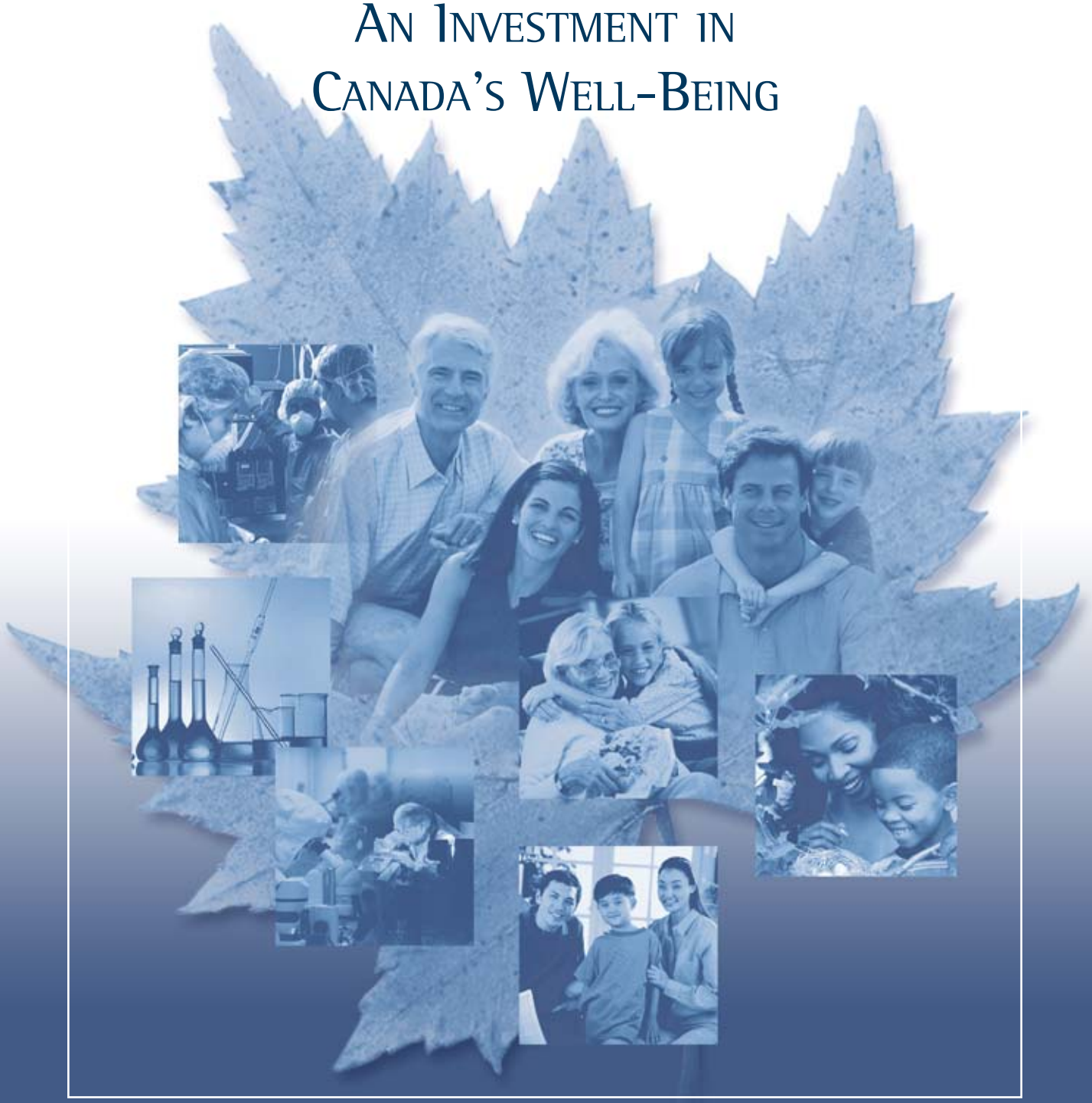
Health Research
An Investment in Canada's Well-Being



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The Health Research Advocacy Network

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About the Health Research Advocacy Network

The Health Research Advocacy Network (HRAN) is a coalition of national health organizations dedicated to increasing federal government support for health research in Canada. HRAN has two priorities: 1) To profile for government decision makers the "Return On Investment" of federal funding of health research and 2) To secure a multi-year commitment from the federal government to significantly increase funding for health research

Members of HRAN include: The Association of Canadian Academic Health Care Organizations (ACAHO), Canadians For Health Research (CHR), the Council for Health Research in Canada (CHRC), the Canadian Federation of Biological Societies (CFBS), Friends of the Canadian Institutes of Health Research (FCIHR), the College of Family Physicians of Canada (CFPC), the Health Charities Council of Canada (HCCC), the Association of Canadian Medical Colleges (ACMC) and the Canadian Institute of Academic Medicine (CIAM). For a description of HRAN members, please see Appendix I.

We welcome your comments on this report. We would especially like to hear from you if you have other examples of the important contribution that health research is making to Canada's social and economic goals.

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Executive Summary:

This report was prepared by the Health Research Advocacy Network. The Network is a coalition of national healthcare organizations and professional associations dedicated to ensuring Canada is a world leader in health research. This report profiles the return on investment associated with public funding of health research in Canada.

In its recent Speech from the Throne, the Government of Canada identified several priorities, including helping families and children out of poverty, improving the health status of Canada's Aboriginal peoples, ensuring a healthy environment for all citizens, providing young Canadians with greater support for graduate studies and creating competitive cities and healthy communities. Health research plays a central role in all those priorities.

The Speech from the Throne also re-affirmed the Government's commitment to health research through long-term investments, increasing funding for the federal granting councils and addressing the issue of the indirect costs of research.

In the past several years, the Government of Canada has increased its investment in health research through:

- The creation of the Canadian Institutes of Health Research (CIHR);
- The establishment of the Canada Research Chairs Program;
- The creation of the Canada Foundation for Innovation;
- The creation of Genome Canada; and
- The provision of a one-time grant for the indirect costs of research.

In addition to helping Canadians maintain and improve their health, these investments in health research are supporting the health care system and supporting Canada's Innovation Agenda.

Health Research: The Key to Innovation in our Health Care System

We are in a period of challenges to our health care system. Health research will be critical to meeting those challenges.

Health research:

- Provides the evidence that facilitates sound decision-making and provides governments with the information required to develop sound public policy;
- Supports a health promotion and wellness agenda by helping to understand how best to achieve our goals in this area;
- Provides the health system with the tools it needs to effectively diagnose and treat Canadians when they become ill;
- Provides the means to test the effectiveness of new treatments, first in controlled environments, through clinical trials, then in actual use, through ongoing surveillance;
- Helps to prevent disease by teaching us more about the factors that increase the probability of illness, including how health factors in our environment and in the way we lead our daily lives affect our susceptibility to disease; and
- Supports the development of the most efficacious and cost-effective means of delivering health care services to Canadians.

Health Research: A Pillar of the Innovation Agenda

The economic engines of the future are the world's knowledge-based industries. Our health system is Canada's largest knowledge-based sector. As the 21st century unfolds, "the health sector is emerging as the largest and most important driver of the global economy."[1]

Biotechnology and life sciences are the backbone of the innovative economy and will drive economic growth in the 21st century. And the backbone of their success is the research carried out in our universities, teaching hospitals and research institutions, as well as by industry.

[1] *Follow the Leaders: Canadian Innovation in Biotechnology*, Government of Canada, 2002.

The return on Canada's investment in health research is measured not only in terms of health, but also in terms of wealth. The Government of Canada's investment in health research is underpinning the Innovation Agenda by:

- Providing the foundation for spin-off companies that supply important health services and products to Canadians while generating economic growth and creating jobs;
- Fostering partnerships with the private and voluntary sectors that are leveraging the federal investment, integrating all partners into the development and implementation of strategic agendas for health research and maximizing the impact of health research dollars;
- Providing Canada with skilled graduates who are equipped with advanced levels of training, knowledge and expertise;
- Repatriating Canadian researchers from abroad and attracting distinguished foreign researchers to Canada, where their discoveries will benefit Canadians; and
- Creating a brighter future for Canada's youth by providing opportunities to harness their energy and creativity in becoming the next generation of health researchers.

Health Research: Building on the Return

The Government of Canada is achieving an outstanding rate of return on its investment in health research.

The creation of CIHR, in particular, has brought unprecedented integration of health research activity and created synergies among researchers that are the envy of the world. The result is a more strategic research agenda that is identifying gaps and priorities and mobilizing partnerships to meet those needs. Because of this, knowledge is being translated more quickly to prevent disease, diagnose it more rapidly and treat it more effectively.

For governments and other partners in the health research enterprise, the question now is how to augment that return in the face of two key challenges:

- While funding for health research has increased, so have its parameters. Funding must now be spread among a far larger range of research priorities, researchers, disciplines and sites; and
- The nature of health research requires a long-term and sustained funding commitment.

The federal investment in health research is paying dividends to Canadians. Further investments will continue to show positive returns for Canadians and for governments in terms of better health, a stronger health care system and a growing economy ready to take on the challenges of the 21st century.

I. Introduction

This report was prepared by the Health Research Advocacy Network. The Network is a coalition of national healthcare organizations and professional associations that is dedicated to ensuring Canada is a world leader in health research. The report profiles the return on investment associated with public funding of health research in Canada. It demonstrates that, in addition to helping Canadians maintain and improve their health, investments in health research support the health care system and Canada's Innovation Agenda.

