

EUREKA!

WORLD'S FIRST DISCOVERIES AND OTHER MAJOR MEDICAL
BREAKTHROUGHS IN ACAHO MEMBER INSTITUTIONS



MARCH 2008



ASSOCIATION OF CANADIAN ACADEMIC HEALTHCARE ORGANIZATIONS

WHO WE ARE...

The Association of Canadian Academic Healthcare Organizations (ACAHO) is the national voice of Teaching Hospitals, Academic Regional Health Authorities (RHAs) and their Research Institutes. The Association represents over 45 organizations, with members ranging from single hospitals to multi-site, multi-dimensional regional facilities (also known as "Research Hospitals").

Members of ACAHO are leaders of innovative and transformational organizations who have overall responsibility for the following integrated activities:

- Provision of and timely access to a range of specialized and some primary health care services.
- Provision of all of the principal clinical teaching sites for Canada's health care professionals including partnerships with all 17 Faculties of Medicine and Faculties of Health Sciences.
- Infrastructure to support and conduct health research in its dimensions — medical discovery, knowledge creation, knowledge translation, and innovation and commercialization.

There are no other organizations in the health system that provide the unique combination of health services that our members do. We consider our institutions to be vital "hubs" in the health system — in addition to being a national resource.

OUR MISSION...

The mission of ACAHO is to advance and promote excellence in the delivery of quality health services, the teaching and educational experience, and the health research and innovation enterprise.

OUR MANDATE...

The mandate of ACAHO is to provide effective national leadership, advocacy, and policy representation in the following three related areas of the:

- Funding, organization, management and delivery of highly specialized tertiary and quaternary, as well as primary health care services.
- Education and training of the next generation of Canada's health care professionals.
- Infrastructure to support and conduct basic and applied health research, medical discovery, innovation and commercialization.

For more information on the activities of the Association, please visit our website at www.acao.org.





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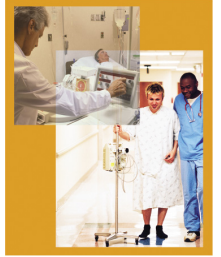


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This report was prepared by Emily C. Gruenwoldt (Senior Advisor, Research and Policy Development, ACAHO) and Glenn G. Brimacombe (Chief Executive Officer). Thank you to all of the ACAHO members (specifically, the Vice-Presidents of Health Research) who took part in this exercise to compile world's first discoveries and major medical breakthroughs in their institutions and the Academic Health Science Centres across Canada. In particular, ACAHO would also like to acknowledge the inaugural groundbreaking work of the Council of Academic Hospitals of Ontario (CAHO) in this area.

A MESSAGE FROM THE PRESIDENT

Building on the release of the Association's "Moving at the Speed of Discovery...From Bench to Bedside to Business" – a comprehensive document examining the linkages between the "inputs" of health research and the "outputs" that come from such investments – in November 2007, this report is intended to underscore the significant "world first" advances to human health and health care that public investments in the country's health research enterprise have produced for Canadians, and the rest of the world.

In our view, the fundamental role and value that comes from federal and provincial government investments in early stage, discovery-based research cannot be overstated; as a result, Canada's Research Hospitals have played a crucial role in not only advancing the body of knowledge of science related to health and health care, but continue to drive innovation and new evidence into the clinical, administrative and policy-making processes. While the generation and application of new knowledge is ongoing, clearly, the overall objective is to improve the health status of Canadians, and provide timely access to a range of cost-effective quality health services.

Building on the publicly-funded platform of Medicare, *Eureka!* demonstrates the diversity and depth of health research within ACAHO member institutions. This report highlights over 100 world's first discoveries and major medical breakthroughs which have taken place in Canada's Teaching Hospitals, Regional Health Authorities and their Research Institutes.

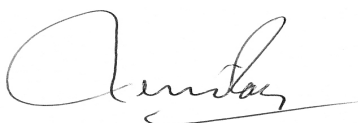
From the discovery of insulin in 1922, to the first artificial kidney machine (1948), to the insertion of the first cardiac pacemaker (1950), to the first physical map of the human genome (1995), to the identification of a gene that causes colon cancer (1996), to the sequencing of the SARS virus genome in order to develop a diagnostic test and possibly a vaccine (2003), Canada has an impressive track record when it comes to achievements in health research. There are a series of examples where ACAHO member's research has been groundbreaking, if not revolutionary in nature; global in its impact and playing a significant role opening up new avenues of scientific inquiry.

Eureka! is also intended to give the reader a sense of the span-of-time that is required for research to be translated into new knowledge and innovations. In this regard, if Canada is to continue to build on its international reputation and impressive track record, it will be important to sustain the momentum that we have created over the past decade by continuing to invest in the *people, processes, structures* and *outcomes* that are required to compete in what is an increasingly interdependent and knowledge-based global economy.

A move away from commitments to funding research, innovation and commercialization, would result in Canada falling out of step with those countries that place tremendous value on the linkages between creating knowledge and its spin-off effects, particularly in a global economy that competes on the advancement and translation of knowledge.

Finally, as much as *Eureka!* has focused on the importance of world first discoveries and major medical breakthroughs, our sister report ("*From Microscope to Marketplace...Spin-Off Companies from ACAHO Member Institutions*") focuses on the translation of this new knowledge that has created spin-off companies, and their derivative economic benefits.

In closing, while health research has been our past and present – and uniquely defines the mission and mandate of our members, it is our *future* where we look to continue to blaze new paths of discovery, bringing with it innovations that will enhance the overall quality of life and standard of living of Canadians, while also being of benefit to the rest of the world.



Dr. Denis-Richard Roy

President, ACAHO

Directeur général

Centre hospitalier de L'Université de Montréal

Montréal, Québec





INTRODUCTION

When it comes to our health, the value of research is recognized globally. The discovery of penicillin, the advent of contraception, the invention of the stethoscope and the CT scan are all examples of world class discoveries that have taken place internationally, and yet, have directly impacted nearly every Canadian at some point in their life. It is important to recognize that each of these breakthroughs were the result of initial public investments in discovery-based or basic health research.

Eureka! is a publication of the Association of Canadian Academic Healthcare Organizations (ACAHO) designed to showcase the leading edge – or world class – research that is conducted in Teaching Hospitals, Academic Health Regions and their Research Institutes across the country that results in major medical breakthroughs recognized globally. *Eureka!* is one of three publications in a series focusing on the health research enterprise in Canada including *Moving at the Speed of Discovery: From Bench to Bedside to Business* and *From Microscope to Marketplace: Spin-Off Companies in Canada from ACAHO Member Institutions*.

