of wealth for Canada. Since medicare's inception, Canada has invested over \$1 trillion in the nation's health care support system, but has produced few if any branded health products that sell more than \$100 or \$200 million a year. We spend almost 10% of our GDP on health services, equipment and devices, much of which we buy from others. Our balance of payments deficit in health is about \$6 billion a year, which translates into some 50,000 to 60,000 private sector jobs in foreign countries supported by our health tax dollar. This is not the kind of stewardship that will fulfill our responsibility to future generations.

Health ministries today are focused exclusively on trying to maintain control and reduce costs,

which is a shortsighted approach that sees health care only as a public good to be consumed. There is a complete failure to recognize the economic potential of the sector. No health ministry in Canada has an economic development branch.

## The public advantage

The first step in seeing Canada's health system as a generator of wealth is to recognize the competitive advantage held by our publicly funded health system. Canadians have not yet perceived this as an advantage, but it is actually the foundation for a globally competitive industry sector. Canada needs to capitalize on and leverage the \$112 billion it spends on health care every year, and to take its place as a leader in the industrial sector that will

Right now, Fedex managers know more about the movement and location of their packages than health care managers know about their patients

define the winning economies of the 21<sup>st</sup> century. The global market for health care products exceeds \$1 trillion, and 50% of it is right next door in the United States. Canada now captures between one and two percent of that market, even though we produce 3% of the world's knowledge. At a minimum, Canada should aim to match market share to knowledge production, which would immediately double the economic opportunity.

The opportunities come in many different forms and sectors, from pharmaceuticals to information technology to medical devices to medical imaging (Figure 1). Studies here and elsewhere have identified the importance of managing the health care

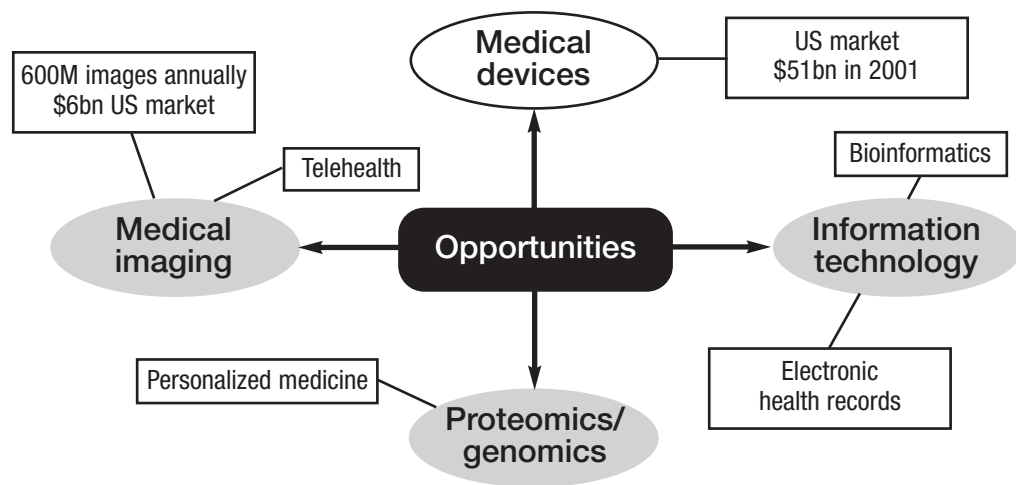
system more effectively and have concluded that more effective and appropriate health information systems are required. The federal government has set aside over \$1 billion to be spent through Canada Health Infoway, creating the databases, networks and electronic health records that will allow health system managers to access information more appropriately. Right now, Fedex managers know more about the movement and location of their packages than health care managers know about their patients.

Health facility design, construction and furnishing are other areas where we can leverage public investment into economic opportunity. More than \$2 billion is to be spent on the construction of two major health care centres in Montreal. If the companies with winning contracts produce innovative results, the expertise gained can be marketed globally. The lead architect for the Canadian Science Centre for Human and Animal Health used the knowledge gained on that project to become the world's leading authority on the design and con-

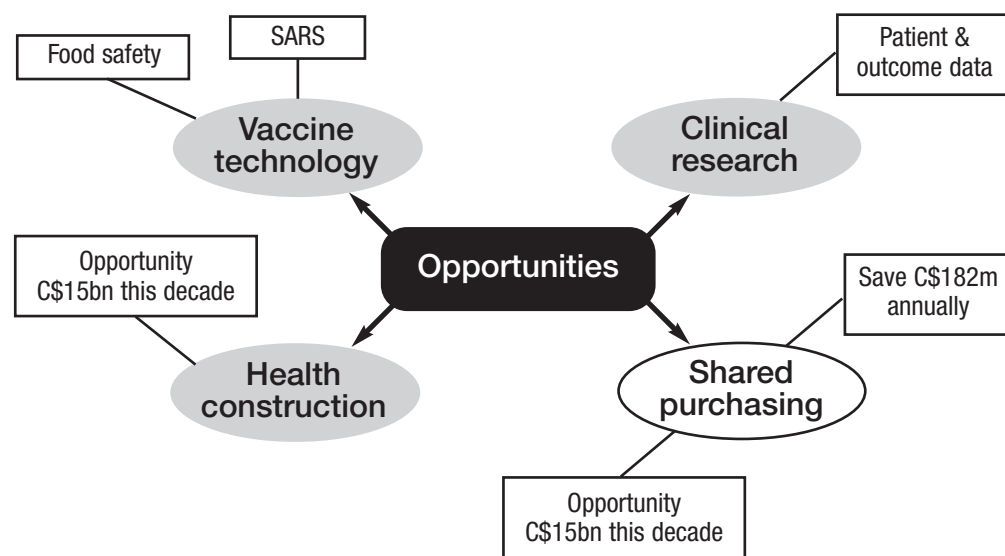
FIGURE

1

### Opportunities (1)



### Opportunities (2)



Courtesy: Dr. Henry Friesen

struction of high-containment facilities – an outcome that saw a \$130 million public investment in Manitoba transformed into over \$1 billion of high-containment construction around the planet.

Clinical research is a sector of growing importance. The many new molecules in the pipeline need to be properly evaluated before they are released into the market, and Canada, through its publicly funded health system, has a great advantage if we get the conditions and circumstances right. We need to do this quickly because the US National Institutes of Medicine has highlighted clinical trials as an area to pursue, and the US will gain an advantage in this highly competitive field unless we act fast. Canada already has quality and cost advantages, but impediments in the regulatory system make it difficult to offer companies the speed, timing and intelligent regulation they need.

## The push and pull of innovation

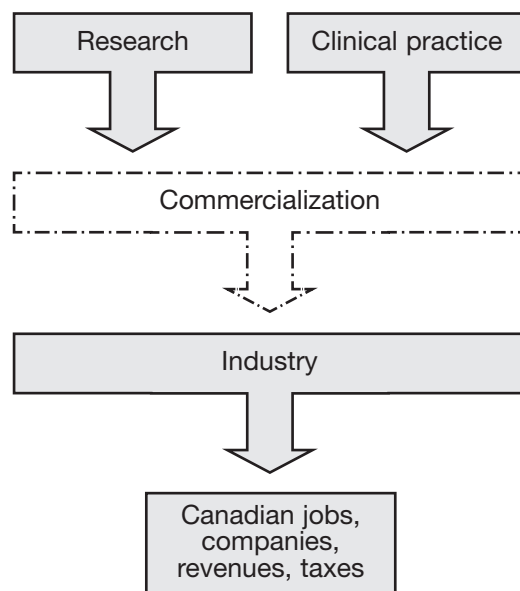
Roger Martin, Dean of the Business School at the University of Toronto, argues that health innovation is composed of at least two major elements:

supply, or the push side, and demand, the pull side. Federal and provincial government innovation programs have emphasized investments on the supply side – the creation of new ideas and new opportunities – and have invested some \$18 billion in pushing innovation forward. However, only a very modest amount has been invested on the demand side, which is equally important in bringing new ideas into practice and proving their worth. The Canadian health system could act as a vast receptor, or pull mechanism for innovation, if it were properly positioned and aligned in partnership with the private sector to incorporate and evaluate innovations. The Université de Montréal’s new Health Evaluation Institute (the Institut d’évaluation en santé) is a perfect example of how this can be structured.

Investment in the supply of innovation must continue to grow, but needs to be supplemented with investment in the receptor mechanism to make the cycle of innovation more functional and productive (Figure 2). The widely acknowledged commercialization gap in Canada exists in part because of a misalignment between the receptors and suppliers of innovation. When international

FIGURE  
2

### Canada’s Commercialization Gap



Canada has no focused mechanisms for commercialization in the health system

Courtesy: Dr. Henry Friesen

comparisons of the commercialization of discoveries are made, Canada does not come out well, although university efforts to enhance commercialization arrangements may improve our standing. Analyses of health market opportunities in both Montreal and Toronto have pointed to the deficiency in commercialization as a major impediment. A large part of Canada's investment in health care is currently used to purchase products and services from other countries. What a sound stewardship policy should have encouraged long ago is the development of opportunities for bright young Canadians.

## A health innovation strategy

Changing course now will take a national vision, leadership and a clear articulation of the case for our publicly funded health system becoming an engine of economic growth that sets a global standard for innovation while retaining value in Canada. In practical terms, this will involve aligning the health and economic agendas, finding

The Canadian health system could act as a vast receptor, or pull mechanism for innovation

mechanisms to fund health innovation, and creating a good investment environment. Existing clusters of health innovation need to be grown and knit together, and champions for health innovation need nurturing.

We should be using the national public system to our advantage. There are 40 academic health centres across Canada employing 200,000 people with an annual budget of \$17 billion, but each centre buys at off-the-rack prices as opposed to using more creative purchasing mechanisms. If we organized these centres collectively as a national franchise, they would suddenly have enormous power to negotiate creative purchasing mechanisms and create wealth and opportunity. Every major health contract could incorporate a business plan for export market development opportunities into its bidding criteria.

Canada is part of a global environment and the search for participants willing to engage productively in the Canadian scene should not be limited to Canadian players. Multinationals are already active in Canada's pharmaceutical industry and there is a need to expand discussions with them about the creation of an environment that capitalizes on Canada's advantages. There is potential in the area of clinical trials, in partnerships to develop investments made by government in new ideas and products, and in assisting innovative Canadian entrepreneurs. In recent years, a growing number of the pharmaceutical products being licensed have their origins not in the industry's internal development, but in research that was outsourced or purchased in partnership by multinationals.

Innovation itself, however, happens locally, spurred by health innovation clusters led by industry partners in collaboration with teaching hospitals and universities. This is a mechanism that needs to be fostered. The potential power of this model is plain to see: health innovation units operating at a local level, specializing and differentiating themselves as they share expertise and link up across the country.