If you think research is expensive, try disease.
Mary Lasker (1901–1994)

In 2000-2001, according to the Canadian Institute for Health Information, Canada spent about $102.5 billion on health care. That's about $3,300 per Canadian, almost three-quarters of it from public funds. The costs of ill health extend far beyond this figure. In 1993, the most recent year for which data are available, Health Canada estimated that illness, disability and premature death cost Canadians an estimated $156.9 billion. Direct costs totalled $71.7 billion, while indirect costs totalled $85.1 billion, almost half of which resulted from loss of productivity because of long-term disability. In today's dollars, the corresponding total costs would certainly exceed $200 billion annually.

The total cost of illness is much more than economic. For every Canadian who is disabled or dies due to illness or injury, there is a circle of family and friends, a community of people, who experience loss.

Health research is helping to alleviate the financial and human burden. For example:

- Canada has a long history of discovery in the prevention and treatment of diabetes, since Banting and Best discovered insulin in 1921. Today, the University of Alberta's Drs. James Shapiro and Ray Rajotte are giving people with diabetes new hope that they can one day leave their insulin injections behind. The technique is called islet cell transfer. So far, it has enabled recipients to live without insulin for up to two years. The province of Alberta has just included islet cell transfer on its list of covered procedures. Diabetes affects more than two million Canadians and costs the health care system $9 billion each year.

- Drs. Sam Lee and Mark Swain, at the University of Calgary, have developed a new treatment for hepatitis C that has cured more than half the patients involved in initial testing. An estimated one per cent of Canadians have hepatitis C, a disease that was only identified in 1989.

These health benefits, while significant, are only part of an exciting Canadian story that has begun to emerge in the past several years. Today, there is an implicit contract between governments and researchers; in return for their investment in research, governments expect more direct and specific benefits. And Canadian researchers are delivering on this promise.

In its recent Speech from the Throne, the Government of Canada identified several priorities, including helping families and children out of poverty, improving the health status of Canada's Aboriginal peoples, ensuring a healthy environment for all citizens, providing young Canadians with greater support for graduate studies and creating competitive cities and healthy communities. Health research is playing a central role in achieving all of those priorities.

The Government of Canada has substantially increased its investment in health research over the past several years. For example:

- It has created the Canadian Institutes of Health Research (CIHR) as Canada's premier agency for health research funding, with an annual budget in 2002–2003 of $562 million;

- It is attracting and retaining the finest minds in Canada and throughout the world by investing $900 million in the creation of 2000 Canada Research Chairs;

- It is supporting infrastructure development through the Canada Foundation for Innovation, investing $3 billion that will leverage $9 billion from partners by 2010;

- It is supporting breakthroughs in genetic research through the establishment of Genome Canada with an investment of $300 million; and

- It has allocated $200 million in one-time funding for the indirect costs of research and is involved in ongoing discussions about establishing a permanent mechanism to recognize these costs.

The Speech from the Throne reaffirmed the Government's commitment to health research through long-term investments, increasing funding for the federal granting councils and addressing the issue of indirect costs of research.

While the Government's past and current commitments are impressive, much work remains. Despite recent budget increases, per capita funding for health research remains four times greater in the United States than in Canada and the Government's own reports indicate that Canada is seventh among the G8 in public investment in R&D. And while the number of grants awarded by CIHR increased by 22 per cent in 2002 over the previous year and the average grant amount increased by 11 per cent, CIHR is having to turn down increasing numbers of excellent proposals because the money isn't available to fund them. Since 2000, 892 proposals that were considered very good to excellent by peer review panels have been turned down. In 2000, that amounted to about 22 per cent of all proposals eligible for funding; by 2002, that had increased to more than 25 per cent of such proposals.

Despite recent increases, per capita funding for health research remains four times greater in the United States than in Canada.

Today, Canadians and their governments are overwhelmingly preoccupied with health services: what services should be provided, to whom, how services should be organized and how they should be funded. Opinions and ideologies abound in the national discussion on health services. What is often lacking in the national debate, however, is evidence that indicates which procedures and service strategies are of most value — and which have little or no value. This evidence can only come from research that is rigorous, integrated and focused not on emotions, not on belief systems, but on facts. In an age of information, evidence-based decision making is the only prudent basis for public policy choices. This contribution of health research to our health system is not well understood, but it is particularly crucial at this point in its evolution.

Health research is also a foundation for innovation. Canada is committed to being one of the most innovative countries in the world and it is implementing a strategy to realize that vision. Canada's Innovation Strategy, as set out in two reports, *Achieving Excellence* and *Knowledge Matters*, focuses on two key priorities: investment in science and research capacity and the development of our national human resources capacity. Health research is integral to both these priorities. Investments in health research allow Canada to attract and retain some of the finest minds in the world and also create knowledge that can be translated into jobs and economic growth through commercialization of discoveries.

Growing investments in health research position Canada as a leader in knowledge creation. This is allowing Canada to develop new breakthrough treatments and procedures that are of benefit not only to Canadians, but to the rest of the world.

Canadian researchers are at the forefront of new discoveries. When *Nature* magazine recently published a list of the world's most influential papers in stem cell research over the past 30 years, 16 of the 34 originated from Canada. According to a recent review by the Heart and Stroke Foundation of Canada, Canadian cardiovascular researchers consistently have more citations per capita in scientific journals than their American counterparts. Canadians are also world leaders in cancer research and HIV/AIDS research. These are just a few examples of areas where Canadian researchers set an international standard of excellence.

Health research contributes to the development of an entrepreneurial climate. It generates new employment capacity, higher incomes, growing wealth and a robust tax base that supports a range of social programs, including the health care system.

Health research is a global undertaking and Canadians benefit from the knowledge generated throughout the world. However, health research carried out in other countries cannot respond to the unique needs and priorities of Canadians. And knowledge generated elsewhere will not translate into economic benefits for Canadians.

Canada needs to ensure that the full benefits of health research accrue to Canadians. And that can only happen with a strong health research enterprise here in Canada.

II. Health Research: The Key to Innovation in our Health System

> The health and healthcare sector should be viewed, not as a cost to be endured, but as an opportunity to be explored, embracing a vision for Canada to create the most innovative, high quality healthcare system committed to continuous improvement.
>
> *Public Policy Forum*

A Changing Health System

Canada's health system has much to be proud of — and Canadians are proud of it. For many Canadians, it is a uniquely Canadian institution that sets us apart from our neighbours to the South. Fully 88 per cent of Canadians believe that a strong, nationally funded system is important to them, according to a study of Canadian public opinion commissioned by the Romanow Commission (June 2002). According to research commissioned by CIHR and carried out by Pollara in October 2001, 85 per cent of Canadians agree that the future quality of Canada's health care system is directly related to the commitment we make to invest in health and medical research.

Eighty five per cent of Canadians agree that the future quality of Canada's health care system is directly related to the commitment we make today to invest in health and medical research.

Today, our health system is facing a number of serious challenges. Canadians believe that the health care system has deteriorated over the past decade; they are concerned about waiting lists, about a lack of equipment and about a shortage of specialists. In short, Canadians are concerned that their health system, such an important part of our national identity, may not be able to provide care when it is most needed. These pressures will only increase with the aging of the population.

There has been no shortage of studies of our health system. The recent report of the Romanow Commission, the various reports issued by the Kirby Senate Committee on Social Affairs, Science and Technology and many provincial/territorial reviews of health care are setting the stage for a period of transition and change.

As the mandate of the Commission on the Future of Health Care in Canada states, recommendations are needed that will address the long-term sustainability of a quality, universally accessible, publicly administered health care system for all Canadians. This will involve not only what we think of as the traditional health care system — health care providers, hospital beds and pharmaceutical products — but attention to the entire continuum of health services, from prevention to palliation.

Decisions are required at a time when greater complexity in our health system is making these decisions much more difficult. In 1961, for example, the *New England Journal of Medicine* (NEJM) published an article that estimated that, of 1000 adults considered at risk of illness, 750 reported illnesses or injuries in a month, 250 consulted a physician, 9 were admitted to hospital, 5 were referred to another hospital and 1 was referred to a university medical centre. In 2002, the NEJM revisited those figures. The broad numbers were roughly the same — for every 1000 people at risk, 800 reported symptoms. However, 327 considered seeking medical care, 217 visited a physician's office (113 of them a primary care physician), 65 visited a complementary or alternative medical care provider, 21 visited a hospital outpatient clinic, 14 received home health care, 13 visited an emergency department, 8 were hospitalized and 1 was hospitalized in an academic medical centre. While the proportion of people seeking care has changed little in 40 years, the types of care they are seeking have changed dramatically, creating a landscape that is infinitely more varied and complex than it was in the 1960s.

While these studies took place in the United States, they paint a picture that will be familiar to Canadians. Health policy makers are attempting to deliver the best health system for the 21st century in the face of unprecedented complexity. Health research will be critical to managing that complexity.

Providing Evidence for Sound Decision Making in the Health Care System

It is fair to say that, in the past, the "squeaky wheel" has often been the driving force for change in health care. Professional and interest groups put forward their points of view and, in the absence of evidence and a framework for evaluation, health policy makers had little other information on which to base their decisions.

Today, it is widely recognized that this approach to health care decision making is no longer acceptable — not to health care funders, not to health care providers and not to health care consumers. Health research is paving the way for evidence-based decision making. Evidence resulting from health research provides care providers, consumers and governments with the information they need to make sound decisions.