The mission and mandate of Canada's Teaching Hospitals, Academic Regional Health Authorities and their Research Institutes – also known as "Research Hospitals" – is to provide timely access to a range of specialized and some primary health care services, train the next generation of health professionals, and to have a strategic focus on the value chain related to health research, innovation and commercialization.

In an increasingly interdependent global economy, the creation, dissemination and ownership of knowledge matters. More particularly, where a growing number of countries are competing – and winning – on the basis of new discoveries, speed wins. Understanding these forces suggests that it is to our individual and collective advantage to nurture and support sectors that discover and produce leading-edge innovative products and services that are not only available to the benefit of Canadians, but to the rest of the world.

At a time where many breakthrough technologies are either under development or in the process of implementation, the demand for increased accountability and transparency to funders and Canadians in terms of what we are producing for our investments in health research has never been greater.

To better understand the relationship between health research "inputs" and "outputs", *Eureka!* clearly identifies **over one hundred** world's first discoveries and other major medical breakthroughs that have stemmed from research conducted in ACAHO member institutions, and whose impact is felt globally.

With strategic, sustainable and predictable public investments into discovery-based research, Canada is well positioned to continue to occupy a global leadership position when it comes to research and innovation. Furthermore, if we are to maximize the "return on innovation", it is incumbent upon Canada to consider ways in which we can accelerate the different ways in which we *translate knowledge and apply that knowledge*. Only then will the true value of research be fully captured – moving from a laboratory bench to the patients' bedside.

"...if we are to maximize the "return on innovation", it is incumbent upon Canada to consider ways in which we can accelerate the different ways in which we translate knowledge and apply that knowledge."

CONTEXT

When it comes to health research, few metrics define the notion of “return-on-investment” more clearly than breakthrough discoveries. In a league of their own, these inventions, discoveries or innovations speak to the world class efforts of clinicians and scientists who call members of ACAHO home.

Members of the Association of Canadian Academic Healthcare Organizations (ACAHO) are leaders of innovative and transformational organizations who have overall responsibility for the provision of and timely access to a range of quality health care services; they represent the principal clinical teaching sites for Canada’s health care professionals; and they provide the infrastructure to support and conduct health research in its dimensions – that is, medical discovery, knowledge creation, knowledge translation and innovation and commercialization. For a list of ACAHO members, and the Vice-Presidents of Health Research, please see Appendices A and B.

As *engines of health innovation*, an essential component of the mission and mandate of members of ACAHO is to advance the body of scientific knowledge that comes from health research, and to translate this knowledge to the public, clinicians, administrators and policy makers to improve the quality of care provided to Canadians. As a result, Teaching Hospitals, Academic Regional Health Authorities and their Research Institutes play a crucial role in converting research findings from the “bench to bedside to business”; that is, from the laboratory through to the production of innovative goods and services with the goal of further distinguishing Canada internationally for its most cherished social program – Medicare.

As a result of the fact that close to 80% of all publicly funded health research in Canada occurs in ACAHO member institutions, a significant proportion of groundbreaking health research occurs in the country’s Teaching Hospitals, Academic Regional Health Authorities and their Research Institutes.¹ These institutions play an essential role in the renewal of the health care system. They are dedicated to innovation and evidence-based best practices in patient care, teaching, research, medical discovery, knowledge creation and sharing, and have an established record of achievement that has attracted international acclaim.

Research hospitals transfer knowledge in at least three important ways, they are:

1. Giving individual Canadians access to state-of-the-art information that is both readily available and understandable so that they can have a more direct influence on their health status;
2. Driving new evidence through the health system so that providers can make cost-effective clinical decisions that improve patient outcomes, and so that administrators and policy makers can apply evidence to improve the overall architecture, functioning and management of the health system; and
3. Accelerating the speed at which Canadian-owned leading-edge discoveries are converted into innovative products and services that will compete in an increasingly interdependent and competitive global economy; brining with it highly skilled jobs, income, wealth creation and a growing public revenue stream.

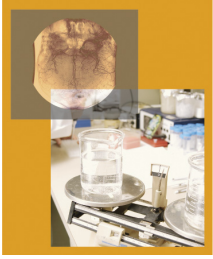
In this regard, members of the Association should be considered engines of innovation that contribute to the *health* and *wealth* of the country.

With over 20,000 scientists, clinical investigators and other researchers and staff employed in ACAHO member institutions across the country, new discoveries and major medical breakthroughs are being published and reported on a regular basis. These landmark research findings can be thought of as innovations which can have a direct impact on advancements in patient care. Consider, for example, how the discovery of insulin has impacted the lives of 2 million Canadians living with diabetes, or how advances in stem cell research will revolutionize treatment protocol following physical trauma, degenerative conditions or genetic diseases in the future.

ACAHO members have produced some of the most significant medical/research discoveries of the 19th and 20th century. These discoveries have manifest themselves in many ways: from improving the health status of individuals and communities; introducing more effective ways in which to deliver a range of health services; and impacting on the way in which we organize and manage our health delivery system; to producing economic benefits by having a healthy, adaptable and well-trained workforce; and developing



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innovative goods and services that create jobs, capital formation, (private and public) income streams and wealth generation. With over \$3.0 billion invested in ACAHO members' institutions annually – specifically targeted for health research – the foundation is in place to underpin our collective ability to strengthen the fabric of Canadian life and build a truly modern and prosperous 21st century.