One positive idea is the possibility of creating a body that could be called something like Health Innovation Canada. Part of its mandate would be to build innovation capacity locally, regionally, and nationally in partnership with existing health industries. The other part would be to create incentives within the system by funding mechanisms to enhance commercialization, marketing, and export readiness. The desired outcome is to capitalize on the Canadian advantage of a publicly funded health system by building a globally competitive Canadian health industry sector capable of delivering world-class innovative health products and services. Stewardship of the health system moves from a reactive, inward-looking concentration on protecting and preserving what we have, to a social program not only grounded in the values of Canadians, but embedded as an economic driver for our country. ■

## CHAPTER 2

## Attracting investment to Canada

■ **André Marcheterre***President, Merck Frosst Canada*

When Michael Porter's innovation index is graphed against GDP per capita, it becomes obvious that the countries with the highest innovation index are also those with the highest GDP per capita. This is why supporting innovation is and should be at the core of the economic development strategies that industrialized nations pursue.

Innovation can be defined as the investment we are willing to make in the public and private sectors in order to discover new things. As the president of a subsidiary of a global organization, I am only too aware that research and development is the key to survival. The rate of renewal in the biopharmaceutical sector is very fast: the products that constitute 70% of sales in Canada today were not on the market 10 years ago. The opportunity to prosper and grow depends on the ability to discover technologies that will help health care providers and government produce better therapeutic outcomes in a cost-efficient way.

The real question of interest, however, is not whether R&D will be done, but where it will be done. What makes a company choose to do its R&D in one country over another? One obvious reason: The use of the productive innovation system that exists in that country. But many countries have similarly productive innovation systems. More important, perhaps, are the incentives a company gets for investing in R&D and the attractiveness of the country's commercialization system.

## Factors that influence investment

Investment decisions in this area are influenced by a number of criteria, the first of which is the level of intellectual property protection a country pro-

vides. Bringing a new pharmaceutical product to the market takes an investment of about eight to 10 years and \$1 billion in R&D. Researchers typically look at some 15,000 molecules before finding one that can become a pharmaceutical product. Out of 10 products that make it to market, only three will actually have sales sufficient not just to pay for the R&D but also to turn a profit. Moreover, the innovative product that emerges at the end of that process is usually something that can be reproduced quite easily by a good team of chemists. Therefore, unless a company is assured a sufficient time period over which to earn back this investment and make a profit, it will not conduct R&D in that country.

Canada has largely succeeded in the last 15 years in assuring world-standard intellectual prop-

The patent on an innovation may be well protected, but if the innovation never gets to market, the protection is worth nothing

erty protection (IPP) through Bills C-22 in 1987 and C-91 in 1993. However, a few problems remain. Canada does not yet provide patent-term restoration, despite the fact that the US, Japan, and European Community have moved in that direction. Also, mechanisms to enforce patent protection in Canada are weak and provide loopholes that allow the generic sector to bring their product to market before the patent expires. These weaknesses make the environment less predictable for innovative companies and take away from the competitiveness of the Canadian environment.

The second criteria companies look for is market access. The patent on an innovation may be well protected, but if the innovation never gets to market, the protection is worth nothing. In Canada, market access is defined by the ability to get prod-

ucts accepted as a reimbursement benefit on provincial formularies. The situation is not as good as it should be, with only 30 to 50% of new molecules accepted for reimbursement by the various provinces in the past few years, many of these with restricted use provisions. The notion of market access also includes pricing. The current discussion of cross-border drug sales effectively illustrates that pharmaceutical product prices in Canada are 40-50% lower than prices in the US. They are also five to 10% lower than prices in the European Community.

Another important criteria is the time it takes for regulatory agencies to review the file a company submits in order to get a notice of compliance (NOC). Time spent waiting for Health Protection Branch (HPB) approval cuts into effective patent life significantly. The situation has improved from the early 1990s when it took on average 1,143 days to get a product approved; by 1996-97 the

deciding where to invest the three or four billion they spend each year on R&D. Canada should compete for these investments. Innovation is key to this country's prosperity, and prosperity will help sustain our health care system.

## An ambitious goal

There are many indications that Canada has decided to compete globally for biopharmaceutical investment. The 2001 Speech from the Throne set the goal of Canada becoming, by 2010, one of the top five jurisdictions in terms of R&D intensity (R&D as a percent of GDP) in North America. Attempting to envisage what that goal would involve is a difficult task helped considerably by a study done by Dr. Douglas Barber. Conducted for the Information Technology Association and published in *Research Money Inc.* in September 2003, Dr. Barber's study tried to define what the achievement of this goal would look like. He found that overall R&D spending as a percent of GDP in Canada was currently 1.9%. If Canada's goal for 2010 were to be achieved, that percentage would have to rise to 3.1%. To reach that, the public sector would have to essentially double its current level of investment in R&D, which the federal government has in fact committed to do by 2010. The private sector would have to increase its current investment in R&D by 150%.

Dr. Barber then tried to break down the numbers and see whether the goal was actually feasible. He was shocked by the results of the analysis. The challenge of moving Canada into the top five among innovation intensive economies hinges on just 120 companies, primarily in the areas of information technology, communications and biopharmaceuticals. They are responsible for the vast majority of R&D accomplished by the private sector in Canada. For private sector investment to grow by 150% by 2010, these 120 companies would have to grow their revenues by 15% per year and invest 13% of their revenues in R&D. If this were to happen, Canada would achieve the level of 3.1% of GDP going to R&D that would make this country one of the top five worldwide in terms of R&D intensity. Dr. Barber's analysis tells

The challenge of moving Canada into the top five among innovation intensive economies hinges on just 120 companies

wait was down to about 700 days. The objective of bringing that down to 350 days – the norm in other industrialized countries – was set in 1998 when the pharmaceutical industry started paying for file reviews by the HPB to help achieve that goal. Despite the \$40 million the industry now invests in reviews, the 700 days has remained constant from 1997 to 2003. However, the goal remains valid. In the last Speech from the Throne, Canada's federal government announced that shorter review times remain a priority.

Companies also want to see investment in R&D by the public sector. Significant federal and provincial investment in health research contributes to creating infrastructure in hospitals and universities, as well as in developing scientists locally. A healthy local environment has a very positive synergistic effect with biopharmaceutical company activities.

These are the factors a multinational pharmaceutical company like Merck Frosst will consider in

us that the goal is feasible and that moving towards it requires not even picking winners, but backing winners: those organizations that already operate and already invest in R&D in Canada.

What is needed is a strategy to back these organizations. The formulation of any successful strategy requires that Canadians realize they are in a global race, and must take as its starting point an understanding of what drives decision-making in the particular R&D intensive industries this country supports. Biopharmaceutical companies are driven by the strength of the innovation system, its productivity, and the attractiveness of the market. A productive innovation system relies on a comprehensive scientific base, qualified scientists, productivity enablers, and IPP. Commercial environments are made attractive by market access, pricing and review times. You do not need a lot of research to find out what changes are needed to create attractive environments that promote growth in the targeted knowledge industries. But the policy frameworks developed need to be consistent and predictable.

At the provincial level, both Ontario and Québec now want to target the biopharmaceutical sector for economic development. Québec has traditionally done so and Ontario is just starting to look at it as a real opportunity. Yet in both provinces, market access is decreasing. In both, a price freeze on the reimbursement of pharmaceutical products has been in place for the last 10 years, making it impossible for companies to increase their prices and creating pressure on revenues. This makes it less likely for pharmaceutical companies to increase revenues by 15% per year so they can invest 13% of sales in R&D to achieve the research intensity goal.

Revenue growth in the biopharmaceutical sector need not translate into equivalent increases in health care spending. Canada does face problems with the productivity of its health care system. Canadians invest about 50% of provincial government revenues in health without any assurance that the money is going to produce optimal therapeutic outcomes in the most cost-effective way. There are many strategies in place to control cost, but few to manage the productivity of the system.

The equation between increased revenues to companies and improvements in the health of the population should become more balanced. There is

Revenue growth in the biopharmaceutical sector need not translate into equivalent increases in health care spending

an extraordinary opportunity for the public and private sectors to work together to collect information on interventions, results and costs, and to then better manage disease to obtain optimum, cost-effective results. The principal players in the pharmaceutical sector believe strongly in the importance of such partnerships. ■

## CHAPTER 3

## Understanding the competition

## ■ Dr. Mark Poznansky

*President, the John P. Robarts Research Institute*

If my views on innovation in Canada are somewhat negative, it is because of real worries about this country's competitiveness. However, Canada has the potential to be a great country in the fields of medical research and biotechnology.

What is happening today in the biotech industry that makes bankers say it is "passé"? Over the past two years the market capitalization of many of biotech companies has halved, even as sales have risen by 25% per year. Each of the major American companies – Amgen, Chiron, Genzyme and Genentech – has followed this pattern. Indeed, biotech industry sales will keep going up by 20% per year as they have for the last 10 years, will exceed those of the automotive industry somewhere around the year 2014, and will hit a trillion dollars by 2024.

The biopharmaceutical sector will grow. The question is where that growth will be based. A good number of cities internationally want to have significant biotech industries. If Canadian cities want to be among those that succeed, they need to keep track of what their competition is doing and surpass them.

California, Massachusetts, Québec and Ontario rank first through fourth in North America in numbers of biotech companies. The ranking is similar for numbers of life scientists. However, federal R&D investment in Québec and Ontario is only one tenth that in California and Massachusetts, and venture capital investments follow these almost directly (Figure 3).

Boston, Massachusetts, a city that was totally dependent on the military industrial complex all though the Cold War and saw company after company go bankrupt in the late 1980s, now has a GDP 2.5 to three times that of Montreal (Figure 4).

## Evaluating the Canadian Biotech Industry

FIGURE

3

	California	Massachusetts	Québec	Ontario
No. of companies	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
Life scientists	6,000	4,900	3,200	3,200
Federal R&D	\$1.4B	\$1.5B	\$106B	\$144B
VC investments	\$4.5B	\$2.0B	\$2B	\$09B

Courtesy: Dr. Mark Poznansky

## Prosperity from new technology

FIGURE

4

City	GDP
Boston	\$73,470
San Francisco	\$64,836
St. Louis	\$35,318
Toronto	\$33,581
Montreal	\$26,629

Source: *The Gazette*, October 26, 2003 • Courtesy: Dr. Mark Poznansky

That new prosperity is coming from the biotechnology, pharmaceutical and high tech industries, and to a lesser extent from information technology (IT) industries. Across North America there are beacons of innovation in universities in Montreal, Toronto, Boston and San Francisco, but the places that light up in terms of patents and the commercialization of innovation are MIT and Harvard in Boston, and Berkeley and Stanford in San Francisco. Not surprisingly, that is also where the money is. While it is true that Boston and Toronto

have similar populations and fairly similar numbers of companies, there are 18.5 times more employees in the Boston sector than in Toronto and a similar gap in market capitalization.