As the Association of Canadian Medical Colleges noted in its submission to the Romanow Commission, biomedical and health services research are important contributors to the outstanding quality of Canada's health care system. Research helps to ensure a health system that is adaptable, responsive, innovative, cost-effective and accountable.

Health Promotion: Supporting a Wellness Agenda

In the recent Speech from the Throne, the federal government made a commitment to develop a national strategy for healthy living. Health promotion is one of the key roles of the Government of Canada in the area of health. Health research is critical to understanding what works and what does not in achieving health promotion goals.

The best long-term strategy to sustain the health system is to find ways for people to stay healthy. Research tells us what initiatives will achieve this goal and what incentives will help people to act in ways that promote their own health.

- Physical inactivity is one of the leading contributors to preventable death in Canada. Dr. Karen Chad, at the University of Saskatchewan, wants to reduce these deaths by getting people moving. Her project, Saskatoon in Motion, is one of the Community Alliances for Health Research being funded by CIHR. Dr. Chad is working with a host of community partners to develop programs to examine physical inactivity among disadvantaged youth and older adults. The partners want to learn more about the benefits of exercise for these groups, the factors that determine levels of physical activity and why some people abandon active lifestyles. Dr. Chad's research will provide a sound basis for policy makers and provide long-terms solutions that promote physical activity at the community level.

- Health promotion is important in the workplace as well. Drs. Stephen Bornstein and Barbara Neis, of Newfoundland's Memorial University, want to promote healthy workplaces among coastal workers in the fisheries and oil and gas sectors, as well as in other jobs that expose workers to cold air and water. Their project, SafetyNet, also funded by CIHR, is bringing together more than 60 researchers and 40 partner organizations for the most extensive research ever conducted into occupational health and safety in Atlantic Canada.

Health promotion also incorporates the notion of surveillance to monitor the health of the population to determine who is at particular risk. In the United States, for instance, the Framington Heart Study is one of the world's most famous epidemiological studies. In existence for more than 50 years, it has generated more than 1,000 research papers that have documented, for example, the relationship of LDL, or "bad" cholesterol, to coronary heart disease. The study was only possible because it received long-term funding. Because of its "single-payer" system, Canada is rich in the databases needed to support such research. But the development of these kinds of studies is slow and requires decades of "staying power". As the Auditor General of Canada recently observed, there is a desperate need for better surveillance research to support government decision making in the health sector.

Diagnosing and Treating Disease

Health research is the source of new drugs and diagnostic techniques, as well as greater understanding of the mechanisms of disease, providing our health care system with the tools it needs to effectively diagnose and treat Canadians. The discovery of insulin by Drs. Banting and Best is one of the first examples of a Canadian discovery that alleviated the impacts of disease — in this case, diabetes — but it is far from the last.

Health research provides our health care system with the tools it needs to effectively diagnose and treat Canadians.

The impact of new tools for diagnosing and treating disease can be significant. The knowledge that is gained as a result of health research reduces the costs of illness and cures disease. Research sponsored by the Mary Lasker Charitable Trust in the United States found, for instance, that the development of lithium to treat manic depressive illness has resulted in health cost savings of $9 billion each year in that country; preventing hip fractures in post-menopausal women at risk of osteoporosis saves $333 million annually; and a 17-year program that invested $56 million in research on testicular cancer led to a 91 per cent cure rate and annual savings of $166 million. Health research, supported in most cases by CIHR, has had equally dramatic results here in Canada.

- Every year, nearly 20,000 Canadian women are diagnosed with breast cancer and many more need biopsies to discover whether a lump is cancerous. Dr. Aaron Fenster, at the University of Western Ontario in London, has developed three-dimensional ultrasound that significantly enhances both diagnosis and treatment, not only of breast cancer, but of prostate cancer and many other diseases. Dr. Fenster holds a Canada Research Chair in Biomedical Engineering.

- Early diagnosis is critical to keeping Alzheimer's disease under control. Two University of Toronto researchers, Drs. Konstantine Zakzanis and Mark Boulos, have concluded that a simple verbal memory test, the California Verbal Learning Test, offers the clearest means for diagnosing the disease's early onset. Every year, nearly 85,000 people are diagnosed with Alzeimer's; by 2031, experts predict that 750,000 Canadians will suffer from the disease.

- A bold new treatment for multiple sclerosis is showing hopeful signs of beating this debilitating chronic disease that strikes in the prime of life. Dr. Mark Freedman, of the University of Ottawa, is conducting a trial that combines chemotherapy to wipe out the body's immune system with a transplant of stem cells harvested from the patient's own bone marrow before the chemotherapy. Six months after undergoing the treatment, some patients are showing signs that the disease is in remission.

- Not all interventions are effective. A team led by McMaster University's Dr. Barbara Schmidt has found that some drugs commonly given to low birthweight babies as a precaution do not increase their chances of survival or prevent disability. These findings are helping to avoid needless exposure to drugs among infants and reduce costs.

- Obsessive-compulsive disorder results in its victims having uncontrollable urges to wash, tidy, straighten and hoard. Now Dr. James Kennedy, a researcher at Toronto's Centre for Addiction and Mental Health, has identified a gene that makes people nearly three times more likely to suffer from the disorder. His finding narrows the search for a genetic target for drug therapy and could help in designing new medications to treat the disorder.

- The University of Calgary's Dr. Sam Weiss and his team, part of the Canadian Stroke Network, have developed a new treatment that appears to be capable of restoring movement in animals paralyzed by stroke-like injuries in the brain. They increase the number of stem cells in the brains of the rats, then introduce a second class of growth factors that command the stem cells to become neurons. Ten years ago, Dr. Weiss was the first researcher to discover stem cells in the brains of adult mice.

- A new breast cancer treatment developed at the University of Alberta is significantly improving women's chances of surviving the cancer and researchers expect it to become one of the standard treatments in the early stages of breast cancer.

- Toronto researcher and CIHR Distinguished Investigator Dr. Peter St. George-Hyslop and his team have successfully immunized mice against Alzheimer's disease. Their drug not only prevents the onset of the disease, but halts its progress after it strikes. A drug to immunize humans could result from their work.

- Asthma is reaching epidemic proportions in Canada, particularly among youngsters. Dr. Abelilah Soussi Gounni, at the University of Manitoba, is studying the role played by white blood cells, called neutrophils, in diseases such as asthma. He has found that activation of these cells can induce a harmful mediator release, which exacerbates asthma. His research could lead to new and better ways to treat asthma and allergies.

- CIHR researchers Drs. Josef Pennigner, Graham Pitcher and Michael Salter are part of a team of Toronto-based scientists who have discovered a genetic mechanism involved in pain modulation. They found that mice who lack a gene called DREAM (downstream regulatory element antagonistic modulator) are much less sensitive to pain than mice who have the gene. Their research could lead to an entirely new approach to pain control.

- Dr. Susan Quaggin, at the University of Toronto, is trying to understand the genes that are responsible for kidney failure, to identify new targets for treatment and prevention. She and her team are dissecting the genes and pathways that are responsible for establishing and maintaining healthy kidney filters so that they can learn how to fix the scarred filters that cause kidney failure.

Testing for Success: The Role of Clinical Trials

The evidence of effectiveness for a treatment is amassed through a long process of testing, beginning with animal models and ending with clinical trials in humans. The importance of these trials was brought home this summer, when Canadian women were jolted by news that hormone replacement therapy, which has been promoted for more than 20 years as a way of preventing heart disease and stroke in menopausal women, may actually do the opposite. A clinical trial of more than 16,000 women found that the risk of cardiovascular disease was higher among women taking the therapy.

There are many similar examples of the importance of clinical trials. For example, a clinical trial conducted in Canada has shown that arthroscopic knee surgery, an operation frequently performed to alleviate symptoms of osteoarthritis, is not beneficial. This single finding, like the findings of many clinical trials, has the potential to help thousands of Canadians avoid needless treatments, such as drugs or surgery, while saving the health care systems millions of dollars.

In some cases, trials come too late in the process; they should have taken place before ineffective treatments and procedures became widely accepted. In other cases, results in controlled clinical environments are different than those in the "real world", where many other factors can affect outcomes. Ongoing surveillance is, therefore, often necessary to evaluate how well treatments continue to work even once they have become accepted therapies. Without these continuing investments, the health system and health care consumers pay the costs of ineffective treatments.

Clinical trials, where patients are randomly assigned to receive either the treatment being tested or a standard treatment or placebo, are expensive, time-consuming and challenging to execute. But they are the test that every treatment needs to pass before being made widely available. Canadians are leading the way in this type of research:

- Through the Heart Outcomes Prevention Evaluation (HOPE) study, McMaster University's Dr. Salim Yusuf demonstrated that the drug ramipril could improve survival rates for high-risk cardiovascular patients while reducing their future risk of heart attack or stroke. He

also found that the drug reduced self-reported cases of Type II diabetes by 34 per cent — a positive outcome he didn't expect. Now, he has joined with his colleague, Dr. Hertzel Gerstein, in a new project called DREAM — Diabetes Reduction Approaches with Ramipril and Rosiglitazone Medication. This clinical trial, one of the largest ever undertaken, will further examine the use of ramipril to prevent and treat diabetes.

- Many people with HIV/AIDS do not benefit from the drug therapies that are currently available. Canadian researchers in 22 centres, led by the University of Ottawa's Dr. James Cameron, are participating in a $25 million tri-national trial to investigate clinical management alternatives for combining drug treatments for AIDS patients who have not responded well to conventional therapy. The OPTIMA (Options for Management with Anti-retrovirals) trial also involves researchers from 25 clinics in the United Kingdom as well as 30 in the United States. Its results could have significant implications for people with HIV/AIDS and for how our health care system treats them.