Research *matters*, and support for Canada's health research enterprise is growing – beyond the traditional stakeholders (the scientific community, public policy makers, the private sector), to include the broader Canadian public. A recent public opinion survey confirms that 91% of Canadians think this country should be a global leader in health and medical research, while another 80% recognize the linkage between health research and economic prosperity in Canada.²

This view is confirmed by the Standing Committee on the Future of Science & Technology in Canada which stated: *"The committee believes that good science is good economics and that the government has a crucial role in maximizing the gains for Canada and its citizens."* The report continues: *"We are convinced that countries with a strong health research network are more capable of translating advances and innovations into cost-effective health services, modern and internationally competitive policy and regulatory frameworks, new or adaptive products, and new health promotion activities. An energetic health research environment contributes to improved health, higher quality of life, and an efficient health care system. This in turn, engenders public confidence, a vibrant business environment and a strong economy."*³

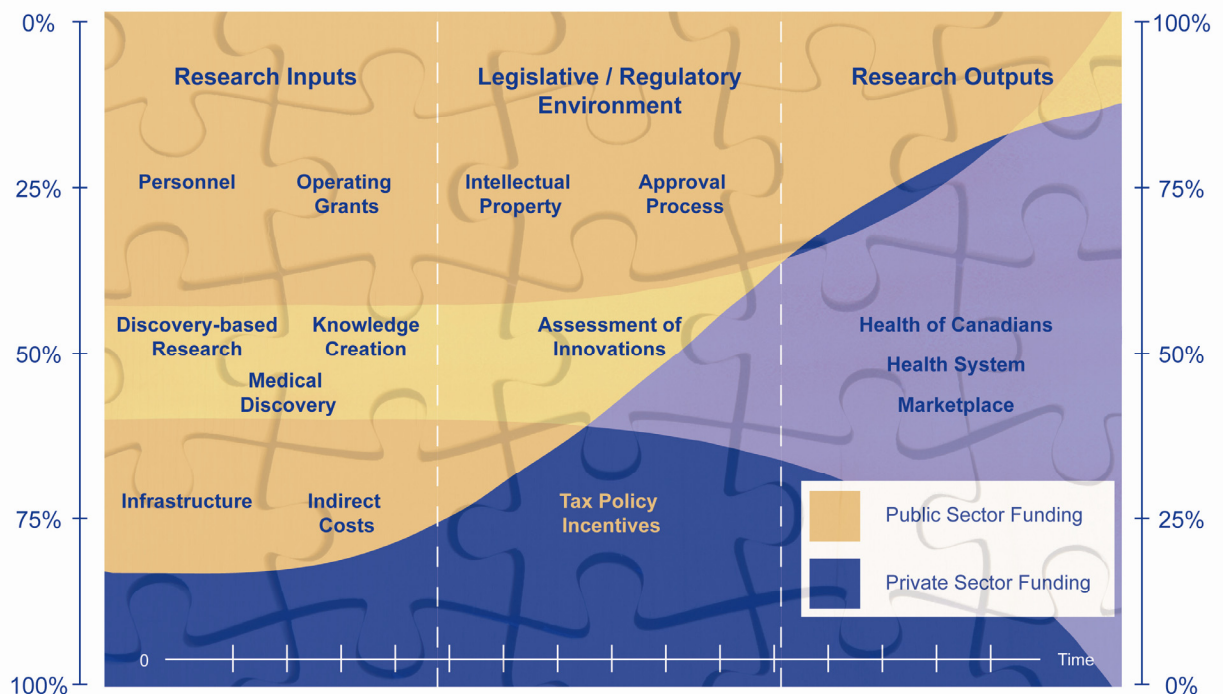
The "energetic health research environment" referred to by Senator Kirby can be thought of in just that regard: a health research ecosystem which incorporates a number of different and complementary programs which cut across both the public and private sectors. As such, each of the individual programs must be self-sufficient and sustainable in order to fully harness the benefits that come from investments in Canada's health research enterprise.⁴

Exhibit 1 illustrates the health research ecosystem as it exists across a seamless continuum. As research moves from its infancy (basic discovery) to a mature good or service, a number of pieces of the innovation puzzle that must be strategically aligned or in sync.

"An energetic health research environment contributes to improved health, higher quality of life, and an efficient health care system."

Exhibit 1

The Structure and Funding of Canada's Health Research Ecosystem



Source: ACAHO

The Association believes that a series of “research inputs” are required to support and sustain the early stages of the health research enterprise, and to take full advantage of the new knowledge that is discovered and subsequently translated:

1. *Development, Recruitment & Retention of Scientists* – The development, recruitment and retention of health researchers is a key to our future success. This requires that we carefully consider our training requirements, and equally important the programs (e.g., Canada Research Chairs) that develop, retain and attract world-class researchers so that Canada – and the global community – will benefit from their expertise and potential.
2. *Operating Grants* – We need to ensure that our granting agencies (e.g., Canadian Institutes of Health Research, Genome Canada) are funded at internationally competitive levels so that we can continue to support research excellence and a growing number of cutting-edge health research projects.
3. *Indirect Costs* – Support for the ongoing costs that are associated with health research, such as through the federal government’s Indirect Cost Program, is a critical link in continuing to develop the country’s capacity for health research.
4. *Infrastructure* – Appreciating the increasing complexity of infrastructure and technologies that are required to support leading-edge research, such as through the Canada Foundation for Innovation, it is critical that we continue to invest in developing world-class research facilities.

Understanding that the research and discovery process can take time, we must continue to “till the soil” if we are to fully harvest the fruits of our labour – and remain as a world leader. Combined, commitments to invest in each of these four areas serve to accelerate the country’s advancements in health research. These public investments ensure that ACAHO members will continue to produce a number of value-added “outputs” including breakthrough medical discoveries, with the benefits of improved quality of care flowing to all Canadians.

In this context, ACAHO would like to applaud the federal government for its ongoing and substantial commitment to a number of programs and instruments that fund and support health research in Canada. For example, the combination of investments in each of the above four areas have served to accelerate the country’s advancements in health research, and the production and dissemination of new knowledge.

METHODOLOGY

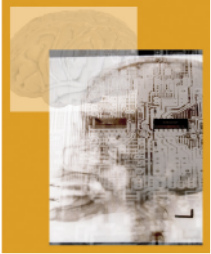
The information contained in this report was collected by means of an ACAHO member survey conducted in 2006. Members were asked to report major medical discoveries (world’s firsts) as they had taken place within their teaching hospital, regional health authority, or research institute. Specifically, members were asked to report the discovery, the date of discovery, as well as any funding information that was available. Participating institutions include:

- McGill University Health Centre
- Ottawa Health Research Institute
- Children’s Hospital of Eastern Ontario
- Kingston General Hospital
- The Hospital for Sick Children
- Mount Sinai Hospital
- Toronto Rehabilitation Institute
- Sunnybrook Health Sciences Centre
- University Health Network
- Centre for Addiction and Mental Health
- Bloorview Kids Rehab
- St. Josephs Healthcare (Hamilton)
- St. Michael’s Hospital
- Hamilton Health Sciences Centre
- Lawson Health Research Institute
- London Health Sciences Centre
- Provincial Health Services Authority (Vancouver)
- Robarts Research Institute
- Saskatoon Health Region
- Capital Health



“These public investments ensure that ACAHO members will continue to produce a number of value-added “outputs” including breakthrough medical discoveries, with the benefits of improved quality of care flowing to all Canadians.