Competition is also coming from further afield. A few years ago, Singapore grew concerned that much of its high-tech manufacturing was relocating to Malaysia and China, and decided that its future would be as the biotech centre of South-East Asia. A downtown area called Biopolis has been created as a world-class place to “work, live, play

## US, European & Canadian Biotech

FIGURE

5

	US	Europe	Canada
Sales/Revenue	\$39.0 B	\$7.5 B	\$1.0 B
Annual R&D spending	\$12.3 B	\$4.2 B	\$474 M
Number of companies	1,457	1,879	474
Number of employees	157,000	61,104	7,005
Number of public cos.	356	104	85
Market capitalization	\$382 B	\$51 B	\$11 B

All numbers 2001 year-end unless otherwise noted.

Source: Burrill & Company; E&Y; Peter Winter, *Canadian Biotech News* • Courtesy: Dr. Mark Poznansky

and learn in a setting dedicated to vision and inspiration.” Many pharmaceutical companies and contract research organizations (CROs) are now moving there. The project was financially supported by government and through policies that allowed stem cell and embryonic stem cell research. Research Triangle Park in North Carolina is another example of this trend: a farmer, a dean of medicine, and a mayor created the Park, which now has 38,500 people working in biopharmaceuticals and related industries. Canada, this is the competition.

The best indicator of future prosperity generated by biotech clusters is R&D expenditure because that is the prelude to product sales and real productivity (Figure 5). Montreal and Toronto are doing abysmally here. But there is a case to be

The best indicator of future prosperity generated by biotech clusters is R&D expenditure because that is the prelude to product sales and real productivity

made that R&D expenditures are driven directly by government R&D expenditure. As a result, along with improving the regulatory and investment environment for the biotech sector, our governments need to show sustained and considerable financial support.

The good news is that the biotech industry is still young. We are only in the early innings of a long ball game in a long season. Different levels of Canadian government have indicated strong interest in and support for a biopharmaceutical/biomedical industry in Canada. They have started to put policies and funding in place to endorse and promote this sector. But they have only started and they have to show the same staying power demonstrated by our competitors south of the border and abroad. ■

## CHAPTER 4

# Resolving contradictions in the policy environment

## From an analysis of Québec's biopharmaceutical sector

■ Daniel Denis and David Griller

*Partners, SECOR*

We are at the start of a revolution in the health sciences sector that could be as big as the revolution in information technology. Medications are rapidly replacing many other forms of treatment. They are cost-effective and often vastly superior to traditional treatments. Medications will capture a growing slice of the health expenditure pie – a major economic shift.

Demand is being stimulated by factors such as the aging of the population and by innovative products. In the biopharmaceutical area, a multitude of ideas with the potential for commercialization are rapidly emerging. The US is the focal point of this activity. Almost \$20 billion worth of research has moved from Europe to the US. Canada needs to find a way to take advantage of this shift.

Canada currently represents about 2% of global spending on medication but receives only about 1% of biopharmaceutical research spending. It lags behind other industrialized nations, and this lag has widened slightly over the past few years. Canada has a wealth of world-class scientists, as well as a strong base of companies in the biotechnology and pharmaceutical areas. It needs to do more, but is not maximizing the potential of even its current opportunities.

Much greater coherence is needed in economic development and health policies if Canada is to improve its standing. Our federal and provincial governments express the desire for more investment from the pharmaceutical sector even as they try to squeeze spending on pharmaceutical products. Although Canadians indisputably want access

to the best medicines, Canada has the slowest approval system of all industrialized countries. We want more innovation and research, but Canada's intellectual property protection system does not meet the standards set by the competition.

Much greater coherence is needed in economic development and health policies if Canada is to improve its standing

These problems have no easy solutions, but must be addressed if a winning strategy is to be developed. Resolving the contradictions in current policies will require much more collaboration between ministries, between different levels of governments, between public and private sectors, and between stakeholders in the health care sector. Coherence in policy demands that we understand both the innovation system that underlies the biopharmaceutical sector, and the key elements that make it dynamic (Figure 6).

## Understanding the biopharmaceutical sector

The biopharmaceutical sector is the most knowledge intensive of all, and universities are key players in its innovation process. It is a sector nourished by fundamental research. However, it also has the longest development cycle among industrial sectors and is the most regulated at all stages, from product development all the way through to commercialization.

Figure 7 describes the value chain in the life sciences, which starts with science, moves through

to products, and then to the commercialization and approval of those products. Each part of the chain is vital and if one element is weak the overall system suffers.

A sound strategy requires clear objectives for increasing R&D. Canada could easily increase its research intensity in the biopharmaceutical sector by 50%. Currently, Canada's research intensity is at 10% of sales, while the average in the main industrialized countries is 20%. Québec is something of an exception in Canada with research intensity at 19% of sales, but other provinces are far lower. Increasing the country average from 10% to 15% by 2010 is feasible, and one of the main determinants of success will be the ability to grow the biotech companies created in the past few years.

## A ten-point strategy

SECOR developed a ten-point strategy for improving Canada's performance in health innovation. Five are oriented towards innovation and five towards commercialization – getting products to market.

### 1 Continue support for basic research

For the first time in history, we can now look inside the cell at the level of genes, proteins and

molecules. We can see what is going wrong and how to fix it. Canada has responded positively to these new possibilities, doubling investment in academic research in the second half of the 1990s to bring CIHR funded research up to \$500 million. Another total \$1.7 billion has been put into Genome Canada, the Canada Foundation for Innovation, research chairs, and tax credits for small firms. Canada still trails the US by a considerable margin, but is keeping up on a per capita basis with most European countries. Investment into the research base needs to continue increasing by about 15% a year.

### 2 Support biotech startups

Canadians in the know often boast about the presence of 400 to 500 biotechnology firms in this country – a third the number of those in the US. But numbers alone can mean very little. One concern in Canada is that we spin out companies at too early a stage, creating weak and unprepared firms that lack management capacity. Very often the academic who developed the underlying research assumes the managerial function, as past experience in business is not always considered relevant. As a result, the mortality rate for new firms is very high. We need to invest in proof of concept and in taking proven concepts to market.

## Understanding Innovation Systems

FIGURE

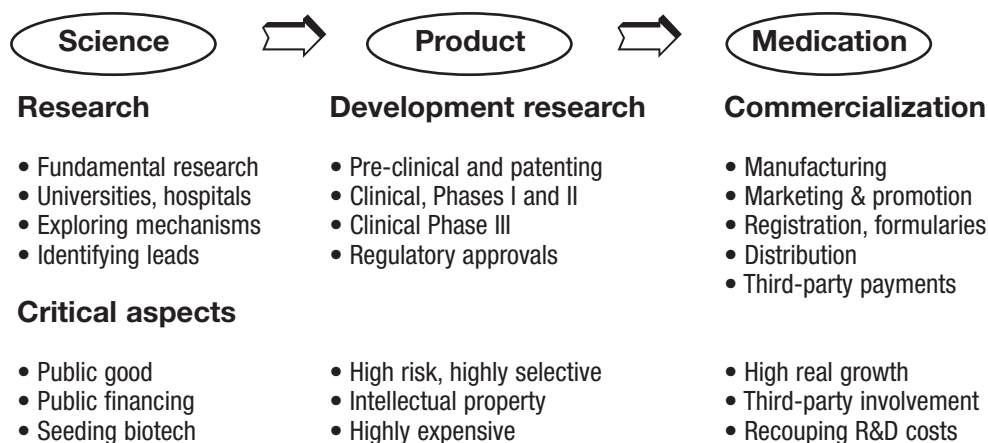
6

	<b>Aerospace</b>	<b>Computers</b>	<b>Biopharma</b>	<b>Energy</b>
<b>Value creation</b>	Anticipating needs in complex systems	Aligning products with evolving architecture	Transforming research into approved products	Reducing costs and improving quality
<b>Source of ideas</b>	Internal and clients	Internal and competitors	Internal and public domain	Suppliers and partners
<b>Influencers</b>	Clients	Clients and competitors	Regulator and scientific community	Partners and environmentalists
<b>Role of R&amp;D</b>	Advisory role	Interface role	Strategic role	Process role

Source: SECOR Consulting • Courtesy: Daniel Denis and David Griller

# The Life Sciences Value Chain

**FIGURE**  
**7**



Source: SECOR Consulting • Courtesy: Daniel Denis and David Griller

### 3 Clarify and stabilize intellectual property rights in Canada

While Canada provides 20 years of patent protection, eight to ten of these are burned up in research and development, another two are lost to regulatory approval, and yet another goes to listing drugs on provincial formularies. This puts firms in Canada at a huge disadvantage compared to those in other countries. At the other end of the patent's life, Canada makes it easier for generic products to come into the marketplace. Canadian patents must be extended by three to five years to bring them into line with US and Japanese standards, and to clean up the application of patent protection regulations. This would send a signal to the rest of the world that Canada is open for business on the same terms and conditions as other countries.

### 4 Make our regulatory process more efficient

The Health Protection Branch at Health Canada has approximately one tenth the number of employees as the US Food and Drug Administration (FDA). It cannot possibly review the same number of drugs to the same depth and levels of safety as the FDA. In Canada, we tend to review summary data rather than reconstituting raw data from clinical trials as is done in the US. Because of this situation, Health Canada needs to work much more closely with the

FDA, trading our expertise in reviewing chemistry and manufacturing for American know-how in reviewing clinical trials and data. Canada should harmonize its protocols and procedures much more closely to those in the US.

### 5 Support Canadian biotech companies

To strengthen Canadian biotechs, venture capital needs to be attracted, which will flow much more

One concern in Canada is that we spin out companies at too early a stage, creating weak and unprepared firms that lack management capacity

easily if there are stronger propositions to present. Canada also needs to facilitate good alliances between biotech companies and major pharmaceutical firms. The small biotech companies are excellent at research and development and the medium size biotechs are very good at bringing inventions through to Phase I and II trials. Big pharmaceutical firms are the ones with sufficient money to conduct Phase III clinical trials and take products to market. They are key to the growth of biotech companies.

**6** Clearly delineate generic and pharmaceutical territory

The rules that describe how products are genericized are currently unclear, changing, and never formally implemented in a consistent manner. The major pharmaceutical firms often play around with patents on drug formulations in a process known as “evergreening” to try and sustain patent lifetimes. The generic companies have armies of lawyers fighting patent battles in court at every opportunity. Canada has to clean up its rules, give the large pharmaceuticals a decent patent lifetime, and make it clear that when the patent is over, the generics have a decent right to start producing the drug in question.