- Many patients require blood transfusions as a routine part of surgery, but are concerned about the risk of infections. As a result, many patients choose blood conservation strategies, such as banking their own blood prior to surgery or taking a hormone before surgery that stimulates the production of more red blood cells. The PROBE (Program to Reduce Orthopedic Blood Exposure) study, being conducted at the University of Western Ontario, is investigating which blood conservation strategies are the most effective and cost-efficient among patients undergoing hip replacement surgery in 30 Ontario hospitals.

A Focus on Prevention

Health research leads to discoveries about the factors that increase the probability of illness or enhance recovery. As quickly as Canadian researchers are learning about the genetic basis of disease, they are also learning how factors in our environment, including air and water quality, social factors such as poverty and unemployment and the way we live our daily lives can affect our susceptibility to disease.

Canadian research institutes, such as Toronto's Canadian Institute For Advanced Research, have been world leaders in this important field. Today, there is a growing network of researchers, including epidemiologists, psychologists, public health physicians, nurses and specialists in health care delivery, who are focusing on prevention research. Their findings are providing health authorities with the evidence they need to target their efforts more effectively.

- *Folic acid: it's never too early!* That's the message being given to women who are thinking about becoming pregnant. They are being told to make sure they get sufficient

folic acid, one of the B-vitamins, in their diets. The reason? It prevents neural tube defects, such as spina bifida, a permanently disabling birth defect that affects more children than muscular dystrophy, multiple sclerosis and cystic fibrosis combined. The rate of neural tube defects in Canada was cut in half between the early and mid-1990s after Health Canada ordered grain products to be fortified with folic acid. Dr. Rima Rozen, a geneticist at McGill University, was the first to discover a gene that, when mutated, places people at higher risk of developing spina bifida. Some 10-12 per cent of North Americans carry this mutation. They need increased amounts of folic acid, through a multivitamin or foods rich in folates, such as legumes, liver and green vegetables. Dr. Rozen's research has been critical in alleviating heartache to families while reducing the costs associated with neural tube defects. The lifetime economic cost to society for every person with spina bifida is estimated at US$260,000. An analysis conducted in the United States found that fortifying grain with folic acid could have an economic benefit of US$94 to $252 million in that country.

- Type II diabetes, which used to be almost exclusively seen in adults, is showing up more and more in children. Dr. Heather Dean, from the University of Manitoba, has taken the first look at the long-term health consequences of developing the disease at a young age and found that the consequences can include heart disease, blindness, kidney failure and amputations later in life. Her findings underscore the need for prevention strategies aimed at children.

- The ability of health professionals to predict when a newborn will need special attention can make a tremendous difference in preventing negative outcomes. Dr. Patricia Janssen, at the University of British Columbia, is establishing Canadian standards for normal growth at birth, separating babies by sex and ethnicity. Her research will allow doctors and nurses to know when babies haven't grown properly in the uterus and when they will need careful observation and frequent feeding right after birth.

Health Care Delivery: Finding Solutions in Research

Health research sheds light on the most efficacious and cost-effective means of providing health services. Are interventions effective? Is there a better way of providing them that costs less without compromising care? What are the evidence-based best practices and guidelines that can help physicians and other health care professionals make sound clinical decisions? And what information do administrators and policy makers need to allocate health care resources and organize health care services more effectively? Health research can be directly translated into best practices and guidelines that help physicians and other health care professionals provide excellent care.

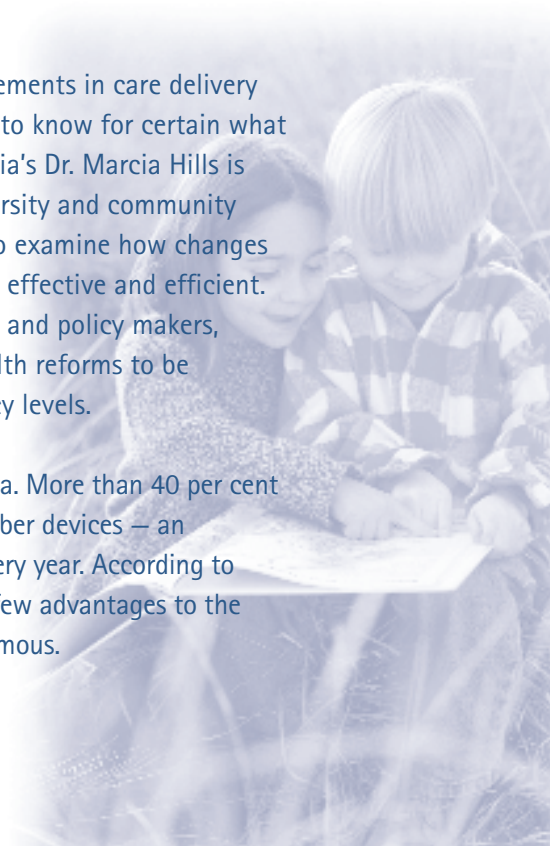
Health research can be directly translated into best practices and guidelines that help physicians and other health care professionals provide excellent care.

- One of the questions we know little about in our health system, but that is of great interest to decision makers and consumers, is the degree to which providing care prevents untimely and unnecessary deaths. A study conducted by researchers at Toronto's Institute for Clinical Evaluative Sciences and reported in the September 2002 issue of the *American Journal of Public Health* found that, for 9 of 11 disease groups considered avoidable, Canada had lower mortality rates than the United States. Proportionally fewer people died of treatable diseases like asthma, tuberculosis and cervical cancer. In particular, the mortality rates were lowest for disease groups such as those above, where public health or primary care played a major role. Mortality rates were still lower, but not to the same degree, in diseases such as appendicitis, Hodgkin's disease and peptic ulcer, which are most often treated in a hospital. Most dramatically, death rates from asthma rose by 56 per cent in the United States between 1980 and 1996, while Canadian rates dropped over the same period by 79 per cent. The authors believe the better outcomes in Canada are due to the comprehensive health services that are freely available in Canada and the greater emphasis placed on primary care in Canada. This type of research is important to decision-makers because it looks beyond waiting lists and available hospital beds to examine the effectiveness of alternative types of care delivery.

- Although there is currently no Canadian research, it is believed medication errors in hospitals cause many hundreds of deaths in Canada each year. CIHR's Institute of Health Services and Policy Research, together with its Institute of Population and Public Health and the Canadian Institute for Health Information, is determining the extent of such adverse events in Canadian hospitals. They are also investigating better systems to monitor and reduce the occurrence of such errors in the future.

- Primary care is a key focus of concern in health reform. Improvements in care delivery are widely supported — but often there is not enough evidence to know for certain what kinds of changes will be most effective. The University of Victoria's Dr. Marcia Hills is helping to fill gaps in knowledge by leading a coalition of university and community partners in a CIHR "Community Alliance for Health Research" to examine how changes to primary health care could make the health care system more effective and efficient. By bringing together researchers, practitioners, decision makers and policy makers, Dr. Hills' project will help develop strategies that will allow health reforms to be implemented simultaneously at both the practical and the policy levels.

- Every year more than 10,000 pacemakers are implanted in Canada. More than 40 per cent are dual-chamber types that cost $2,500 more than single-chamber devices — an additional cost to the health care system of some $10 million every year. According to research by McMaster University's Dr. Stuart Connelly, there are few advantages to the more expensive pacemaker. The potential for cost savings is enormous.



- When is it appropriate to order a radiograph for an injury to the ankle, knee, neck, or brain? Dr. Ian Stiell, a CIHR Distinguished Investigator from the University of Ottawa, has developed rules to help emergency room physicians around the world know when to order tests — and when not to. The Ottawa Ankle and Knee Rules and the Canadian C-Spine and CT Head Rules are helping physicians provide better treatment to people with injuries, while helping hospitals save millions in unnecessary diagnostic tests.

- More experienced and educated nurses are the difference between life and death for some people leaving hospital after a heart attack, pneumonia, stroke or blood poisoning. A study by the Institute for Clinical Evaluative Sciences compared the outcomes of care provided by registered nurses, registered practical nurses or nursing assistants and that provided by unlicensed personnel, including nurses' aides. The study, conducted in 75 Ontario hospitals, found that fewer patients died within 30 days of discharge when care was provided by registered nurses. Increasing the proportion of RNs by 10 per cent would mean five fewer patient deaths for every 1,000 patients discharged.

- Making home care part of our health care system could achieve better care at lower cost according to Health Canada's synthesis of 15 home care studies. Home care was found to cost only 25 to 60 per cent as much as institutional care, regardless of the gravity of a patient's condition. Home care costs accounted for only 20-50 per cent of total costs, while the remainder went for hospital admissions, doctors' visits and drugs. The synthesis report, released in September 2002, also found that investing in home-support services, such as helping frail seniors clean their homes and buy their groceries, pays dividends for the health system and for the quality of life of seniors.

- Dialysis is used in kidney disease to compensate for failed kidneys. It is a rigorous regime, often taking three days out of every week for affected patients. But an experiment conducted by Dr. Chris Chan of the Toronto General Hospital has found that providing dialysis at night, while patients sleep, is less stressful for patients and also less costly for the health care system. All patients in the trial experienced lower blood pressure and no longer needed blood pressure medication. As well, nighttime dialysis costs nearly 20 per cent less — $56,000 compared to $68,000 per year per patient. Dr. Chan estimates that the new approach could be appropriate for up to a quarter of the nearly 15,000 people on dialysis in Canada — a potential savings of $43 million for the health care system.