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The information in this report has previously been published in November 2007 ACAHO report entitled *Moving at the Speed of Discovery: From Bench to Bedside to Business*.

WORLD'S FIRSTS AND OTHER MAJOR MEDICAL BREAKTHROUGHS

As *engines of health innovation*, an essential component of the mission and mandate of members of ACAHO is to continue to advance the body of scientific knowledge that comes from health research, and to translate this knowledge to the public, clinicians, administrators and policy makers to improve the quality of care provided to Canadians. As a result, Teaching Hospitals, Academic Regional Health Authorities and their Research Institutes play a crucial role in converting research findings (i.e., "from bench to bedside to business") into innovative products and services.

Without question, the research findings play an important role in advancing patient care in each area of focus. At times, the research builds on the initial work of other scientists, and at other times ACAHO members' work has been groundbreaking, if not revolutionary; global in its impact and playing a significant role in opening up new avenues of scientific inquiry.

Exhibit 2 provides an overview of select world firsts and major medical breakthroughs which have occurred in Canada's Teaching Hospitals, Regional Health Authorities and their Research Institutes. From the discovery of insulin in 1922, to the development of the world's first viral proteins (a powerful new class of anti-inflammatory drugs) to treat heart disease in 2005, there is an impressive track record when it comes to Canada's achievements in health research.

"At times, the research builds on the initial work of other scientists, and at other times ACAHO members' work has been groundbreaking, if not revolutionary; global in its impact and playing a significant role in opening up new avenues of scientific inquiry."

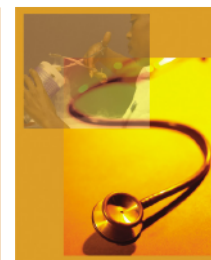
Given that close to 80% of all publicly-funded health research in Canada occurs in ACAHO member institutions,⁵ a large proportion of extraordinary health research breakthroughs have occurred in the country's Teaching Hospitals, Regional Health Authorities and their Research Institutes. These institutions play an essential role in the renewal of the health care system. They are dedicated to innovation and best practices in patient care, teaching and education, research, medical discovery, knowledge creation and sharing, and have an established record of achievement that has won international recognition.⁶

Exhibit 2

SELECT WORLD'S FIRSTS AND OTHER MAJOR MEDICAL BREAKTHROUGHS IN ACAHO MEMBER INSTITUTIONS

1877	Introduction of sterilized cotton wool swabs in test tubes (reducing contamination). (McGill University Health Centre Research Institute — Montreal, Quebec)
1907	First bronchoscopy performed. (McGill University Health Centre Research Institute — Montreal, Quebec)
1908	Installation of the first milk pasteurization plant in Canada, 30 years before it becomes mandatory. This all but eliminates diseases transmitted by unpasteurized milk like tuberculosis, salmonella, and e.coli. Pasteurization dramatically decreases infant mortality in Canada. (The Hospital for Sick Children — Toronto, Ontario)
1912	First surgical treatment of tuberculosis. (McGill University Health Centre Research Institute — Montreal, Quebec)
1919	Researchers at the Hospital for Sick Children become pioneers in blood transfusions for children. (The Hospital for Sick Children — Toronto, Ontario)
1922	First clinical use of insulin for diabetes in human patients. (University Health Network — Toronto, Ontario)
1930	Development of a new infant cereal that later becomes famous internationally as "pablum". This fortified cereal (the first of its kind) significantly reduces death from malnutrition. (The Hospital for Sick Children — Toronto, Ontario)
1933	First excision of the entire lung performed (pneumonectomy). (McGill University Health Centre Research Institute — Montreal, Quebec)
1935	First clinical use of Heparin as a blood thinner. (University Health Network — Toronto, Ontario)

- 1935** Researchers study lead poisoning in children, resulting in the prohibition of lead pigments in paints on children's toys and furniture. (*The Hospital for Sick Children — Toronto, Ontario*)
- 1939** Invention of the corneal splitting knife (still standard in surgery to reduce pressure in glaucoma). (*McGill University Health Centre Research Institute — Montreal, Quebec*)
- 1946** Design and use of North America's first artificial kidney. (*University Health Network — Toronto, Ontario*)
- 1948** **Development of the first artificial kidney machine. (Lawson Health Research Institute — London, Ontario)**
- 1948** First 25 million electron-volt beta-tron to be established in any university or hospital – calibration takes nine months. The electron-volt beta-tron is used for cancer research and to improve treatment accuracy. (*Saskatoon Health Region — Saskatoon, Saskatchewan*)
- 1948** Physician researchers first recognize sexual dimorphism in human cells. This discovery leads to knowledge of the relationship of sex chromosome abnormalities to disease. (*London Health Sciences Centre — London, Ontario*)
- 1950** Introduction of lumpectomy for treatment of Breast Cancer. Lumpectomy is a surgical procedure designed to remove a discrete lump (usually a tumor, benign or otherwise) from an affected woman or man's breast. (*University Health Network — Toronto, Ontario*)
- 1950** Use of total body cooling as a method of making heart surgery safer. (*University Health Network — Toronto, Ontario*)
- 1950** First neuro-surgical treatment of epilepsy performed. (*McGill University Health Centre Research Institute — Montreal, Quebec*)
- 1950** Use of first regulated cardiac pacemaker. (*University Health Network — Toronto, Ontario*)
- 1951** **First use world-wide of calibrated cobalt-60 for cancer radiotherapy treatment. (Saskatoon Health Region — Saskatoon, Saskatchewan)**
- 1951** First "cobalt bomb" in the world used to deliver radiation therapy to cancer patients. (*Lawson Health Research Institute — London, Ontario*)
- 1951** Use of radiation to cure Hodgkin's disease. (*University Health Network — Toronto, Ontario*)
- 1952** First use of a device that determined whether or not a patient's thyroid is cancerous through the use of radioactive iodine. (*Saskatoon Health Region — Saskatoon, Saskatchewan*)
- 1956** **Major breakthrough in virology by discovering that positive strand Ribonucleic Acid (RNA) could be infectious. (Capital Health/University of Alberta — Edmonton, Alberta)**
- 1957** Invention of the artificial cell for application in medicine and biotechnology. It was thought that artificial cells could one day be used as a partial substitute for human cells and organs. (*McGill University Health Centre Research Institute — Montreal, Quebec*)
- 1958** World first surgical treatment on cerebral aneurysms. (*Lawson Health Research Institute — London, Ontario*)
- 1960** Implementation of genetic screening programs for hereditary metabolic diseases in newborns. (*McGill University Health Centre Research Institute — Montreal, Quebec*)
- 1960** First implanted mammary artery into the heart wall in order to restore functionality of the heart. (*McGill University Health Centre Research Institute — Montreal, Quebec*)
- 1961** Discovery of blood forming stem cells enabling bone marrow transplants. (*University Health Network — Toronto, Ontario*)
- 1963** The first widely successful surgery to correct the birth defect known as "Blue Babies" is performed. Before this procedure, this condition used to kill 9 out of 10 patients in their first year. (*The Hospital for Sick Children — Toronto, Ontario*)
- 1965** Researchers develop a lab procedure that cuts the time required to diagnose whooping cough from five days to thirty minutes. (*The Hospital for Sick Children — Toronto, Ontario*)
- 1965** **First artificial knee joint in the world created. (McGill University Health Centre Research Institute — Montreal, Quebec)**