**7** Conduct more utilization research

Utilization research is almost certainly the key to increasing productivity in the health care system. Our health care system has problems with over-administration of drugs and underutilization of drugs. The situation could be made better with the improvement of continuing education for doctors and a more effective use of the Internet for that purpose. Pharmacoeconomics research needs to be stepped up in order to increase productivity. Finally, more research should be carried out on new uses for existing drugs. Pharmaceutical companies cannot be relied on to do this, and research of this kind should be conducted in the medical realm. This type of research can be very important in oncology where combinations of drugs are used to treat disease.

**8** Eliminate grey markets

The Internet pharmacy companies operating in Manitoba have highlighted the issue of grey markets for pharmaceuticals. While the companies themselves may benefit, Canada will certainly lose out in the end. Canadian prices for drugs are much lower than American prices, and the grey Internet market provides a mechanism for prices to equalize. Since Canada is the small market and the US the large market, our prices will rise to match American prices unless Internet pharmacies are forced to stop operating. Some firms are already debating whether to sell drugs in Canada while others are trying to control the supply.

**9** Improve the coherence of health and industrial policies

The departments of Health and Industry operate as silos, with Health trying to contain costs and Industry trying to promote innovation. If this were a game of chess, pieces would not be moved independently like this, but would instead be used as a group to gain a strategic advantage, even if it meant sacrificing a piece here and there. Individual silos have to be rationalized and brought together in order to create a coherent industrial policy. It is also important to realize that the large pharmaceutical companies and smaller biotech companies are not distinct entities, but are instead closely linked and interdependent. Today’s biotech is potentially tomorrow’s major pharmaceutical company, and policy must respect the interests of both groups.

**10** Forge a new deal with global pharmaceutical firms

Global pharmaceutical firms clearly have a pivotal role to play in Phase III clinical development. They are the only companies that can afford to bring new products to market. But they should commit much more to R&D, not only in post-market clinical research or university research, but in the type of laboratory research Merck Frosst conducts to discover new drugs. This is a reasonable expectation if Canada cleans up its act on patents, grey markets and so forth. Canada should also accept a more realistic pricing regime and base formulary decisions on cost-benefit analysis. A drug that has a reasonable cost-benefit impact on the economy should be listed. Québec provides a good model for other Canadian provinces, with more comprehensive formulary listings, better tax credits and an environment that is generally more cohesive and stimulating for innovation and industrial research. ■



## CHAPTER 5

# Commercializing discovery for a viable biotech industry

## What's needed now?

Innovation will only lead to prosperity if we can get ideas out of the laboratory and transform them into useable products promoted by viable companies. In this chapter, three experts offer perspectives on the various challenges facing universities and biotech companies as they move innovation into the marketplace.

### Entrepreneurial thinking

Dr. Ulrich Krull is Vice-Principal of Research at the University of Toronto at Mississauga. According to Dr. Krull, Canada's innovation agenda has been hampered by a weak link – the quality of entrepreneurship needed to get products beyond proof of principle. He believes that finding a middle ground between academic and commercial views of intellectual property may make it easier for academic researchers to introduce concepts such as obligations, timelines and deadlines into their research design. "Universities also have to maintain the view that incremental wins are as important as breakthroughs," he says. "They need to focus on the stability of the overall research portfolio."

Canada's innovation agenda has been hampered by a weak link — the quality of entrepreneurship needed to get products beyond proof of principle

Dr. Kelvin Ogilvie is Chair of the Nova Scotia Premier's Council on Innovation. He thinks that harmonizing university policies on royalties and other rights would encourage the commercialization of

discovery and innovation. As he puts it, "a united stance in universities would emphasize the importance of ongoing intellectual input into the development phases of knowledge-based industries."

### Redefine success for universities

In recent years, there has been a preoccupation with measuring the success of investments in university research. But Dr. Krull suggests that measures such as invention disclosures, patents, and intellectual property revenues are taken from a business model and do not always reflect universities' main sources of revenue. He thinks a truer picture would recognize that "real income generation is often better reflected by indirect performance measures such as federal funding, strategic collaborative R&D and highly qualified personnel, contracts and alumni support."

### Target public investment

Perry Niro is the Executive Director of BIOQuébec. He agrees that the creation of Canadian start-ups with public backing has led to sometimes disappointing results. "American universities have an enormous advantage right away," he says. "Public funding in the US allows academic researchers to push their research further in the university setting. They have the money and time to establish proof of concept or do pre-clinical testing before they venture into licensing and creating spin-offs. In contrast, we spin out biotech firms too quickly, which can be problematic."

But is Canada really focusing its resources to develop national and regional strengths? Dr. Ogilvie thinks not. “We have a decentralized political culture that diffuses and bogs down decision-making. This makes it difficult to focus on key areas, and often causes us to waste our efforts.” More successful nations and regions target their efforts to strategic areas that drive their economies through all levels of innovation.

## Improve access to university research

The notion that receptor capacity for innovation is weak is a commonly heard claim. But it also has to be acknowledged that universities are weakened by the way they are structured. “Universities behave very much like gated communities that make access by outsiders difficult,” says Dr. Krull. “It’s difficult to find the faculty member, or even the department or division, that is doing the kind of work you might be interested in.” The University of Toronto is looking at potentially structuring research into two streams: one academic and another in the form of an institute with a governance structure that allows the rules of intellectual property to be more compatible with industry and local partnerships.

In the same vein, Mr. Niro suggests creating a one-stop shopping bionetwork that would give industry access to all licenses available from

Canadian universities. “It is still hard to find out about technologies being developed within universities,” he says. “There have been very few, if any, spin-off companies created in Québec.” But Mr. Niro feels that universities should not rush unprepared into the marketplace. “We need to promote devel-

Public funding in the US allows academic researchers to push their research further in the university setting

opment but also avoid the premature creation of new companies. We should consider biotech companies accelerators of innovation, and make public moneys available to them.” He thinks university intellectual property policies should be modified to favour institutes rather than researchers, and that technology transfer office personnel should be remunerated according to success. “The incentives need to be there to create value from university discovery. Performance contracts from universities should be issued every year to record the level of technology transfer.”

## Public attitude

Krull, Ogilvie and Niro all believe that a positive public attitude towards innovation and commercialization is extremely important. Public attitudes will have an enormous impact in creating an envi-

## Two Pillars of Biotech Development

FIGURE

8

**Research**



- Government research investment
- Patents

**Commercialization**



- Venture capital
- R&D partnerships
- Startup firms
- Established firms

Source: Brookings Institution Center, June 2002 • Courtesy: Perry Niro

ronment where research synergies are an accepted part of Canada's development. The effects of public perception are often far-reaching, says Dr. Ogilvie. "In Canada," he says, "the federal position on patents has had a major negative impact on social attitudes. The same people that go to great lengths to protect copyright and extol the societal virtue of writers often convey an unduly negative image of inventors. This has to change."

## Skilled management

Canada still lacks the managerial expertise needed to foster the emerging innovation sector, although universities have begun actively working with industry to remedy the situation. "In the life sci-

Universities behave very much like gated communities that make access by outsiders difficult

ences, there are only a handful of seasoned veterans with the experience to drive the biotech industry forward," says Dr. Krull. "It is very difficult for a seeded company to find good managers." As a result, the University of Toronto has just started a Masters of Biotechnology program to train middle management in partnership with industry.

## Partnerships

Figure 8 depicts the many players involved in biotechnology development. There is a real need to promote partnerships between them. BIOQuébec has more than 240 innovative member companies. In 2002, the umbrella organization held its first biotechnology summit bringing together the academic, governmental and pharmaceutical partners involved in developing the industry. BioQuebec's latest initiatives are aimed at forming relationships with Montreal International to promote biotech-pharma partnerships, as well as developing a council of biopharmaceutical innovation in which academic, government and industry sectors are participating. ■

## CHAPTER 6

# Integrating, testing and assessing innovations in health care

How compatible is Canada's health system with the innovation agenda? In this chapter, five professionals intimately involved with the issues consider the challenges at stake. Their ranks include the head of a health technology assessment unit, the executive director of a university health centre, the CEO of a provincial cancer care centre, a provincial assistant deputy minister and an information technology researcher. Each of the five brings a unique perspective to bear on the health care system's testing, assessing and integration of innovation.

## Towards a new paradigm

Dr. Renaldo Battista is President and CEO of AETMIS, a health technology assessment unit based in Québec. Dr. Battista believes that Canada's two predominant schools of thought on innovation are heading towards a clash. "One school of thought is based upon the economic discourse of innovation, which focuses on economic development and wealth creation. It necessarily takes the offensive because competition is fiercest on an international level. And then there is the public health system discourse. It is defensive, self-protective, and led by administrators of a health system incapable of integrating technological innovation. We are currently in an uncomfortable transition phase where it is difficult to reconcile discourses based on such different logic. The challenge is to create a new paradigm that brings all the pieces into a single concerted strategy."

Dr. Battista describes three factors in this challenge. "The first is innovation, a strategy that is well underway, although we have yet to determine whether it will position us competitively on the

international playing field. We already have champions for this strategy and must work to support this effort in the years to come."

The second factor is the need for health care systems to reform from the inside, to become much more efficient and better managed. "We need to understand what is happening with the receptors of innovation because right now they are not capable of integrating progress. This challenge needs to be addressed at the policy, institutional and professional practice levels."

Dr. Battista sees the third factor as the interface between the health care system and innovation. "The future lies in creating new partnerships between technology developers and users that will work to encourage the development of innovation and facilitate its introduction into the health system."

## Integrating innovation into health care organizations

Dr. Hugh Scott is Executive Director of the McGill University Health Centre. He takes the long view, and points out that change does get incorporated, though not always as quickly as some would like. "Forty years ago in this country, there were no coronary care units, intensive care units or pace-makers. Heart attack patients stayed in hospital for close to a month, and nurses, believe it or not, spent an enormous amount of time removing plants from patients' rooms at night."

He also cautions that innovation comes in many forms. "It was a piece of equipment – the cathode ray tube – which permitted us to display biologic functions in real time and paved the way for intensive care," he says. "A simple outcomes study cut the average length of stay for heart attack patients to four days." Dr. Scott describes the administra-

tor's challenge as sorting through innovations to decide which could be adopted to best advantage.

According to Dr. Scott, innovational anarchy takes place when the introduction of innovation is not managed appropriately. The first challenge to administrators is to recognize that innovation is coming and decide if the institution should not only accept it but also embrace it. "The second organizational challenge is to acknowledge the law of unintended consequences," he says. "Innovation has a ripple effect that extends into other parts of the organization. Failing to acknowledge and anticipate these effects can lead to a revolt against the innovation itself."