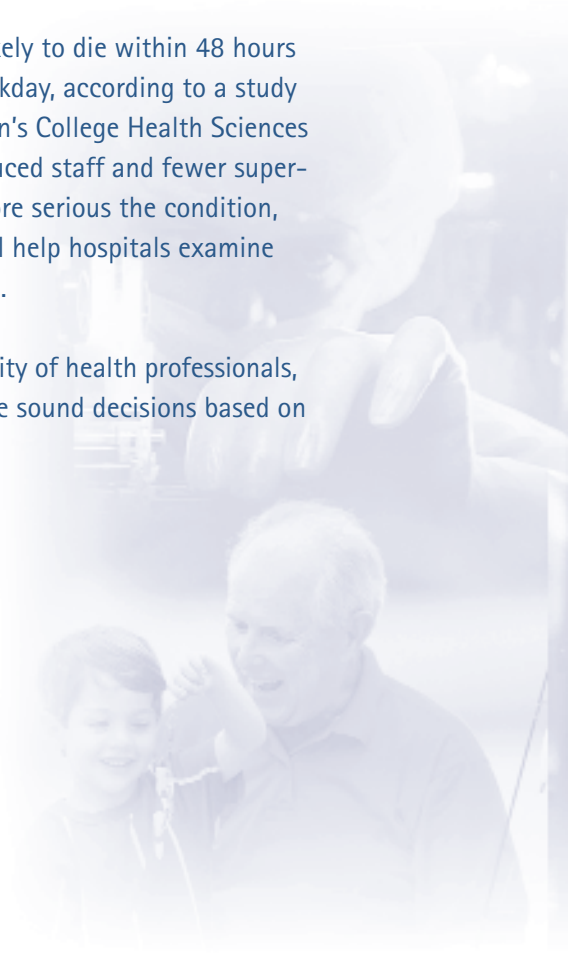
- More than half of Canada's rural population is elderly. Many elderly suffer from chronic illness, a challenge for traditional rural health systems. Dr. Renée Lyons, at Dalhousie University, is leading a team of researchers and community representatives to develop a new model for organizing Canadian rural health systems to better care for people with chronic health problems. The Office for Rural Health that is being established in Yarmouth, Nova Scotia, will yield important insights about how to improve the quality of life for elderly people with chronic illness, while reducing financial and social costs.

- Children hospitalized with ear infections are far less likely to need further surgery if they undergo a two-part procedure that combines the removal of the adenoid glands with the insertion of tubes into the ears. This finding by Dr. Peter Coyte and his team at the University of Toronto could prevent unnecessary surgeries and save the health care system more than $300 million per year.

- A new clinical trial by Dr. Julio Montaner, from St. Paul's Hospital in Vancouver, found that a delay in starting anti-retroviral therapy for people with HIV/AIDS does not reduce the therapy's effectiveness. The study could save health care systems millions of dollars. The team has also developed a way to tailor individual medication doses through a combination of gene-sequencing procedures. Their work will help to reduce the toxicity and side effects of powerful AIDS drugs, while saving money by delivering more precise amounts of these costly medications when they are really needed.

- Patients admitted to the hospital on the weekend are more likely to die within 48 hours compared to those admitted with the same diseases on a weekday, according to a study by Dr. Donald Redelmeier, at Toronto's Sunnybrook and Women's College Health Sciences Centre. His study suggests the problem may be related to reduced staff and fewer supervisors with less seniority and experience on weekends. The more serious the condition, the greater the risk, according to the study. These findings will help hospitals examine their staffing patterns so that quality of care can be improved.

These and many other studies are dramatically improving the ability of health professionals, consumers, health care administrators and policy makers to make sound decisions based on high-quality Canadian research.



III. Health Research: A Pillar of Canada's Innovation Agenda

> Innovation: a process through which additional economic value is extracted from knowledge.
>
> *Conference Board of Canada*

The economic engines of the future are the world's knowledge-based industries. Knowledge, creativity and innovation are the fuels that power these engines.

The health system is Canada's largest knowledge-based sector, employing thousands of Canadians with expenditures of more than $100 billion each year. Indeed, it is increasingly clear that the health sector, driven by health research, will comprise an ever-larger proportion of total research and development activity in Canada.

In its survey of biotechnology in Canada (*Follow the Leaders)*, the Government of Canada noted that "as the 21st century unfolds, the health sector is emerging as the largest and most important driver of the global economy." In fact, growth in biotechnology is quickly expected to outpace growth in the information technology sector.

> Innovation is as much about tearing down barriers as blazing trails.
>
> *Harvard Business Review, August 2002*

Biotechnology and life sciences are the backbone of the innovative economy. And the backbone of success in biotechnology and the life sciences is the research carried out at Canada's universities, teaching hospitals and research institutions.

Basic Research: The Foundation for Commercialization

Public investment in the creation of knowledge is at the beginning of the pipeline of development. The OECD has found, for instance, that more than 70 per cent of biotechnology patent citations in the United States were to papers originating at public science institutions. While the private sector can be looked to for the development of a specific drug or device, public investment is required to uncover the fundamental knowledge that makes commercialization possible.

In 1930, researchers at the Hospital for Sick Children in Toronto invented Pablum, making the lives of mothers instantly easier. The profits from that invention have supported research at the hospital ever since.

Pablum notwithstanding, commercialization of the knowledge created through Canadian investment in health research has, in the past, taken place primarily in other countries. Canada's strength lay in discovery. Translating those discoveries into products and services often occurred elsewhere, primarily the United States. Canadians bought back their own innovations at inflated prices. Today, public investment in health research is changing that picture, as public research institutions pay increasing attention to the commercialization of products and services. Right across Canada, new knowledge created through publicly funded health research is being translated into health benefits for Canadians through the creation of private companies, jobs and economic growth.

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During 2001, Canadian biotechnology and life sciences companies were the recipients of 22 per cent of the $4.9 billion in venture capital disbursed in Canada. Overall, the life sciences are forecast to account for 130,000 jobs in Canada by 2003 and there are more than 100 publicly listed Canadian health-related companies with a market value of some $15 billion. This sector of our economy is growing faster than any other, at 10-20 per cent per year.

The return on Canada's investment in health research can be measured not only in terms of health, but also in terms of wealth. Research-intensive public institutions and academic researchers form a nucleus of discovery around which innovation, commercialization and economic diversity revolve, to the benefit of all.

In August 2002, the Public Policy Forum convened a roundtable on new models for linking the health care system with Canada's Innovation Agenda. It proposed a national strategy for securing an economic return on investments in health care and predicted that spin-off benefits could easily reach $7 billion per year. It called upon Canadians to align and integrate Canada's most cherished social program, the health care system, with a strategy to capitalize on the public investment in health care by supporting the development of products and services that can be shared and sold around the world. Thanks to public investment, this is already beginning to happen.

Health research is leading to the alignment of the government's social and economic goals by creating high quality jobs for Canadians both directly and through the creation of spin-off companies. Companies formed as spin-offs of CIHR investments are found in every large university community in Canada and in many smaller ones as well. For example, 23 companies have been formed from discoveries by scientists at the University of British

Columbia, employing 732 people. At McGill University in Montreal, 18 companies have been formed, employing 392 people. And 10 companies have been formed from research carried out at the University of Ottawa, employing 459 people.

In the early phases of discovery, it is the publicly funded researchers who have the opportunity to discover the knowledge that later supports commercial applications. Long before techniques such as recombinant DNA methodologies were diffused to the wider community, for example, it was scientists in public institutions who conducted the research on these techniques and who held the ability to gain early benefits.

Spin-off companies resulting from public investment in health research are already producing stunning health and economic benefits for Canadians. For example:

- 3TC has helped to change AIDS from a death sentence into a chronic illness. It was developed at the University of Montreal with the support of federal funding. BioChem Pharma, recently acquired by Shire Pharmaceuticals, has its head offices in Montreal. The company employs 278 people and boasts a market capitalization of US$3.7 billion.

- Organ transplants save lives, but they also require recipients to take anti-rejection drugs for the rest of their lives. Cyclosporine, the current "gold standard" for immune suppression therapy, has dramatically improved survival rates for transplant recipients, but it can also cause the kidneys to fail. Isotechnika, an Edmonton biotechnology company, has received a $125 million investment from Swiss pharmaceutical company Roche to test its new anti-rejection drug, ISAtx247. Initial findings have indicated that it is more potent and much less toxic than cyclosporine.

- Researchers from the University of Ottawa, led by Drs. Wilbert Keon and Tofy Mussivand, began developing the world's first fully implantable artificial heart in 1989. Today, WorldHeart Corporation is experiencing outstanding success. It has applied to the U.S. Food and Drug Administration for premarket approval of its Novacor LVAS device. Its HeartSaver VAD, the implantable device, is in pre-clinical trials.

- QLT Inc. is producing the only approved treatment for age-related macular degeneration, the leading cause of age-related blindness. Visudyne, which is approved for use in more than 30 countries, was developed at the University of British Columbia with support from CIHR. QLT Inc., with its head office in Vancouver, employs more than 350 people and has a market capitalization of US$1.5 billion.

- Dr. Tony Pawson is a world-renowned health scientist who has dedicated his career to conducting basic research on proteins at the Samuel Lunenfeld Research Institute in Toronto with the support of CIHR. His company, MDS Proteomics, raised $82.5 million in financing in 2001, with another public offering of $100 million expected soon.