- 1969** Discovery of a carcino-embryonic antigen – a tumor marker for cancer. (*McGill University Health Centre Research Institute — Montreal, Quebec*)
- 1970** Discovery that hereditary metabolic diseases could be treated with vitamins. (*McGill University Health Centre Research Institute — Montreal, Quebec*)
- 1971** Developed the world's first paediatric electric prosthetic arm. (*Bloorview Kids Rehab — Toronto, Ontario*)
- 1975** Development of software used worldwide for 20 years to control radiation therapy. (*University Health Network — Toronto, Ontario*)
- 1976** Identification of P-glycoprotein as a major cause of cancer drug resistance. (*University Health Network — Toronto, Ontario*)
- 1978** Developed the internationally-recognized AeroChamber, a medical device used to administer aerosolized medication for patients with asthma. This device continues to be used in practice around the world. (*St. Joseph's Healthcare — Hamilton, Ontario*).
- 1978** Discovery of reversibility of brain damage from alcohol with abstinence. (*University Health Network — Toronto, Ontario*)
- 1979** **Invention of a radically different ventilator (now used worldwide) that gently "shakes" oxygen into the lungs of children with severe lung disease, sparing many of them painful lung bypass procedures. (*The Hospital for Sick Children — Toronto, Ontario*)**
- 1979** "Continuous Passive Motion" (CPM) – a revolutionary treatment for injured or diseased joints is developed. Before this treatment, patients with damaged cartilage had to be totally immobilized. CPM is such an improvement that it is now being used in 17,500 hospitals in more than 77 countries world-wide. (*The Hospital for Sick Children — Toronto, Ontario*)
- 1980** Initial studies using real time ultrasounds and detailing biological factors affecting human fetal behavioral activity and breathing movements. (*Lawson Health Research Institute — London, Ontario*)
- 1981** World first heart operation to correct a life-threatening heart condition known as right ventricular dysplasia. (*Lawson Health Research Institute — London, Ontario*)
- 1983** Successful single lung transplant. Lung transplants extend life expectancy and enhance the quality of life for end-stage pulmonary patients. (*University Health Network — Toronto, Ontario*)
- 1983** The Department of Nuclear Medicine becomes to use a special imaging agent to diagnose Parkinson's disease. Called [18] F6-fluorodopa PET, the chemical was produced by Hamilton Health Sciences and is now used worldwide. (*Hamilton Health Sciences/McMaster University — Hamilton, Ontario*)
- 1984** Discovery and cloning of the T-Cell receptor genes, significant in the field of immunology. (*University Health Network — Toronto, Ontario*)
- 1986** First successful double lung transplant. (*University Health Network — Toronto, Ontario*)
- 1986** **Developed first predictive testing for late onset genetic diseases (Huntington Disease). (*Provincial Health Services Authority — Vancouver, British Columbia*)**
- 1986** Discovery of the SH2 domain, which controls the ability of proteins to interact with other SH2 containing proteins and thereby direct the function of enzymes involved in transmitting cellular signals. This finding has revolutionized our understanding of how proteins form signaling pathways inside cells. It is already informing research to control these pathways in diseased cells – the basis for novel therapies. (*Mount Sinai Hospital — Toronto, Ontario*)
- 1987** First aortic valve replacement in the world using the Toronto Heart Valve, which is now used world-wide. (*University Health Network — Toronto, Ontario*)
- 1987** **The gene responsible for Duchenne Muscular Dystrophy is identified. (*The Hospital for Sick Children — Toronto, Ontario*)**
- 1987** World's first pace-maker cardioverter defibrillator is implanted. (*Lawson Health Research Institute — London, Ontario*)
- 1988** Researchers solve the structure of rennin – a key enzyme in the kidney that plays a role in the development of high blood pressure. (*Capital Health/University of Alberta — Edmonton, Alberta*)