Dr. Scott thinks this is less a demonstration of people's resistance to change itself than it is an example of the perils of inadequate planning. "I do

Innovation is often sold on the basis that it will improve efficiency, but if budgets are not transferable, such arguments hold no weight

not believe that people are resistant to change, but rather that change is often mismanaged. Before we introduce changes in academic health centres, administrators need to ask who stands to lose something with the arrival of this innovation, whose independence might be compromised. And finally, we need to deal with the education and training challenge inherent in innovation."

A third challenge Dr. Scott raises is the need to evaluate innovation to find out whether it really provides the benefits suggested by promoters. All parties must be committed to collecting the data and demonstrating that real change has occurred.

"There is also a fourth and often overlooked challenge," he says, "by which I mean the perversion of financing considerations and systems. A current example is the drive to incorporate nurse practitioners into teaching hospitals. There is a lot of support for the idea that they could take on some of the work done by resident physicians. However, hospital administrators do not pay residents, while nurse practitioners come at a fairly high price. This perversion becomes a real obstacle to changing

practice even when it makes sense in every other way." Innovation is often sold on the basis that it will improve efficiency, but if budgets are not transferable, such arguments hold no weight.

## The importance of sequencing

Dr. Scott thinks that sequencing is most challenging when considered in the context of the drive to improve information systems. "In some of our approaches to try and solve the information system infrastructure challenge, we have built the penthouse before the basement," he says. "An information system for the emergency room (ER) will not make it more efficient until we also have one for the labs so ER staff can get lab results faster. We have to build the foundation first and work our way up. If we come in with a radical innovation which will markedly enhance step number 37, and do nothing about step number 35 or 25, the enhanced step 37 will not make a difference despite the commitment of its promoter." He feels we need to focus on innovations in clinical information systems because so many other innovations depend on that infrastructure, as does the possibility of meaningfully assessing what innovations can bring.

Public commitment is needed to convince Canadians that health care is part of the Canadian economy and not just an expense. "We do not look at any other sector of society and say that spending 10% of GNP is a problem," says Dr. Scott. "Indeed, we dedicate more and more resources to the communications sector and the transport sector, and see this as a sign of a vigorous and growing economy. The health sector is also a vigorous and growing part of our economy but we see that as a terrible problem that needs to be contained. First and foremost, attitudes need to shift."

## Testing innovation in the health care system

The system of clinical trials is tightly linked to quality improvement in health care. Dr. Hartley Stern is CEO of the Ottawa Regional Cancer Centre. In his view, our clinical trials system as currently

functioning and supported is not a facilitator of innovation but a barrier to it. He feels it will take a significant shift in the paradigm, different thinking about funding trials, and a different set of government policies before clinical trials can begin to promote and enable innovation.

“The health ministers in charge of regulating and bringing new products into clinical care have little regard for research or innovation,” says Dr. Stern. “What they care about is getting the patient in and out of the system safely, and getting through the next election. Unless we begin to demonstrate the quality and safety advantages of new technologies, the priorities of politicians will not change.” He thinks that a clinical trials programme would test commercial pharmaceutical innovations in a Canadian context. If worthwhile, they would then be quickly integrated into academic teaching and community practice. “Right now,” he says, “we are dependent on pharmaceutical detailing to communicate clinical trials results.”

Dr. Stern bemoans the fact that only 4% of Ontario adult cancer patients get on a clinical trial, and that the bulk of these patients are recruited in large teaching hospitals providing less than 20% of cancer services in the province. “Doctors in small community hospitals who provide 80% of cancer services, particularly surgery and chemotherapy, have no access to the clinical trial process. Neither the doctors nor the small hospitals have any incentive to participate in trials because no one in Canada demands it or invests in it.” In contrast, pediatric oncologists get 95% of their patients on clinical trial because they have a developed infrastructure and an enormous advocacy group behind them.

But Dr. Stern thinks the development of a cancer research network in Ontario is a sign that the situation is improving. “One hundred million dollars has been invested to put infrastructure in most of the hospitals that want to participate in clinical trials,” he says. The objective is to increase the proportion on trials from 4% to 10%. Dr. Stern points to a study presented at the American Society for Clinical Oncology (ASCO) as evidence that patients enrolled in clinical trials survive longer. “The problem is not patient resistance to going on trials,” he says, “but system resistance.”

He attributes the resistance to a number of factors. The first is that health ministers lack interest in clinical trials because they do not fund research. A second is the slowness of the research cycle due to development, regulation, and ethics committees. “At the University of Ottawa,” he says, “the slowness of the ethical review required for us to get a patient on trial is actually an impediment to doing business with industry.” The post-trial stage of moving evidence into practice is also slow, according to Dr. Stern. “In Ontario, the new drug funding formula for cancer chemotherapy requires that an evidence-based guideline be developed at McMaster University, a process that takes at least eight months per drug per disease site. We need a parallel system to move evidence through the system faster, one that convinces governments to incorporate clearly beneficial drugs into the funding model at a much earlier date.”

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## What’s needed to increase clinical trials activity?

### ■ Dr. Hartley Stern

- 1 A clinical trial infrastructure that would increase the percent of cancer patients on trials from 4% to 10, 20 or 30%. Initiatives are needed in every provincial jurisdiction in the country.
  - 2 Much more support for the production of evidence-based guidelines. Currently, volunteers develop all of the Ontario guidelines.
  - 3 Research infrastructure will only be improved once Ministries of Health and Ministries of Innovation or Industry start working together and explore the possibility of cross financing.
  - 4 A system of differential hospital funding on the basis of participation in clinical trials. The accreditation process can also be used to promote this goal.
-

## Assessing innovation in health care

“We are falling behind in the operationalization of science,” says Todd Herron, Assistant Deputy Minister for Alberta Health and Wellness. He cites Ontario as an example, where the number of identified gene diseases has grown steadily while the number of molecular tests available to identify people who carry them has pretty much gone flat. Mr. Herron also points out that there is currently a lag in workforce strength, as the number of specimens to be analyzed increases much faster than the number of technologists available to conduct the analyses.

Alberta recently adopted a quality framework against which spending on health care could be assessed. The six measures of quality adopted

We want to get to the point where we can actually monitor the performance of investments against these quality indicators

include appropriateness, effectiveness, safety, efficiency, accessibility and acceptability. According to Mr. Herron, “The indicators provide a common lexicon for measuring the system and for communicating budget priorities to the public. There are many competing pressures on the health care budget, all of which promise wonderful things. We want to get to the point where we can actually monitor the performance of investments against these quality indicators.”

Mr. Herron also works on the Committee on Information and Emerging Technologies, which brings together health ministry officials from federal, provincial and territorial jurisdictions to look at pan-Canadian policies that will influence the shape of technology diffusion curves. “As a member of this Committee,” he says, “I took the quality indicators developed for Alberta and laid them on the horizontal axis of a grid, with the five streams of technology diffusion being looked at by the Committee on the vertical axis as inputs to the system: devices and systems, pharmaceuticals,

telehealth, genomics and proteomics and information technology.”

He advocates taking a portfolio view of investments in innovation and technology, and placing bets as policymakers on which will maximize quality outcomes. “For this, we need to focus on evaluation,” he says. However, he highlights the deficiencies in the current national system of evaluation. The Canadian Coordinating Office For Health Technology Assessment (CCOHTA) is experienced in devices, systems and pharmaceuticals and is beginning to gain experience with telehealth and genomics, but there is no formal evaluative mechanism to assess information technology investment. “This is going on,” says Mr. Herron, “even as we prepare to spend at least \$1 billion on such systems through Canada Health Infoway.”

Mr. Herron points to some seemingly inherent conflicts between the scientific community and the policy community when it comes to assessment. “Policy makers want information right away,” he says, “while primary research scientists and health technology assessors want to hold off making recommendations until they have all the data they need.” One potential solution to this impasse, Mr. Herron feels, would be to create four levels of health technology assessment (HTA): bronze, silver, gold and platinum, based on the level of research available at a given point. “A bronze HTA would tell policymakers roughly which way the wind was blowing and allow us to start making some investment decisions. These could be revisited as more evidence became available.” He concludes that a broader definition of HTA, which examines innovation right through to technology diffusion, is needed to develop receptor capacity and delivery capacity among health ministries.

Mr. Herron hopes that electronic health records (EHRs) will promote the innovation agenda by providing policymakers with a view of how technologies are used on a day-to-day basis in clinical practice. “They will facilitate the creation of decision-support systems which in turn will feed the research agenda ideas for products to support clinical practice,” he says. The EHR, recommended by the Romanow report, the Kirby report, and the Mazankowski report, was launched in Alberta in

October 2003. Evidence from primary care physicians using the system shows that the information affects about 20-25% of their clinical decisions when they have access to the right lab data and the right prescription data.

## Innovation in IT to enhance the effectiveness of care

In the next five to ten years, information technologies will be among the most important innovations improving the safety and quality of health care delivery, says Dr. Robyn Tamblyn, Associate Professor of Epidemiology and Biostatistics at McGill University. They will revolutionize the way clinical and population health research is conducted. Innovations in IT can address four critical issues in health care: 1) safety in a fragmented health care system; 2) the speed at which science becomes practice using customized patient decision-support systems to the point of care; 3) the evaluation of new technologies and treatments; and 4) planning, as reliable information about what needs to be done becomes available.

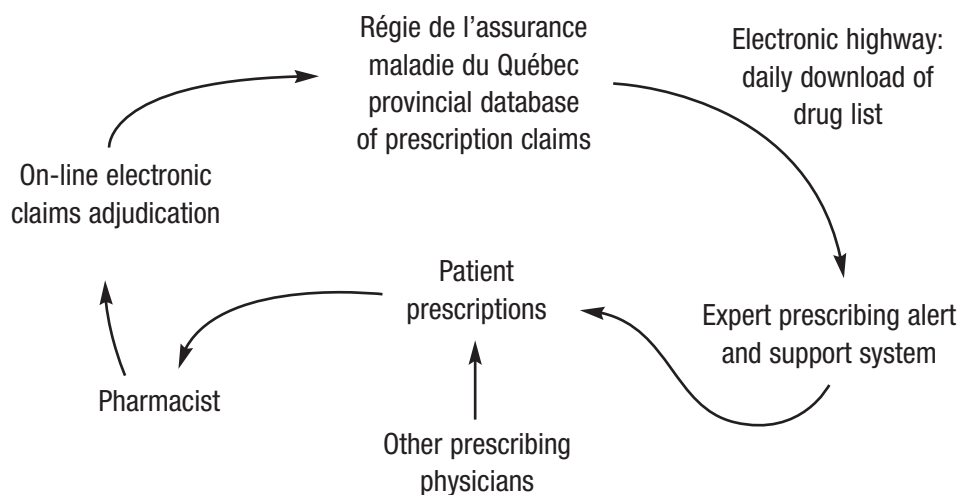
One pressing issue is prescription errors. Five to ten percent of admissions to hospitals are for adverse drug-related events of which half are avoidable, caused by prescribing errors, sub-optimal management, over or under use of medication, and drug-alcohol interaction. All studies to date report the same ballpark figures and show that the likelihood of an inappropriate prescription increases exponentially with the number of prescribing physicians and pharmacists used by an individual. Illegible prescriptions are yet another facet of the problem. In the US, Florida has now declared handwritten prescriptions illegal. The new US medicare bill requires that computerized electronic prescriptions be in place by 2007 for medicare patients. This is one issue that information technologies can solve very rapidly.