In 2001, he received a major investment from IBM, which recognized the potential for information technology to be applied to proteomics research. As a result, MDS Proteomics is at the international leading edge of proteomics, technology and drug development.

- Bioniche Life Sciences Inc. is testing a vaccine to prevent *E-coli* infections in cattle, the source of the infection in humans. Every year in North America, some 50,000 people become sick from the *E. coli* bacteria and 500 die. The disease costs meat producers as much as $5 billion a year, because the slightest trace of the bacteria requires the destruction of an entire meat shipment. CIHR Distinguished Investigator Dr. Brett Finlay, a professor at the University of British Columbia, developed the vaccine. It has proved effective in small numbers of cows and is now being tested on more than 70,000 animals. If successful, Dr. Finlay's vaccine will help to reduce the dramatic economic and health costs of *E. coli* infection.

Others companies arising from public investment in health research are at an earlier stage in their development but are already showing great promise:

- LymphoSign Inc., a Toronto-based biotechnology start-up, was launched to commercialize a possible treatment for leukemia. The treatment is based on more than 12 years of public support for research at the Hospital for Sick Children by Dr. Chaim Roifman. The company will soon launch Phase 1 clinical trials for its novel treatment.

- GeminX is a Montreal company working to fight cancer. It is linked with two CIHR-funded projects. One project has led to the discovery of a human adenovirus protein involved in killing cancer cells. Research is now examining the development of a therapy based on the protein. The other project has developed a drug that inhibits the BCL2 protein, which suppresses apoptosis, the normal process of cell death. The drug is set to go into clinical trials in 2003. GeminX originated in CIHR-funded projects carried out by its co-founders, Dr. Philip Branton, Scientific Director of CIHR's Institute of Cancer Research, and Dr. Gordon Shore.

- Diabetogen Biosciences Inc. was incorporated in June 2000 to focus on the development of drugs to prevent and treat Type I diabetes. Diabetogen, which is based on work conducted in the laboratory of Terry Delovitch of the Robarts Research Institute, is the only company in the world with a multi-faceted program to treat all three stages of diabetes — early, intermediate and late.

- Enhanced Vision Systems Corp. (EVS) was also established out of research conducted at the University of Western Ontario. The company has developed and commercialized leading micro-CT (computed tomography) technology for high-resolution, three-

dimensional imaging. The technology can be used in bone research, with a focus on arthritis and osteoporosis, drug discovery, vascular imaging and tissue pathology. With leading pharmaceutical and biotechnology companies and research institutes as its customers, EVS is poised to be the global leader in the rapidly evolving market of small animal imaging.

- A spray to keep the flu away? A Vancouver biotechnology company is testing its FluINsure vaccine nasal spray to see if it is effective against the flu. If earlier clinical studies on six flu strains and 320 patients are confirmed, ID Biomedical Corp. has what analysts predict could be a US$500 million product. As a result, the flu shot could be no more than an unpleasant memory for many people. The vaccine should be ready for the 2006 flu season.

- Oncolytics is out to conquer brain and prostate cancer with an experimental drug called Reolysin, which is based on a naturally occurring human virus that resides in the respiratory and gastrointestinal tracts. This "reovirus" was originally developed by CIHR-funded researchers at the University of Calgary, who found that it destroyed cells that regulate cell division and growth. In cancerous cells, unlike normal cells, cells divide out of control. Oncolytics is the only company in North America that is pursuing this particular target. In testing, Reolysin effectively killed cancer cells without damage to healthy cells and without the traumatic side effects of chemotherapy, such as hair loss and nausea. If clinical trials go well, Reolysin could be on the market as early as 2007.

- Fusogenix Inc. wants to improve the way drugs are delivered in the body. Dr. Roy Duncan, at Dalhousie University, received support from CIHR to use proteins found in viruses to help drugs and genes fuse with cell membranes to deliver drugs to their destinations in the body. Now he has established Fusogenix to commercialize his work. Should it prove successful, Dr. Duncan and his investors could take aim at the lucrative drug delivery market, estimated at about US$20 billion.

While Canadian companies are already generating a significant return on public investment in health research through the commercialization of products and services, the potential for growth in this area is huge. Life science investments in Canada currently represent about 2 per cent of capital markets, compared to 12 per cent in the United States. Every 1 per cent increase in investment in life sciences within Canadian capital markets would represent about $10 billion of additional investment capital that could contribute to making health products and services available while supporting Canada's economic goals.

An American study of the biotechnology industry has found that technological advances and genomic research will continue to boost growth in biotechnology, while increasing the number of drugs under development by a factor of ten. The study estimated that the ten leading pharmaceutical companies are expected to achieve annual revenue growth of

almost 10 per cent until 2005. In part, this is because the pace of discovery of new drugs is accelerating at a tremendous rate. To date, the world's pharmaceutical companies have directed their research to fewer than 500 known protein targets. Thanks to developments in the emerging areas of genomics and proteomics, there could be as many as 50 — 100,000 potential targets available.

The pace of change is increasing exponentially. A vaccine development company was recently able to use advanced information technology to quickly design 40 different possible vaccines against one pathogen. More than 30 of them were effective in initial tests. This is just one indication of the increasingly rapid pace of drug development.

The implications for Canada are profound. As the Public Policy Forum recently concluded as a result of its health and innovation conference, the scope and scale of the opportunities to be realized in Canada could easily provide several billions of dollars in economic and health benefits. It could also create unprecedented career opportunities in the life sciences, as well as a domestic industry comparable in scope and scale to the resource and manufacturing sectors. This vision cannot be realized, however, without continuing public investment in health research.

Breaking Down Barriers: Partnerships and Leveraging

Innovation is all about breaking down barriers — barriers between disciplines, barriers between different kinds of health research, such as biomedical and population health research, and barriers between institutions, research programs and facilities.

Canada's health research structure, its bold and transformative vision, is the envy of the world in the approach it takes to overcoming these barriers. All partners in the research process now have the opportunity to participate in building strategic agendas for health research that maximize the return on the public investment in health research.

CIHR's 13 virtual institutes are leading in the development of integrated research agendas. Each is charged with developing a strategic research plan to fill gaps in knowledge. They are concentrating on the most promising avenues of research that address the health priorities of Canadians. The Institutes have, during the first two years of their existence, brought together all the players in the research community in an unprecedented planning process to concentrate on achieving the results that are most important to Canadians. Researchers who might otherwise have been unaware of each other's expertise and interests, are now working together to develop collaborative inter- and trans-disciplinary relationships that produce better outcomes for Canadians.

By bringing together all stakeholders in the research process, including other funders, researchers, industry, health charities and consumers, CIHR is building significant partnerships that are leveraging the federal investment in health research. Canada's health charities, for instance, allocate about $300 million each year to support health research. Industry is the largest funder of health research in Canada, contributing $1.1 billion in 2001. By working together to establish priorities and combine resources, each partner — government, voluntary sector and private sector — achieves much more than it could on its own. In fact, CIHR statistics indicate that every $1 million of public investment leverages $7 million additional dollars and creates 60 knowledge economy jobs. Thus, public investment in health research not only advances the health research enterprise in Canada, it moves us towards achieving national social and economic objectives.

Researchers who might otherwise have been unaware of each other's expertise and interests, are now working together to develop collaborative relationships that produce better outcomes for Canadians.

Public investment in health research acts as a catalyst for institutions such as universities, teaching hospitals and research institutes to become centres of excellence. They are using public funding to leverage contributions from other sources, build research staff and support growth in their research facilities. In doing so, they are able to expand both their research and teaching activities.

- Every year, 45,000 Canadians die from tobacco-related illnesses and nearly twice that number of youth — some 84,000 — take up smoking. Past efforts to reduce tobacco use and addiction have not fully addressed the problem. In April 2002, CIHR and the Canadian Tobacco Control Research Initiative sponsored the Canadian Tobacco Control Research Summit. The results of the summit will provide the foundation for building a strategic research agenda for Canada aimed at reducing smoking and its harmful effects.

- Canadian researchers are responsible for significant advances in cancer prevention, diagnosis and treatment. They receive support from a variety of sources, including CIHR's Institute of Cancer Research, the National Cancer Institute of Canada, Health Canada and members of the Canadian Association of Provincial Cancer Agencies. But until recently, these funders were mostly working in isolation from one another. In February 2001 they got together to identify cancer research priorities and coordinate their efforts. As Dr. Phillip Branton, Scientific Director of CIHR's Institute for Cancer Research noted, "We are going to identify things that will be most beneficial and we will make sure they happen. We will combine forces and budgets to make sure they get done properly."

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- Cardiovascular disease (CVD) is one of the leading causes of death and disability among Canadians. A group of leading researchers from five provinces, under the leadership of Dr. Jack Tu of the Institute for Clinical Evaluative Sciences, is creating an atlas of

information on topics such as the burden of CVD in Canada, the prevalence and distribution of risk factors for CVD, mortality rates after cardiac events/procedures, cardiac procedure and drug utilization rates and physician resources and services for cardiac care. The Canadian Cardiovascular Atlas Project (CCORT), a CIHR-supported Interdisciplinary Health Research Team, will produce and communicate important research findings to all stakeholders in the Canadian health care system. All Canadians will be able to take advantage of the latest research findings to enhance care and advance the research agenda.