- 1988** Gene defect that causes Tay-Sachs disease is identified. (*The Hospital for Sick Children — Toronto, Ontario*)
- 1988** **World's first successful liver/small bowel transplant is performed.** (**Lawson Health Research Institute — London, Ontario**)
- 1989** Researchers develop sputum induction techniques and sputum cell analysis. Their research on nasal mucosa suggested ways in which the cellular response to antigen challenge might be studied in bronchial mucosa and sputum. (*St. Joseph's Healthcare — Hamilton, Ontario*).
- 1989** Development of the first oral treatment for Hepatitis B, resulting in the drug Lamivudine. (*Capital Health/University of Alberta — Edmonton, Alberta*)
- 1989** **Discovery of the gene which, when defective, causes cystic fibrosis – the most fatal genetic disease killing Canadian children today.** (**Hospital for Sick Children — Toronto, Ontario**)
- 1990** First measure of neurotransmitter concentration in schizophrenics by Magnetic Resonance Spectroscopy (MRS). MRS allows scientists and doctors to measure chemicals within the body and brain without removing tissue or blood samples and without using dangerous radioactive 'tracers'. It is therefore safe and can be used repeatedly without any ill effects on the patient. (*Lawson Health Research Institute — London, Ontario*)
- 1991** Publication of the first paper demonstrating that treatment of obstructive sleep apnea by nasal continuous positive airway pressure (CPAP) in patients with congestive heart failure improves cardiac function and symptoms of heart failure is published. This discovery has major implications because it suggests that obstructive sleep apnea contributes to the development and progression of congestive heart failure. (*Toronto Rehabilitation Institute — Toronto, Ontario*)
- 1991** Researchers at Sunnybrook invent and license the world's first high frequency ultrasound micro-imaging scanner for preclinical imaging. This scanner is now used around the world for research applications and clinical imaging of the eye to detect glaucoma and anterior segment tumors. (*Sunnybrook Health Sciences Centre — Toronto, Ontario*)
- 1992** Discovery of the first gene responsible for Fanconi anemia. Fanconi anemia (FA) is a rare genetic disease that affects children and adults from all ethnic backgrounds. FA is characterized by short stature, skeletal anomalies, increased incidence of solid tumors and leukemias, bone marrow failure (aplastic anemia), and cellular sensitivity to DNA-damaging agents such as mitomycin C. (*Hospital for Sick Children — Toronto, Ontario*)
- 1993** **Researchers demonstrate that mouse embryonic stem cells are capable of supporting the entire embryonic development and in fact creating completely cell cultured derived mice.** (**Mount Sinai Hospital — Toronto, Ontario**)
- 1993** The International Digital Mammography Development Group is formed. This collaboration of leaders in breast imaging has made dramatic breakthroughs in developing new technologies to detect breast cancer. (*Sunnybrook Health Sciences Centre — Toronto, Ontario*)
- 1993** Discovery of a novel gene associated with Lou-Gehrig's disease. (*McGill University Health Centre Research Institute — Montreal, Quebec*)
- 1994** World's first 3-D ultrasound-guided cryosurgery. (*Lawson Health Research Institute — London, Ontario*)
- 1994** Solved the 30-year old puzzle of why so many people suffer an allergic reaction when they receive a blood transfusion. (*Hamilton Health Sciences/McMaster University — Hamilton, Ontario*)
- 1995** **First physical map of the human genome created.** (**McGill University Health Centre Research Institute — Montreal, Quebec**)
- 1995** Discovery of the gene associated with localized muscular dystrophy. (*McGill University Health Centre Research Institute — Montreal, Quebec*)
- 1995** Discovery of the Inhibitor of Apoptosis (IAP) gene family. The IAPs serve as integrators of cell survival decisions. IAP modulation represents a novel and potent mode of chemotherapy (*Children's Hospital of Eastern Ontario — Ottawa, Ontario*)
- 1996** Identification of a human blood cell that regenerates the entire blood system. This discovery enabled the development of new treatments for blood diseases such as leukemia, thalassemia and sickle cell anemia. (*Hospital for Sick Children — Toronto, Ontario*)





- 1996 Identification of a gene that causes colon cancer. Colorectal cancer is the second leading cause of cancer-related deaths among Canadians. (Hospital for Sick Children – Toronto, Ontario)**
- 1996** The Consort statement, the internationally accepted standards for the design of the randomized control trial (RCT), was formulated by a group of scientists. It is now accepted by over 600 medical journals and is the sine qua non for performing RCTs. (*Children's Hospital of Eastern Ontario – Ottawa, Ontario*)
- 1998** Developed the first trophoblast stem cells – the precursors of cells that form the placenta. Since the placenta is critical for a successful pregnancy, this discovery will have a major impact on research to understand and ultimately prevent pregnancy complications resulting from a failure in normal placental function. (*Mount Sinai Hospital – Toronto, Ontario*)
- 1998** Discovery of the first gene that causes Lafora disease – one of the most severe forms of teenage onset of epilepsy. (*Hospital for Sick Children – Toronto, Ontario*)
- 1999 Imaging scientists develop the world's first method to image blood flow in the microscopic vessels in the muscle of the heart in real-time, a technique now used internationally. An accurate view of the cardiac microscopic vessels is critical to improving diagnosis of and treatment for heart attacks. (Sunnybrook Health Sciences Centre – Toronto, Ontario)**
- 1999** Identification of ABCA-1 gene – key regulator of HDL concentrations in humans. (*Provincial Health Services Authority/BC Children's Hospital – Vancouver, British Columbia*)
- 1999 First islet transplant under the Edmonton protocol for Type I Diabetes. Islet transplantation has been previously performed under other protocols; however, the Edmonton protocol has produced levels of success that are unprecedented in the field of islet transplantation. (Capital Health/University of Alberta – Edmonton, Alberta)**
- 1999** World's first closed chest robotic-assisted beating heart coronary artery bypass graft conducted. (*Lawson Health Research Institute – London, Ontario*)
- 2000** Researchers show that much lower doses of chemotherapy in combination with antiangiogenic drugs (drugs that stop the development of blood vessels in tumors) will significantly delay tumor progression in animal models. Clinical trials are underway to validate these results in Ontario and around the world. If successful, this treatment would have less severe side effects than conventional treatments, and it could help to prevent drug resistance. (*Sunnybrook Health Sciences Centre – Toronto, Ontario*)
- 2000 Discovery on the mechanism of formation of amyloid, the basis of Alzheimers and other diseases, and the subsequent development of drugs to treat this. (Kingston General Hospital – Kingston, Ontario)**
- 2001** Discovery that a protein called Interleukin 13 fuels the growth of Hodgkin's lymphoma. (*University Health Network – Toronto, Ontario*)
- 2001** Discovery of a clinical rule that may reduce use of unnecessary x-rays for low-risk neck injuries and could aid in reducing use of imaging tests in alert and stable patients. (*Ottawa Health Research Institute – Ottawa, Ontario*)
- 2001** Identified the emerging role that albuminuria as an important risk factor for both kidney and heart disease. (*Hamilton Health Sciences/McMaster University – Hamilton, Ontario*)
- 2001** Development of the first animal model for Hepatitis C in mice, using transplanted human cells, providing a convenient way to test new treatments for Hepatitis C. (*Capital Health/University of Alberta – Edmonton, Alberta*)
- 2001** Tissue factor is a cell surface membrane protein involved in the initiation of blood clotting. Over expression or increased activation of tissue factor can increase the risk of cardiovascular disease. The research group demonstrated that over expression of GRP78 (a protein), can block the coagulant activity of tissue factor in human cells. These studies are important because they have identified a relevant cellular factor that can mediate tissue factor activity. (*Hamilton Health Sciences Centre – Hamilton, Ontario*)
- 2002** Deduction of the structure of a molecular complex in the brain involved in many functions including memory and learning. (*University Health Network – Toronto, Ontario*)
- 2002** Pioneered the use of Botulinum Toxin A to reduce upper limb spasticity in children with cerebral palsy. (*Bloorview Kids Rehab – Toronto, Ontario*)