Here in Canada, a look at the situation in Québec since 1994 shows that it is possible to take advantage of features in the public health care system to facilitate the introduction of IT systems in prescribing. In Québec, the health care system's drug insurance covered about half of the province's population. It was hoped that introduc-

FIGURE

9

### Connecting Physicians On-Line to Obtain Complete Information on Current Medication



Courtesy: Dr. Robyn Tamblyn

ing IT systems would reduce errors by doctors and pharmacists unaware of drugs a patient was taking, provide decision-support to cut dosing and follow-up errors, and address issues such as compliance with therapy and the match between evidence and current therapy. Québec has an on-line adjudication system in communication with every pharmacy in the province, and a computer in Québec City called Sophia that records all prescriptions.

In an initial pilot project, Québec physicians were first hooked into Sophia so they could access a complete drug history, at least for patients insured through the public plan. Decision-support was then added to alert doctors to problems with current drugs and diseases. The pilot project was successful in reducing inappropriate prescriptions, but indicated that a more portable device than a desktop

Canada's universal health system  
can certainly be used to facilitate the  
introduction of IT

computer was needed if physicians were to actively use the system. (Figure 9 shows how the system connected various players).

Because of this, wireless technology was made available in the next stage of the project in the form of palm pilots and iPac computers, and the system was redesigned to allow doctors to bring it along wherever they went. The data was stored behind the firewall of an academic health centre for security, and the same link was established to the Québec insurance board. Sending prescriptions on-line to pharmacy computers was introduced to help eliminate transcription errors. The system displayed the list of drugs, allowing doctors to flip back and forth between generics and brand names, and used bar graphs to illustrate start and end dates and drug supply days available. It also provided a menu-driven selection of drugs and dosages designed to reduce errors.

Canada's universal health system can certainly be used to facilitate the introduction of IT, Dr. Tamblyn considers. Instead of asking providers to enter the data they have on all their patients, a

lot of the patient information can be pre-loaded from existing government databases. The medical services claims file can then be used to record emergency visits or hospitalizations for that individual. "Because of interest in the effectiveness of new technologies and treatments," says Dr. Tamblyn, "a mandatory indication field is included on the prescription to provide decision support." This allows pharmacists to know what condition they are dispensing for, and helps provide decision support for physicians on such issues as chronic diseases, the recruitment of patients for clinical trials, and the assessment of new technologies.

Once the essential safety-enhancing system is in place, Dr. Tamblyn has found that value-added modules can be provided. One area being looked at is calculating refill compliance and feeding that information back to physicians so they can identify problems with drug treatment. Some patients who appear not to be responding to medication are, in fact, simply not taking it. Other technologies can be used to improve surveillance between visits. Knowledge about individuals' illness and drug use provides a starting point for chronic disease management systems that integrate the latest science into practice on a highly individualized basis. Physicians can then be provided with the most appropriate treatment algorithms for a particular patient.

"Innovation in the information technology world will not happen unless there are strong partnerships between health care professionals, researchers, the private sector and major stakeholders," concludes Dr. Tamblyn. Partnerships are required between clinicians, managers, researchers and IT specialists in order to produce quality products capable of dealing with actual problems in the health care system. In short, we need technology that solves problems, not technology that tries to find them. ■

## CHAPTER 7

# Setting a new standard for innovation:

## Encouraging better health outcomes and wealth creation in Canada

### Defining a role for the federal government

Health care in Canada is a fragmented market largely controlled by governments under constant pressure to contain costs. This even as technological innovation drives them up, at least in the short term. According to David Fransen, Assistant Deputy Minister of the industry sector at Industry Canada, significant structural barriers will have to be overcome in order to promote health innovation. “The most important barriers are the silos that exist within and between governments. When we talk about innovation, we have to find a way to be coherent within governments and address trade-offs between the social side – the health and health care side of federal responsibilities – and the industrial and economic development side represented by Industry Canada and Agriculture Canada.” He believes internal coherence needs to be developed within both the federal and the provincial governments, and then between different levels of government.

Industry Canada’s preoccupation is wealth generation and productivity. “We want Canadians to maintain and improve their standard of living, and look at various sectors of the economy that contribute to that,” says Mr. Fransen. There are two main questions to ask: How can government stimulate innovation at the local level and draw from that nationally? What levers and instruments are available nationally that will improve innovative capacity at local levels and create local benefits? The challenge is to not only assure a return on research and development investment in Canada, but also tap into the enormous investment in health care that happens in the United States. Figure 10 outlines the key targets in Industry Canada’s innovation strategy.

“National strategies may not be appropriate in a health innovation strategy,” Mr. Fransen states. “We would do better to erect the policies that allow regional or local programs to be more effective. No one wants the federal government picking winners; they should, rather, be facilitating the creation of an environment that will allow those who know the business to operate effectively.”

### Supporting innovation clusters locally

Montreal International encourages innovation and wealth creation by promoting and measuring the development of life sciences clusters in the Montreal area. The concept of “clusters” originated some 15 years ago but referred at the time to activity in a large geographical area. Today, according to Michel Leblanc, Montreal International’s Vice-President of Life Sciences, “We have started thinking of clusters at the regional or metropolitan level. If our area is viewed as part of a chessboard, there are many pieces grouped here, even though they continue to regard themselves as autonomous.

Significant structural barriers will have to be overcome in order to promote health innovation

My goal at Montreal International is to animate the game without any single chess player calling the shots.”

The Montreal cluster represents 275 companies, 125 research organizations and about 30,000 jobs, up from 27,000 at the beginning of 2002. The private sector is the driving force of this cluster, which has a solid core of multinational and inno-

# Industry Canada's Innovation Strategy: Key 2010 targets

FIGURE

10

## **Research, development and commercialization**

- Rank Canada among top five countries in R&D and commercialization
- Triple private sector and double federal investments in R&D
- Double research and triple commercialization from university research
- Raise risk capital investments per capita to prevailing US levels

## **Enhancing innovation environment**

- Ensure competitive tax regimes to attract talent and investment
- Comprehensive review of regulatory environment
- Improve foreign investor confidence, secure greater foreign market access

## **Strengthening learning and skilled work force**

- Increase admission of Master's and PhDs by 5% per year
- Improve recruitment of foreign talent

Courtesy: David Fransen

vative pharmaceutical companies. "The full chain of value creation is represented, from research to development to clinical trials and commercialization," said Mr. Leblanc. "We see agglomerations of companies emerge as centres of excellence because of the proximity effect."

The largest companies in the Montreal cluster are the multinationals, and enhancing competitiveness for their investment is essential in Mr. Leblanc's estimation. "Montreal International adopts the view that our cluster is a dynamic leader in the life sciences, and that success should be measured in terms of maintaining and accelerating that vision over the long term." Work with universities and research centres is considered essential not only because they represent researchers and students, but also because they attract major investments in sponsored research. Montreal International's initiatives focus on preserving Montreal's competitive advantage in human resources, strengthening research infrastructure and equipment, and branding the efforts of the city's cluster.

Job creation is a good indication of success.

Mr. Leblanc would like to see a doubling in Montreal's job creation rate, which over the last 15 years has been fairly stable at 1000 jobs a year. Montreal International also monitors investment decisions and strategic decisions for the cluster to see whether it is becoming increasingly competitive. "The key challenges," said Mr. Leblanc, "are to stimulate an environment conducive to the creation of additional private venture funds, and to attract foreign venture capitalists. Hence the importance of preserving a favourable business climate in Canada for innovation in the pharmaceutical sector." ■

## CONCLUSION

# Capitalizing on Canada's health system attributes

The challenges and solutions raised at the Directions VI National Conference signal that a new way of thinking about innovation in health care is taking root. The common question has become: How do we use our public system to competitive advantage in the quest for top ranking in health innovation? In the words of conference delegate Dr. Ron Dyck from Alberta Innovation and Science, “Our best asset in Canada to foster innovation is our publicly funded, single payer system which allows us to acquire data, analyze data and understand what is happening in the system.”

Consultations about health care, most notably the Romanow Commission on the Future of Health Care, emphasized the importance of the public system to Canadians. It appeals to values of equity, fairness and compassion that help define us as a people. International comparisons also reveal that public health care is more cost effective than other solutions. The final test will be whether our public system can drive innovation and economic growth. This challenge has repercussions for both Canada's prosperity in the global economy and for the sustainability of the public health care system.

The system barriers identified as impediments to innovation are those we often hear mentioned as impediments to the most effective care strategies: fragmentation, decision-making based on poor or incomplete information, regulatory systems overloaded and unresponsive to change and current needs. Innovation need not increase the overall costs of providing health care; in fact, it may be key to keeping costs under control while improving outcomes. This insight is key to regarding innovation and sustainability as compatible rather than contradictory goals.

The other key insight is that not all health technology advances are innovations. Distinguishing true innovation becomes ever more important as the pace of change steps up. Solid technology assessment strategies are needed to guide decisions by all players – from industry right through to formulary managers and health care providers. The new Institut d'évaluation en sante (IDEES) at the Université de Montréal brings academic talent in the life sciences into partnerships with industry and planners to provide the kind of guidance that is needed for this new vision of innovation in health care. Part of the challenge, for the Institute as for innovation itself, is to focus on real problems and find the best way to solve them.

The best new technologies produce the best outcomes, provide the best returns to developers and stand the best chance of competing globally. Canada has great aspirations of achieving “bests” in life sciences, biopharmaceutical industry development and health care. But the competition is fierce. The challenge is to eliminate the barriers to innovation that persist within academic institutions, regulatory agencies, health science centres and the health bureaucracy in order to put the country in the most advantageous starting position as the race begins. ■



# About the speakers

## ■ Renaldo N. Battista

Dr. Battista is President and Chief Executive Officer of Québec's agency for health services and technology assessment (the Agence d'évaluation des technologies et des modes d'intervention en santé or AETMIS), and is a Full Professor in the Department of Epidemiology and Biostatistics and the Department of Medicine of the Faculty of Medicine at McGill University. In January 2004, he also became Director of the Institut d'évaluation en santé (IDEES) at the Université de Montréal.