- The Chronic Disease Prevention Alliance is bringing together organizations and individuals to take an integrated approach to preventing chronic diseases such as cancer, heart disease and diabetes. Its goal is to combine research, surveillance, policies and programs to delay the onset and reduce the incidence of new cases of chronic disease in Canada. It is building on the success of previous initiatives, such as the Canadian Heart Health Initiative and the Canadian Diabetes Strategy and focusing on the three major preventable risk factors for chronic diseases — tobacco use, nutrition and physical activity. Members are working on a coordinated action plan to achieve the integration of chronic disease prevention activities in Canada.

The Core of Health Research: Investment in People

Wealth is measured in more than dollars. Investment in health research provides Canada with a wealth of people — highly trained individuals who bring their experience, ideas, rigour and curiousity to bear on important national priorities. This is a vast resource that is available to address the priorities of the day, but it is also a resource that can be called on in the future to address new threats to well-being, some of which cannot be anticipated today. For example, Canada's ability to respond to the heightened threat of bioterrorism after September 11th was directly and significantly enhanced because of the funding that had been provided to research scientists like the University of Western Ontario's Dr. Bhagriath Singh, the Scientific Director of CIHR's Institute of Infection and Immunity. Similarly, Canada's ability to respond to new challenges, including antibiotic-resistant infections, tropical diseases, obesity and many others, will depend on ongoing public investment in excellent researchers.

Success breeds success. Increased public investment in health research has meant that universities, hospitals and research institutes have been able to attract top scientists to their facilities in recent years. The strength of the research programs already underway, as well as the availability of funds, facilities and support staff, are important incentives that attract top researchers to Canadian institutions, even in the face of stiff international

competition. In turn, these leaders carry out world class research, train the next generation of clinicians and scientists and ensure that Canadians have access to the most advanced and efficacious diagnostic and treatment services.

Skilled graduates are one of the most important ways in which health research benefits the economy. Graduates come equipped with advanced levels of training, knowledge and expertise. But they also bring the social capital that arises from being connected with networks of people like themselves. They know, if not the solutions, then how to go about finding the information and skills needed to develop solutions.

Wealth is measured in more than dollars. Investment in health research provides Canada with a wealth of people.

Talent is the primary strategic resource for innovation. Leaders in the field of health research, as in all other fields, are the key to future success. Investment in health research supports current leadership and provides the resources to train the next generation of scientific leaders.

Canada's health research enterprise will be sustained only to the degree that it continues to train the next generation of health researchers. Fully 25 per cent of CIHR's budget is allocated toward training and support for graduate students and researchers in the early stages of their careers.

- Dr. Linda Cook wants to help women reduce their risk of ovarian cancer while learning more about how the disease progresses at the molecular level. Her innovative approach, combining molecular biology and epidemiology, made this University of Calgary researcher one of the first Lougheed Scholars. This important CIHR career development award, presented to the highest-rated applicants in CIHR's national competition for scholarships, has given her research a major boost. The Lougheed Scholarships were presented for the first time last year to six researchers who are in the first years of a university appointment.

- Dr. Prabhat Jha is undertaking fundamental research about the spread of HIV and tobacco-related diseases. He is developing better tools to control these major causes of premature death among the world's poor, and he is doing it at the University of Toronto, where he holds a Canada Research Chair for the Canadian Initiative for Health and Development. Originally from Manitoba, this Rhodes Scholar returned to Canada from the World Health Organization, where he was a Senior Scientist.

- In the last several months, thanks to an infusion of federal health research dollars, Toronto's Hospital for Sick Children has been able to attract four new cancer researchers, including Dr. Meredith Irwin. Dr. Irwin, who has been nominated for a Tier 2 Canada Research Chair (intended for researchers who are future world leaders in their respective fields) is exploring the genetic causes of resistance to chemotherapy, a line of research

that could lead to improved treatment. Sick Kids has also been able to retain star researchers, including Dr. Benjamin Alman, an American who came to Sick Kids for specialized training and has remained as the holder of a Tier 2 Canada Research Chair. Dr. Alman is investigating the molecular mechanisms of musculoskeletal tumours. This year, he and his team identified the genetic pathway that causes enchondromas, a common form of bone tumour.

- The Clinical Research Institute of Montreal recruited Dr. Vibhuti P. Dave from Philadelphia to set up its Laboratory of Lymphocyte Development. Trained in India, Dr. Dave is exploring the important role played by two genes in the development of the thymus, a glandular organ at the base of the throat that produces lymphocytes and aids in increasing immunity.

Researchers who have returned to Canada in the past two years include:

- Dr. Carol Schuurmans, who left Canada in 1995 for France, but has returned to the University of Calgary, where she is studying the molecular mechanisms of neurons in the brain;

- Dr. Brian Christie, who has returned to the University of British Columbia after moving to the United States in 1989. He is studying how the brain produces new neurons and how neurons can enhance learning and memory;

- Dr. Robert Gendron, who has come to Memorial University after leaving for the United States in 1999, and is studying the mechanisms controlling blood vessel health and disease; and

- Dr. Elaine David, who is at McGill University studying the role of proteins in the control of smooth muscle cell growth in the wall of the aorta. She left Canada in 1992 and was most recently at the University of Texas.

Others have made Canada their first choice, including:

- Dr. Jeremy Grimshaw, of the Ottawa Hospital Research Institute, who comes from the United Kingdom and is studying ways to improve the uptake of research findings by health care professionals;

- Dr. Walid Houry, who came to the University of Toronto in April 2000 from Germany's Max Planck Institute for Biochemistry, and who is studying protein folding inside the cell, using biochemistry, biophysics, proteomics and bioinformatics;

- Dr. Jean-François Gauchat, who moved to the Université de Montréal from France to study multiple sclerosis, neuro-degeneration and immune response; and

- Dr. Jorge Armony, who came to McGill University from the United Kingdom, and who is studying fear processing in healthy humans and in those with anxiety disorders.

Creating a Bright Future for Canada's Youth

The Government of Canada has identified creating a bright future for youth as a priority. Health research contributes to this priority in two important ways: by helping to maintain and improve the health of Canada's young people and by affording the next generation an opportunity to participate in Canada's growing health research enterprise.

Health research provides the evidence that is needed to help improve the health and life chances of Canada's youth, from the prenatal environment right through childhood and adolescence. For example:

- University researchers, public health researchers and community resource workers are working together under Dr. Camil Bouchard on a research project to improve the health and well-being of children in six under-privileged areas of Montreal. The Alliance de recherche sur le développement des enfants dans leur communauté (ARDEC) is helping to create new knowledge through five different community health and well-being projects. ARDEC is also focusing on translating the results of its work to decision-makers, managers, practitioners and the general public, using tools such as web sites and videos.

- Early intervention makes a huge difference for children with autism. About half of all children with autism spectrum disorder (ASD) who receive intensive behavioural therapy during their preschool years perform the same as their peers by school age. Diagnosing ASD is difficult, however, and often doesn't occur until a child is school-aged, when intervention is less effective. Dr. Jeannette Holden, from Queen's University, is leading an interdisciplinary team of researchers in an attempt to identify genes related to ASD. She hopes that a combination of genetics and early developmental assessments will identify children at risk of developing ASD by six months of age. Very high risk infants will be treated to see if this can prevent the development of ASD.

- Streptococcal B infections in pregnant women can cause meningitis in their newborns, often leading to the infants' death. Dr. Michel Bergeron, from Université Laval, has developed a test to diagnose these dangerous infections in pregnant women in less than an hour. Infectio Diagnostic released the diagnostic tool in September 2002.

- Dr. Brian Mishara, of the Université du Québec à Montréal, wants to cut the rate of suicide among youth. He is leading a team of researchers from four Quebec universities

and community partners to explore such areas as suicide among homeless youth in Quebec, the development of effective programs to help schools deal with the aftermath of suicide and the skills that are needed to intervene with those who are suicidal.

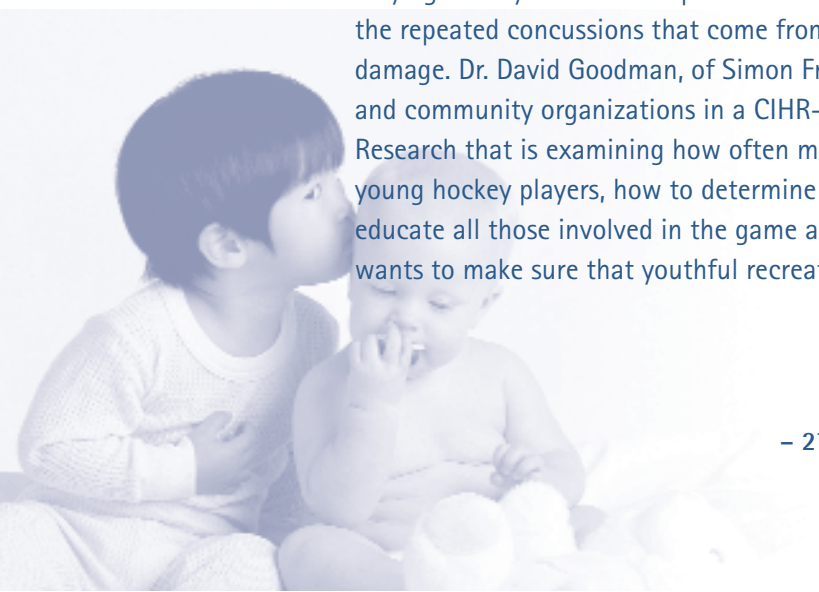
- Dr. Stephen Matthews, at the University of Toronto, wants to know how exposure to hormones before birth affects a person's ability to respond to stress throughout life. He is studying how alterations in the fetal environment can permanently program the development and function of the endocrine system.