- 2002 Introduction of revolutionary medication doses for depression and schizophrenia through positron emission tomography (PET) technology. (Centre for Addiction and Mental Health – Toronto, Ontario)**
- 2002** Creation of a simple system to generate T-cells in a Petri dish. T-cells are a vital component of the immune system that orchestrate, regulate and coordinate the overall immune response. This discovery provided a method to create model systems to study the genetics and molecular biology of T-cell development and points to future clinical therapies for people whose immune systems have been destroyed, for example, by HIV or toxic cancer therapies. *(Sunnybrook & Women's Research Institute – Toronto, Ontario)*
- 2002** Discovery that a type of self-destructing "suicide cell" activity, previously believed to only be detrimental, is in fact necessary for the proper formation of muscle tissue. *(Ottawa Health Research Institute – Ottawa, Ontario)*
- 2002 Demonstration that dense breast tissue, a major risk factor in breast cancer, is mainly determined by genetic factors. (University Health Network – Toronto, Ontario)**
- 2002** Researchers find a relationship between environmental tobacco smoking (second hand smoke) and a heightened risk of Sudden Infant Death Syndrome (SIDS). *(The Hospital for Sick Children – Toronto, Ontario)*
- 2002** Discovery that fragile X syndrome (most common inherited cause of mental retardation) is related to glutamate in the brain. *(University Health Network – Toronto, Ontario)*
- 2002** Proof of efficacy of new treatment for HIV infection. *(University Health Network – Toronto, Ontario)*
- 2003 Performed the world's first hospital-to-hospital telerobotic assisted surgery on a patient more than 400 kilometres away. During the procedure, they completed a Nissen Fundoplication on a 66-year old patient located at North Bay General Hospital from St. Joseph's telerobotics suite in Hamilton, Ontario. (St. Joseph's Healthcare – Hamilton, Ontario).**
- 2003** Discovery of a molecular marker to diagnose hepatocellular carcinoma (HCC), the most common type of liver cancer. HCC is usually asymptomatic at early stages, and has great propensity for invasion, making it difficult to treat. A test was developed for the early diagnosis of HCC, which could also be useful for the screening of individuals that are at high risk for developing this disease, such as people chronically infected with Hepatitis B and C. *(Sunnybrook & Women's Research Institute – Toronto, Ontario)*
- 2003 Researchers discover a way to make the immune system specifically recognize infectious prions, proteins that cause brain-wasting diseases like mad cow disease and Creutzfeldt - Jakob disease, its human equivalent. This discovery paves the way for the development of diagnostic tools, immunotherapy and a vaccine. (Sunnybrook & Women's Research Institute – Toronto, Ontario)**
- 2003** Developed a genetically modified vaccine that can completely prevent the recurrence of metastatic breast cancer through genetically altered cells that only destroy cancer cells. *(Hamilton Health Sciences/McMaster University – Hamilton, Ontario)*
- 2003** Major international clinical trial provides first alternative treatment to taxol for preventing breast cancer recurrence in survivors five years post diagnosis. *(University Health Network – Toronto, Ontario)*
- 2003** Compilation of the complete DNA sequence of chromosome 7. Researchers decode nearly all of the genes on this medically important portion of the human genome. Chromosome 7 contains 1,455 genes, some of which, when altered, causes diseases such as cystic fibrosis, leukemia and autism. *(Hospital for Sick Children – Toronto, Ontario)*
- 2003 Found that the vast majority of heart attacks can be predicted by nine easily measurable factors that are the same in virtually every region and ethnic group worldwide. (Hamilton Health Sciences/McMaster University – Hamilton, Ontario)**
- 2003** Study makes it easier to identify patients with deep vein thrombosis (DVT), providing faster diagnosis and significant savings to the healthcare system. *(Ottawa Health Research Institute – Ottawa, Ontario)*
- 2003** Performed the world's first deep brain stimulation for depression, causing previously treatment-resistant depression to go into remission. *(University Health Network – Toronto, Ontario)*