An internationally recognized expert in health technology assessment, Dr. Battista has been a member of the Scientific Advisory Board of the Agence nationale pour le développement de l'évaluation (ANDEM, Paris), the Board of Directors of the Canadian Coordinating Office for Health Technology Assessment (CCOHTA, Ottawa), and the Scientific Advisory Board of the Catalan Agency for Health Technology Assessment (CAHTA, Barcelona). He also served for two years as Chairman of the Board of the International Society of Technology Assessment in Health Care (ISTAHC, Montreal). Since 2001, he has been a member of the Advisory Board of the Institute of Health Services and Policy Research with the Canadian Institutes of Health Research (CIHR).

## ■ Alain Caillé

Dr. Caillé is a graduate of Université de Montréal in physics. He completed his Master and Ph.D. degrees in theoretical condensed matter physics at McGill University. He was elected to the Academy of Sciences of the Royal Society of Canada in 1990. In 1996, he received the Léon-Lortie prize for his contributions to pure and applied sciences. His present research activities cover the structural properties of soft matter. He has authored 115 articles in international scientific journals.

Dr. Caillé has served on the governing boards of many national and international organizations and councils for research funding. He served three terms on the Board of the Natural Sciences and Engineering Research Council of Canada. He was also on the Council of the Fonds FCAR from 1989 to 1998. He was founding president of Valorisation Recherche-Québec and the President of the Association francophone pour le savoir. He is presently on the boards of Canvac, a network of centres of excellence, and the Foundation for Sustainable Development Technology Canada.

He was Vice-President, Research, at the Université de Sherbrooke from 1989 to 1996. Since 1998, he has been Vice-President, Research, at the Université de Montréal.

## ■ Daniel Denis

Mr. Denis joined SECOR in 1984 and is the partner responsible for the Economy practice. He was President of the firm from 1996 to 2000. His areas of specialization include energy, financial markets, regional development, environmental issues and public finance. He has worked with public and private corporations in Canada and Europe, assisting them in identifying major economic issues, defining objectives and directions, as well as designing policy recommendations. Mr. Denis frequently serves as expert advisor to governmental authorities, associations and media organizations in economics and finance.

A specialist in economic analysis, Mr. Denis has published works in public finance and is regularly invited to comment on government budgets and policies, at both the federal and provincial levels. He has directed many mandates dealing with industrial analysis, economic impact analysis, competitiveness analysis, regional analysis and public policy issues. He has also coordinated and collaborated on numerous task forces dealing with major economic issues.

Mr. Denis holds a B.A. and a M.Sc. in Economics from the Université de Montréal. Prior to joining SECOR, Mr. Denis worked as a financial economist for a major Canadian bank.

## ■ David Fransen

Mr. Fransen is Assistant Deputy Minister of the Industry Sector at Industry Canada. He has had a varied public service career, serving as an historian at the departments of Finance and National Defence, as security and intelligence analyst with the Solicitor General and the Privy Council Office (PCO) and as policy advisor to the PCO environmental policy. He joined Industry Canada in 1995 as the Director of Economic Framework Policies, moving in 1997 to become the Director General of the Office of Consumer Affairs. In 1999, David joined Health Canada as the Director General of the Centre for Healthy Human Development, returning to Industry Canada in 2001 as Associate Assistant Deputy Minister in the Spectrum, Information Technologies and Telecommunication Sector. Mr. Fransen became Assistant Deputy Minister of the Industry Sector at Industry Canada on March 3, 2003.

The Industry Sector promotes the global competitiveness of Canadian industry, particularly in the areas of life sciences; biotechnology; environmental technologies; automotive; aerospace; defense; energy; marine; manufacturing; and, service industry sectors.

Mr. Fransen has a Bachelor of Theology degree from Canadian Mennonite Bible College, a B.A. and M.A. from the University of Waterloo, and a Ph.D. in History from the University of Toronto.

### ■ Henry G. Friesen

Dr. Friesen obtained his medical degree from the University of Manitoba. He began his career in research in endocrinology at the New England Medical Center, Boston. His academic appointments include McGill University from 1965 to 1973 and the University of Manitoba from 1973 to 1992, where he served as Professor and Head of the Department of Physiology. He discovered the human pituitary hormone prolactin and its role in health and disease, defining it as a major cause of infertility. His collaboration with others in the introduction of new therapies has resulted in the effective treatment of tens of thousands of women worldwide. Currently Dr. Friesen is a Distinguished Professor Emeritus at the University of Manitoba, and a Senior Fellow at the Center for the Advancement of Medicine.

Dr. Friesen has published over 400 papers in scientific journals and has served as a mentor for more than eighty post-doctoral fellows and graduate students, many of whom today are in leadership positions around the world. He has received many distinguished awards, including a Gairdner Foundation International Award in 1977 and 2001, the McLaughlin Medal of the Royal Society of Canada, the Koch Medal (the highest award of the Endocrine Society), the Order of Canada (promoted to Companion in 2001) and eight honorary degrees. He was inducted into the Canadian Medical Hall of Fame in 2001. He is also a Foreign Associate of the National Academy of Sciences, USA.

In the last decade, Dr. Friesen has served Canada with great distinction as the seventh President of the Medical Research Council of Canada. He has proved to be an outstanding advocate of biomedical and health research and has been an eloquent and persuasive voice to government for the funding of research. Dr. Friesen was both architect and champion for a bold new vision for Health Research in Canada. Through imaginative leadership and tireless effort, he set the stage in 2000 for the establishment of a new agency designed to encompass all aspects of Health Research along with major new funding: the Canadian Institutes of Health Research. He was also the guiding force that led the government to form the Canadian Health Services Research Foundation. He is currently Chair of Genome Canada, a corporation created to spearhead the development of genomics research and its impact in Canada.

### ■ David Griller

Mr. Griller is a partner at SECOR, where he focuses on life sciences. He has worked with many stakeholders in the pharmaceutical sector, including researchers, multinational pharmaceutical firms, generic drug firms, regulators, start-up companies, granting agencies and spin-offs. He has looked at the pharmaceutical sector from many different angles and brings a unique perspective on problems and solutions. Mr. Griller has a Ph.D. in chemistry and has worked in research for a number of years.

### ■ Todd Herron

In September 2002, Mr. Herron was appointed Executive Director of Alberta Wellnet and moved to the position of Assistant Deputy Minister/CIO, Health Accountability, Alberta Health and Wellness in October 2002. He has since been formally appointed as the Assistant Deputy Minister/CIO of Health Accountability. He is also the National Co-Chair of the Advisory Committee on Information and Emerging Technologies.

Alberta Wellnet has projects that support the recommendation of the Premier's Advisory Council on Health. A key recommendation of the council's report was to invest in technology and establish an electronic health record for Albertans. Alberta Wellnet is harnessing the power of information technology to improve the availability of health information to health professionals; to use that information to improve health services; and, ultimately, to foster the health and well-being of Albertans.

Prior to his appointment with the Government of Alberta, Mr. Herron worked as an independent consultant to the public sector on a variety of IT management issues, and has been successful in many major IT accomplishments. During the nine years he worked with the airline industry, Todd Herron provided technical and managerial support to projects in Canada's computerized reservations business. Clients included Air Canada, Canadian Airlines, VIA Rail, and numerous smaller, regional carriers. He led the successful implementation of the technical infrastructure for Air Canada's current reservations system, RES III.

Mr. Herron has a B.Sc. in Applied Mathematics from the University of Alberta and an M.B.A. from the University of Manitoba.

### ■ Ulrich Krull

A Professor of Analytical Chemistry at the University of Toronto, Dr. Krull holds the AstraZeneca Chair in Biotechnology. He is the Vice-Principal, Research, at the University of Toronto at Mississauga.

Dr. Krull completed his degrees at the University of Toronto. His research interests are in the area of biosensor technology, and its applications to biotechnology, forensic, clinical and environmental chemistry. His research work has explored chemoreceptive lipid membranes as biosensors and, more recently, the use of single-stranded DNA as receptors to detect DNA and RNA markers. Some of the device technology is presently being commercialized by a spin-off company, FONA (Fiber Optic Nucleic Acid Technologies) Technologies, Inc.

Dr. Krull is a Fellow of the Chemical Institute of Canada. He has received both the McBryde Medal and the Maxxam Award (top prizes in Analytical Chemistry) of the Canadian Society for Chemistry. He has been a recipient of the University of Toronto Faculty Excellence Award. He has served as the Associate Dean of Sciences, Vice-President of the Royal Canadian Institute, and presently is an editor of

*Analytica Chimica Acta*, a major international journal for analytical chemistry. He serves on a number of scientific advisory boards including those of an analytical service firm and a proteomics firm. Dr. Krull is heading the consortium of industry, government and institutions that forms the Western GTA Biotechnology cluster, and he is leading the development of the Biotechnology Convergence Centre (BIOTECC) for this consortium.

### ■ Robert Lacroix

Dr. Lacroix holds a Ph.D. in Economics from the University of Louvain (Belgium), and has been a Professor in the Department of Economics at the Université de Montréal since 1970. He has held various administrative positions at the University, including Chairman of the Department of Economics and Director of the Centre for Research and Development in Economics (CRDE). From 1987 to 1993, he served as Dean of the Faculty of Arts and Sciences and from 1994 until 1998, he was President and Executive Director of CIRANO (Centre for Inter-university Research and Analysis on Organizations). Dr. Lacroix has been Rector of the Université de Montréal since June, 1998.

Dr. Lacroix has accomplished extensive research into the economics of labour and human resources, as well as the economics of technological progress and innovation. He is the author of numerous books, book chapters, scientific articles and research reports. Dr. Lacroix is Member of the Order of Canada, Officer of the Order of Québec, a Fellow of the Royal Society of Canada and Member of the Académie des Grands Montréalais. He has received the award for Exceptional Career of the National Policy Research Initiative (2001) and the Prix Armand-Frappier for outstanding achievement in the field of research administration (2002). In 2002, he was awarded honorary doctorates by the Université Lyon 2 and McGill University.

He is a member of the Board of Directors of the Association of Universities and Colleges of Canada (Chairman 2001-2003), of the Conference of Rectors and Principals of Québec Universities (Chairman 2003), of École Polytechnique and HEC Montréal, of the Corporation for the Implantation of the Université de Montréal Health Center and of the Board of Trade of Metropolitan Montreal. Dr. Lacroix is also a member of the Academic Advisory Committee of the Institute of Canadian Bankers, of the Board of Governors of the Conference of Montreal and of the Foundation for Educational Exchange between Canada and the United States of America (The Canada - US Fulbright Program).