- The Canadian Child Welfare Research Partnership, led by the University of Toronto's Dr. Nico Trocme, is bringing together researchers, service providers and policy makers to promote better health for children in Canada. The partners are focusing on sexually abused children in foster care, chronic maltreating families and adolescent risk behaviour in the child welfare system. They are establishing a shared database of institutional data and health statistics regarding child abuse.

- Dalhousie University's Dr. Patrick McGrath has developed innovative tools (such as a newsletter, audio and video tapes and primary care coaches) to support family physicians who are helping children with behavioural problems, attention deficit disorder, depression and anxiety. His work is filling an important gap in providing care to youth in Nova Scotia, while providing a framework for helping Canadian children whose need for help is impaired by distance from care providers.

- Stopping children from hurting themselves or others from hurting children is the focus of the University of Victoria's Dr. Bonnie Leadbetter. She is leading a CIHR-supported university-community collaboration that is examining ways to reduce youth violence in relationships and among peers. She is also examining abuse of youth involved in the sex trade and negative youth health outcomes resulting from social and economic restructuring. Rather than waiting for the justice system to step in after the fact, Dr. Leadbetter wants to prevent problems before they occur.

- Playing hockey is a national pastime for thousands of Canadian boys and girls, but the repeated concussions that come from being hit from behind can cause long-term damage. Dr. David Goodman, of Simon Fraser University, is leading a team of researchers and community organizations in a CIHR-supported Community Alliance for Health Research that is examining how often mild head injuries and concussions occur among young hockey players, how to determine when medical attention is needed and how to educate all those involved in the game about the severity of head injuries. Dr. Goodman wants to make sure that youthful recreation doesn't leave a lifetime legacy of harm.



Health research contributes to Canadian children reaching adulthood in optimum health. It also provides opportunities to harness the energy and creativity of youth in becoming the next generation of health researchers. In the Speech from the Throne, the Government committed itself to increasing support for graduate students through the federal granting councils. Additional funds in this area will complement existing programs intended to encourage and support young people pursuing careers as health researchers.

Health research provides opportunities to harness the energy and creativity of youth in becoming the next generation of health researchers.

- CIHR's Strategic Initiative in Health Research Training is intended to build a national culture of creativity, innovation and interdisciplinary research among the next generation of health researchers. CIHR's 13 Institutes are working together with health charities, provincial governments and industry to implement this new training program, which has awarded $88 million over the next six years. In all, 51 groups of investigators are developing interdisciplinary training programs to support trainees.

- As part of its Strategic Initiative in Health Research Training, CIHR is working with British Columbia's Michael Smith Foundation to support six training programs on subjects as wide-ranging as transplantation, community partnerships, bioinformatics, ethics and neurobiology. The Michael Smith Foundation for Health Research was established in March 2001 with the mandate to build BC's capacity for excellence in health research.

- Canada's Aboriginal people face unique health challenges and their direct involvement in addressing these challenges is critical to success. The Aboriginal Capacity and Developmental Research Environments (ACADRE) Program has been developed by CIHR's Institute of Aboriginal Peoples' Health to facilitate the development of Aboriginal capacity in all fields of health research. The program, which has established centres in Alberta, Saskatchewan, Manitoba and Ontario, will encourage Aboriginal students to pursue careers in health research.

- CIHR's New Emerging Team (NET) grants support the training and recruitment of new investigators as part of multi-disciplinary teams of independent researchers. The program promotes both the creation of new teams and the growth of small, existing teams.

Health research is at the base of Canada's ability to succeed in its goal of becoming one of the most innovative countries in the world. Public investment is making this happen by supporting the commercialization of health services and products, by fostering partnerships that break down barriers and by investing in the people who will, through their work, realize Canada's vision of innovation.

IV. Conclusion: Building on the Return

The Government of Canada and all Canadians are achieving outstanding returns on public investment in health research. The creation of CIHR, in particular, has brought unprecedented integration of health research activity and created synergies among researchers that are the envy of the world. As a result of its launch in June 2000 and the creation of its 13 virtual institutes, scientists are working within and across disciplines as never before, bringing together basic researchers, clinical researchers and health services researchers with population health researchers, social scientists, ethicists and many others. The result is a more strategic research agenda that is identifying gaps and priorities and mobilizing partnerships to meet needs. The involvement of practitioners, administrators and policy makers ensures research findings are being translated to prevent disease and, when it strikes, diagnose it and treat it more quickly and effectively

The challenge facing governments and all partners in the health research enterprise is how to augment the current return on investment in light of the considerable success that has already been achieved. Two key challenges predominate:

- The parameters of health research have expanded well beyond basic biomedical and clinical research, to embrace population health research, health services and health systems research and other areas of research where multi-sectoral and multi-disciplinary approaches are required to ensure success. Thus while the funding available for health research has grown in recent years, these funds now have to be spread among more researchers, disciplines and sites to continue to build the momentum. The result, as noted in the Introduction, is that increasing percentages of excellent proposals are being turned down for funding.

- Health research requires a long-term and sustained funding commitment. Archimedes aside, "eureka" is no substitute for the slow and steady accumulation of knowledge. Long years of training are required to produce world-class scientists. Most health research requires a period of time to achieve high quality, but the funding to undertake this research is too often short-term. Most grants are usually awarded for three-to-five year periods, yet the budgets of granting agencies are determined on an annual basis. As a result, only about $50 million of CIHR's $560 million budget will be available for new grants in 2002–03. Most of the budget has already been committed to multi-year grants awarded in previous years. Long-term planning for both individual researchers and their institutional homes requires a multi-year fiscal framework to overcome this significant obstacle.

The federal government's investment in health research is paying important dividends. Further investment in health research is an investment in the public good.

Both the Romanow and Kirby reports have called on the federal government to invest one per cent of Canada's health care spending in health research. Based on current health care expenditures of approximately $100b, this amounts to $1b, about a 75 per cent increase over current health research spending.

Such investment by the Government of Canada will contribute to a positive return for Canadians and for governments in terms of better health, a stronger health care system and a growing economy ready to take on the challenges of the 21st century.

Appendix 1: The Health Research Advocacy Network

Members of the Health Research Advocacy Network include:

The Association of Canadian Academic Healthcare Organizations (ACAHO) (**www.acaho.org**) is a member-based association that represents more than 40 teaching centres. Together, these centres provide Canadians with timely access to quality specialized health care services, represent the principal teaching sites for Canada's health care professionals and provide the large majority of infrastructure to support and conduct health research, medical discovery, knowledge creation and innovation. Its mission is to provide national leadership and effective policy representation in these areas.

The Association of Canadian Medical Colleges (**www.acmc.ca**) represents the sixteen faculties of medicine in Canada. Its objective is to promote the advancement of academic medicine in Canada through the review and development of standards for medical education in Canada, development of national policies appropriate to the aims and purposes of Canadian medical colleges, fostering of research into major areas of interest for Canadian medical colleges and representation of the Canadian medical colleges to key agencies.

The Canadian Federation of Biological Societies (**www.cfbs.org**) brings together researchers who belong to the major life science disciplines in Canada. The Federation promotes the acquisition, facilitates the dissemination and encourages the utilization of knowledge in the biological and biomedical sciences. It seeks to ensure that these sciences contribute in substantive ways to the development of a forward-looking science and technology policy for Canada.

The Canadian Institute for Academic Medicine is a national, non-profit organization with a membership limited to 100 Canadian academic leaders. Its objective is the promotion of academic health centres as the centrepiece of the health care system and advocacy for the appropriate funding of research as a means of improving the health, well being and prosperity of the Canadian population.

Canadians for Health Research (**www.chrcrm.org**) is an association of individuals and organizations committed to encouraging communication among the public, the scientific community and government with regard to health research. It seeks to promote the stability and quality of Canadian health research. It is a voluntary, non-profit organization that acts to foster a better understanding of health research, how it is funded and its role in the health-care system.

The College of Family Physicians of Canada (www.cfpc.ca) is a national voluntary organization of family physicians that makes continuing medical education of its members mandatory. The College strives to improve the health of Canadians by promoting high standards of medical education and care in family practice, by contributing to public understanding of healthful living, by supporting ready access to family physician services and by encouraging research and disseminating knowledge about family medicine.

The Council for Health Research in Canada (www.chrc-crsc.ca) is a national, non-profit, non-governmental organization. Members of the Council include the leading health research institutes and health charities in Canada. Together, our members raise public funds for health research and use these funds to address the most pressing health needs of Canadians. The Council's mission is to work with government to promote the health of Canadians by ensuring that Canada is a world leader in health research.

Friends of the Canadian Institutes of Health Research (FCIHR) (www.fcihr.ca) is a national organization of individuals and corporate members that is dedicated to supporting the goals of CIHR. FCIHR serves as a community link on behalf of CIHR regionally and nationally, involving volunteer agencies, universities, hospitals and private corporations in the promotion of health research.

The Health Charities Council of Canada (www.healthcharities.ca) was established in June 2000 to advocate positive change in public policy. It represents national health charities of all sizes that together possess a wealth of knowledge, expertise, experience and resources, all of which improve the health of Canadians and strengthen Canada's health system. The HCCC provides a strong voice on common interests in areas of shared concern. It acts as a resource to member organizations and facilitates networking opportunities. Because of the close ties between national health charities and Canadians, the HCCC can ensure that the concerns of the people of Canada about health and the health system are heard by policy and decision-makers.