- 2003** Identification of a cancer stem cell responsible for brain tumors. This discovery may change how this deadly condition is studied and treated in the future. *(Hospital for Sick Children — Toronto, Ontario)*
- 2003** **Developed first draft DNA sequence for coronavirus implicated as cause of SARS (Provincial Health Services Authority/BC Cancer Agency, Genome Sciences Centre — Vancouver, British Columbia)**
- 2003** Imaging scientists publish the first results to use digital mammography with a contrast agent (dye) to show tumors that cannot be viewed with current clinical mammography. *(Sunnybrook Health Sciences Centre — Toronto, Ontario)*
- 2003** Linkage of maternal folic acid intake to a decrease in neuroblastoma – a deadly childhood cancer. *(Hospital for Sick Children — Toronto, Ontario)*
- 2004** **Development of StemBase, a database of gene expression data from DNA micro array experiments on samples from human and mouse stem cells and their derivatives. This growing resource is used to find genes whose activity is related to stem cells. (Ottawa Health Research Institute — Ottawa, Ontario)**
- 2004** Discovery of the apelin receptor and designed an analogue that can interfere with and block the actions of apelin, in order to decipher its role in the brain. *(Centre for Addiction and Mental Health — Toronto, Ontario)*
- 2004** Performed the world's first simulated underwater surgery during the NASA Extreme Environment Mission Operation (NEEMO 7). During the 10-day NEEMO 7 Mission, they successfully telemented the NEEMO7 crew through various surgical simulations from their base in the underwater Aquarius habitat located 19 metres below the surface off the coast of Key Largo, Florida. *(St. Joseph's Healthcare – Hamilton, Ontario)*
- 2004** Discovery of over 70 novel human receptor genes; many of which, together with their chemical activators, mediate unique functions in the brain and are being targeted for drug design. *(Centre for Addiction and Mental Health — Toronto, Ontario)*
- 2004** **Developed a virtual instrument that allows children with physical disabilities to make music (both therapeutic and recreational applications of the software – which is licensed in 7 countries around the world). (Bloorview Kids Rehab — Toronto, Ontario)**
- 2004** In the first large, multi-centre clinical trial of its kind, researchers provided evidence to suggest that artery grafts from the forearm should be used in place of vein grafts from the leg in heart bypass surgery, because radial arteries have significantly higher graft patency over one year. Graft patency, a measure of whether the bypass remains open enough to permit efficient blood flow, is critical to success after surgery. *(Sunnybrook & Women's Research Institute — Toronto, Ontario)*
- 2004** A research team finds magnetic resonance imaging detects more breast cancer tumors, earlier, compared with mammography, ultrasound or clinical examination in women with the BRCA1 and BRCA2 genes. This finding offers hope for genetically at-risk women, for whom removal of both breasts is the only other option. *(Sunnybrook & Women's Research Institute — Toronto, Ontario)*
- 2004** World's first use beads of palladium, a low-dose radioactive material, to treat women with breast cancer as outpatients. This therapy holds the promise to eliminate anguishing side effects and enhance the quality of life of women considerably. *(Sunnybrook & Women's Research Institute — Toronto, Ontario)*
- 2004** Demonstration of an association between pediatric multiple sclerosis (MS) and the Epstein-Barr virus, indicating that exposure to the virus at a certain time in childhood may be an important environmental trigger for the development of MS. *(Hospital for Sick Children — Toronto, Ontario)*
- 2005** Initiation of first human clinical gene therapy trials for lipoprotein lipase deficiency. *(Provincial Health Services Authority/BC Children's Hospital — Vancouver, British Columbia)*
- 2005** **In the first trial of its kind in the world, researchers begin treating prostate cancer using a 3-D image-guided radiation therapy device that was developed in Canada. This non-surgical technique allows oncologists to visualize the exact position of the target and deliver precise external beam radiation therapy. (Sunnybrook & Women's Research Institute — Toronto, Ontario)**
- 2005** Key discovery in Type-1 Diabetes proves the repair process present within the pancreas during disease development – understanding the repair process could be the key to treatment. *(Ottawa Health Research Institute — Ottawa, Ontario)*

- 2005** Developed the world's first upper respiratory viral panel test that can accurately identify all respiratory viruses including various flu strains including H5N1 and the SARS Coronavirus. (*St. Joseph's Healthcare — Hamilton, Ontario*).
- 2005** Study determines that a specific enzyme, known as pro-protein convertase 4 (PC4) may be responsible for fetal growth restriction, the second leading cause of infant mortality in the developed world. Knowledge may lead to screening for the defective enzyme early in the pregnancy and provide ability to monitor the pregnancy more closely. (*Ottawa Health Research Institute — Ottawa, Ontario*)
- 2005** Scientists show that early surgical removal of the spleen combined with antiangiogenic therapy, which arrests the growth of tumor-feeding blood vessels, may stop the progression of leukemia. (*Sunnybrook & Women's Research Institute — Toronto, Ontario*)
- 2005** Using neuropsychological testing, researchers accurately predict which study participants will develop Alzheimer's disease within five and ten years. Previous studies were able to predict Alzheimer's only for shorter periods of time; other studies showed predictions for ten and even fifteen years, but these did not indicate the predictive accuracy of the tests. (*Sunnybrook & Women's Research Institute — Toronto, Ontario*)
- 2005** Identified novel mutations in the gene that causes Rett Syndrome. The discovery is now licensed as a test for the disorder and is available to the public. (*Centre for Addiction and Mental Health — Toronto, Ontario*)
- 2006** **First demonstration that dietary omega-3 fatty acid deficiency impairs neurogenesis in vivo** (*Provincial Health Services Authority/BC Children's Hospital — Vancouver, British Columbia*)
- 2006** First demonstration that children with cystic fibrosis have choline deficiency. Provision of choline improves redox balance and methyl transfer capacity in humans. (*Provincial Health Services Authority/BC Children's Hospital — Vancouver, British Columbia*)
- 2006** Discovery of the precise molecular chain of events that initiates the wide-scale immune destruction of "super bug" infections such as flesh-eating disease, toxic shock syndrome and severe food poisoning. (*Robarts Research Institute — London, Ontario*)
- 2006** **Implantation of an antibody-coated stent into the first human patient. The invention of the antibody-coated stent reduces complications and prevents blood clots from occurring.** (*St. Michael's Hospital — Toronto, Ontario*)
- 2006** World's first clinical trial to combine gene and cell therapy to treat a cardiovascular disorder. The PHACeT (Pulmonary Hypertension: Assessment of Cell Therapy) trial will assess the use of adult stem-like cells called endothelial progenitor cells (EPC) for the treatment of pulmonary hypertension. (*St. Michael's Hospital — Toronto, Ontario*)
- 2006** First curative therapy for Huntington Disease in a mouse model (*Provincial Health Services Authority/BC Children's Hospital — Vancouver, British Columbia*)





END NOTES

1. ACAHO Research Funding Flow Survey, 2006. Association of Canadian Academic Health Care Organizations, Ottawa, Canada. It is also important to note that there are many important collaborative relationships and partnerships between ACAHO members and Universities that support research in this country. For example, a significant proportion of health research is undertaken by investigators from the Faculty of Medicine, housed and supported by ACAHO Member organizations.
2. Canada Speaks! Research Canada's First Public Opinion Survey on Health Research in Canada. Conducted by Environics, November 2006.
3. The Health of Canadians – The Federal Role. Final Report on the State of the Health Care System in Canada. October 2002. p 207.
4. Canada's Health Research "Ecosystem". Moving at the Speed of Discovery: From Bench to Bedside to Business, 2007. Association of Canadian Academic Healthcare Organizations, Ottawa, Canada.
5. Follow the Funding. ACAHO Member Survey of Health Research In Canada. 2006.
6. World Class Achievements and Major Medical Breakthroughs. Council of Academic Hospitals of Ontario, 2004.

APPENDIX A

MEMBERS OF ACAHO - 2007

While members of the Association are the institutions or regional health authorities, they are represented by the President and CEO of that organization.

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Health Authority
www.easternhealth.ca

Nova Scotia

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Ms. Christine Power
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New Brunswick

Ms. Dora Nicinski
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Mr. Donn Peters
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APPENDIX B

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