### ■ Michel Leblanc

Mr. Leblanc is Vice-President of Life Sciences at Montréal International, which aims to further economic development of the Greater Montréal area and to increase its international involvement and impact. Until 2000, Mr. Leblanc was Director of the SECOR group. In his consulting capacity,

Mr. Leblanc completed many mandates for companies and public and para-public organizations in the areas of economic development, economic impact analysis, government financing strategies and international development. He holds an M.Sc. in Economics from the Université de Montréal and is an expert in economic development strategies and financing of public programs and services. He spent three years as an economist with the Department of Finance in Ottawa.

Montréal International aims to ensure that the Montréal Metropolitan Community (MMC) remains competitive internationally, especially in strategic sectors such as biotechnology and life sciences. With this in mind, it embarked in 2001 on a process that ultimately shaped a vision and action plan to accelerate development of the life sciences cluster.

That action plan, unveiled in April 2002, sets out recommendations that challenge all decision makers within the cluster. Its primary objective is to position Greater Montreal as a dynamic world leader in the life sciences, specifically by creating at least 16,000 jobs by 2010. The strong positive response to the action plan prompted the provincial and federal governments to support its implementation with a combined contribution of \$1,300,000 over three years. That funding was used to start up the action plan, by establishing the Greater Montreal Life Sciences Committee (CSVMM), comprised of 28 decision makers from business, the research community, universities and the public sector. It also created the position of Vice-President, Life Sciences, a component of Montréal International tasked with helping the CSVMM implement the action plan and achieve its objectives. Mr. Leblanc heads up the team with oversight for sustaining mobilization of Greater Montréal's life sciences cluster, carrying out the action plan and achieving the target objectives.

### ■ André Marcheterre

As President of Merck Frosst Canada & Co. and Merck Frosst Canada Ltd., Mr. Marcheterre oversees one of the country's leading research-based pharmaceutical companies with approximately 1,900 employees across Canada engaged in discovering, developing, manufacturing and marketing medicines for human health.

Mr. Marcheterre joined Merck Frosst in 1977 as a professional sales representative. Since then, he has held positions of increasing responsibility in Marketing, Sales and Government Affairs. In 1995 he was promoted to the US Human Health Division of its parent company, Merck & Co., Inc. where he was Vice-President Mid-Atlantic Region Business Group. He was appointed to his current position in December 1996.

Born in Neuville, near Québec City in 1953, Mr. Marcheterre graduated from the University of Ottawa with a Bachelor degree in Administration. He is married to Jacinthe Lépine, and they have two children, Pierre-

Alexandre and Vincent-Olivier. In 1999, Mr. Marcheterre received the "Médaille Trudeau", a prestigious award chosen by fellow Ottawa University graduates, honouring past graduates from the Faculty of Administration.

Mr. Marcheterre is a member of the Board of Directors, Executive Committee and Québec Committee of Rx&D, the Board of Directors of Group Minutia, the Board of Directors and the Audit Committee of Desjardins Financial Security. He is also a member of the Board of Directors and Life Sciences Committee of Montréal International, Governor of the Junior Chamber of Commerce of Montréal, member of the Jury for the Arista 2003 Awards, and member of the Fundraising Campaign Cabinet of the Sainte-Justine Hospital Foundation.

### ■ Perry Niro

A graduate of the Université de Montréal, with a Master's degree in political science and training in public relations, Mr. Niro began his career in 1987 at the Order of Chartered Accountants of Québec as a Public Affairs Advisor.

In 1990, he was appointed Political Advisor in the Québec Environment Minister's Office. In 1993, he founded the magazine *Envirotech*, a business publication that deals with technology and environmental management, and presided over it until 1997. After a stint as Public Affairs Director of the Québec Industrial Research Association (ADRIQ), he was appointed Executive Director of BIOQuébec, the Québec bio-industries association, in January 2000. BIOQuébec is the foremost biotechnology business network in Canada, bringing together nearly 240 companies and 1,500 decision makers, researchers and professionals.

Perry Niro is a member of the Board of Directors of BioAgral and the Québec Biotechnology Innovation Centre. He also sits on the Montreal International Life Sciences Committee and on Pharmabio Development, the human resources sectorial committee for Québec's pharmaceutical and biotechnological products industry.

### ■ Kelvin K. Ogilvie

Dr. Ogilvie is Professor of Chemistry and Past President and Vice-Chancellor of Acadia University in Wolfville, Nova Scotia. A native of Hants County, Nova Scotia, Dr. Ogilvie received his early education in a two-room schoolhouse in Summerville. He graduated Bachelor of Science in 1963 and Bachelor of Science (Honours in Chemistry) in 1964 from Acadia University.

While pursuing graduate studies at Northwestern University, Dr. Ogilvie became fascinated with the central roles of DNA and RNA in all living systems. At the time, there was no general method for the synthesis of DNA or RNA.

Dr. Ogilvie became a faculty member in the Department of Chemistry at the University of Manitoba in 1968. He moved to McGill University in 1974 and in 1984 he was appointed Director, Office of Biotechnology and Canadian

Pacific Professor of Biotechnology at McGill. He held these positions until 1987, when he returned to Nova Scotia and Acadia University to serve as Vice-President (Academic) and Professor of Chemistry.

Dr. Ogilvie is one of the world's leading experts on biotechnology, bio-organic chemistry, and genetic engineering. His scientific accomplishments include the development of the "Gene Machine," an automated process for the manufacture of DNA. He is the inventor of Ganciclovir, a drug used around the world to fight infections that occur when one's immune system is weakened. AIDS and transplant patients benefit from the drug, which is also being tested to treat human brain tumours. Both of these achievements were recognized in 2000 as "Milestones of Canadian Chemistry in the 20th Century" by the Canadian Society of Chemistry. He also developed a general method for the chemical synthesis of large RNA molecules employing silyl protecting groups that is still the basis for RNA synthesis worldwide.

Dr. Ogilvie has served on the Atomic Energy Control Board, the National Advisory Board on Science and Technology (NABST), the National Biotechnology Advisory Committee (NBAC), the NBAC Subcommittee on Intellectual Property and Regulatory Affairs, and the NBAC Subcommittee on Human Biopharmaceuticals and Diagnostics. He was a member of Labour Canada's Occupational Safety and Health Steering Committee on Biotechnology, and chaired the National Research Council Institute for Marine Biosciences' Advisory Board. Dr. Ogilvie also chaired the Selection Committee for the 1997 renewal competition for the Networks of Centres of Excellence Program and was a member of the Council of Ministers Advisory Committee for On-Line Learning. Dr. Ogilvie is a member of the national Canadian e-Business Initiative. He also serves on the scientific advisory boards for Canadian and International corporations. He is currently chair of the Premier's Council for Innovation in Nova Scotia.

### ■ Mark Poznansky

A native of Montreal, Québec, Dr. Poznansky's scientific career brought him from McGill University to Harvard to Paris and then to Edmonton, where he was Associate Dean of Medicine in charge of research at the University of Alberta. His laboratory there, funded by the Medical Research Council and the Alberta Heart and Stroke Foundation, developed an international reputation in the areas of cholesterol and membrane biophysics, as well as in enzyme replacement therapy and the novel approaches to drug delivery.

Dr. Poznansky is author of some 75 full publications and his laboratory generated three international patents in the area of immobilized enzymes. His tenure at the University of Alberta also coincided with the construction of two major research facilities which Dr. Poznansky had a direct hand in planning.

He became President and Scientific Director of the John P. Robarts Research Institute in 1993, succeeding the Institute's founding president, Dr. Henry Barnett. Since his arrival, the Institute has undergone impressive growth, has seen an aggressive technology transfer process put in place, and seven companies spun out of the Institute.

As well as his work at the Institute, Dr. Poznansky is founder and current president of London Biotechnology Incubator Inc., and a founding member and past Chair of the Council for Health Research in Canada, a research advocacy group based in Ottawa. He also chairs the scientific advisory board of the Canadian Medical Discoveries Fund. In 2003, he was awarded the Order of Ontario.

### ■ **Hugh Scott**

Dr. Scott is Executive Director of the McGill University Health Centre. He has served as Physician-in-Chief at the Centre Hospitalier Universitaire de Sherbrooke, Senior Physician at the Royal Victoria Hospital and Associate Dean of Post-graduate Medical Education and Professor at McGill University. He was also Principal and Vice-Chancellor of Bishop's University and Executive Director and Chief Executive Officer of the Royal College of Physicians and Surgeons.

### ■ **Hartley Stern**

Dr. Stern is a Professor and Chairman of the Department of Surgery at the University of Ottawa. He is also the Surgical Head of the Gastrointestinal Site Group for Surgical Oncology and CEO of the Ottawa Regional Cancer Centre. His primary interests are colorectal cancer prevention as well as the use of innovative technology for the treatment of colorectal cancer, including laparoscopic resection. His research interests have also included identifying patients with a genetic predisposition and looking at innovative ways to use his knowledge in prevention with dietary changes to impact the incidence of colorectal cancer. He participates and leads the groups in a number of large multi-centre studies especially evaluating the role of laparoscopy in this disease. At a local level he is developing the Oncology Assessment Unit, which will focus primarily on prevention and the use of a nurse-liaison driven system to facilitate the diagnosis and treatment of patients at risk for or diagnosed with colorectal cancer.

### ■ **Robyn Tamblyn**

Dr. Tamblyn is an Associate Professor in the Department of Medicine and the Department of Epidemiology and Biostatistics at McGill University, Faculty of Medicine. She also holds a position as Medical Scientist at the McGill University Health Center Research Institute, is a CIHR scientist and a McGill University William-Dawson scholar. She heads an FRSQ-funded team to study the relationships between medical training, practice and health outcome and a CIHR-funded team to investigate the use of e-health

technologies to support integrated care for chronic disease. She spearheaded a series of initiatives aimed at optimal drug management and enhancing the early uptake of evidence into primary-care practice, the Medical Office of the 21st Century (MOXXI) projects - phases I, II, and III.

Based on these experiences, Dr. Tamblyn and her colleagues obtained funding from the Canada Foundation for Innovation to establish a novel provincial infrastructure for health care and research, the Infostructure de recherche intégrée en santé du Québec (IRIS-Québec), that will integrate data from four academic university health centers and their extended primary-care networks with the provincial administrative data repository. The purpose of IRIS-Québec is two-fold: 1) to enhance patient care, and 2) to increase the capacity for timely and relevant research to improve disease prevention, treatment, and management. ■

