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The Science and Technology Action Plan
of the Federal Health Portfolio

S & T at Work for the Health of Canadians

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Canada

The Science and Technology Action Plan
of the Federal Health Portfolio

S & T at Work for the Health of Canadians

Our mission is to help the people of Canada
maintain and improve their health.

Health Canada

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Minister's Message

Health is more than health care. It is at the core of who we are and what we can do as a nation. It is a litmus test for government intentions and actions across all areas of public policy: national identity, economic growth, social development and good government.

Now, perhaps more than at any time since adopting a national health system, Canadians are looking to the federal government for leadership. They want reassurance that realigning our priorities and refocusing our resources to manage within the limits of what we can afford will not mean abandoning principles, reducing standards or denying essential services.

Three times since 1991, the United Nations Development Program has ranked Canada first among all the countries in the world in terms of human development and quality of life. The health of the Canadian population plays a vital role in making Canada one of the very best places in the world in which to live. Our life expectancy is among the highest in the world, and years of life lost to premature death among the lowest. Other indicators of the health of the nation are equally impressive.

These indicators reflect more than good fortune in the form of natural resources, favourable environmental conditions and individual effort, although Canada has all three in abundance. They are also the result of a serious and concentrated national effort in building and maintaining a *health system* to prevent disease and injury and to care for people, and our commitment to excellence and innovation across a broad range of *health science initiatives*.

The Liberal Party platform, *Creating Opportunity*, notes that preventive health care is a wise public investment and that “the health care system is one of Canada’s proudest achievements.

Based on the belief that every Canadian has a right to receive the care he or she needs when sick, regardless of personal circumstances, it is an affirmation of Canada’s commitment to human dignity.”

Accessible health care, maintenance and prevention are at the core of what it means to be a Canadian. When asked in a *MacLean’s* and *Decima* poll what most unites us as a nation, Canada’s health system was rated number one by 75% of Canadians. Further to this belief, the federal government is committed to maintaining and enhancing the effectiveness of our health system. It will do so in the face of challenges arising from fiscal pressure amidst continuing, or in some cases, increasing health problems and issues. Health science innovation is critical to ensuring optimal delivery of efficient and effective health services.

Health science and technology (S&T) has an essential role to play in developing and applying innovations that save lives, increase quality of life, create jobs, and save money at the same time. It is vital to finding out more about the determinants of good health, leading to successful prevention strategies and to long-term changes in risky behaviour. Moreover, every year health S&T supports and shapes \$73 billion¹ of economic activity in Canada, employing thousands of people and generating several hundred million dollars worth of international exports.

With federal funding for health research less than a third of the Canadian total, and a tiny fraction of the worldwide investment, we need to make strategic investments in order to achieve the fullest and most effective use of available funds, ideas, facilities and highly

¹ The \$73 billion figure is an estimate of total public and private expenditures on health. Other measures of magnitude could include the cumulative investment in capital stock associated with health care and maintenance, and the annual capital investment in machinery and equipment for health care.

qualified people in the future. Major changes in direction are required to meet these challenges. It is clear that the federal government has to mobilize all the levers at its disposal, including health S&T, to maximize value for money for Canadians.

This Action Plan focuses on three key areas of change in direction to keep Canada on the track of spending our existing S&T resources smarter while delivering a higher quality of life and better health performance than many of its trading partners:

- *Working even more effectively within existing federal resources*, through efforts to sustain and strengthen Canada's national innovation capacity in health S&T, to lever our resources so as to generate more activity for the same dollars, to increase dissemination and use of health S&T information, to link S&T to results, and to strengthen the commitment to excellence and continuous renewal.
- *Coordinating efforts across the whole health S&T system to set priorities* which address critical knowledge gaps, sustain a dynamic and internationally competitive health S&T capacity in the form of ideas, people and facilities, and capture the benefits of partnerships more effectively. Exploring the potential for a *Health Research Agenda for Canada* is an essential next step.

- *Focusing more attention and effort on social science research* to identify ways of renewing and reducing the costs of the health system through funding specifically aimed at projects in this field, with emphasis on evidence-based decision making, outcomes of medical interventions, evaluations of health care delivery options, and health determinants.

This Action Plan is intended to build on the synergies present within the broad Health Portfolio and on strong collaboration among the Medical Research Council (MRC), Health Canada, the Hazardous Materials Information Review Commission (HMIRC) and the Patented Medicine Prices Review Board (PMPRB).

David C. Dingwall
Minister of Health

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1. Health Science and Technology (S&T) Vision, Objectives and Goals

1.1 HEALTH S&T: A PIVOTAL CONTRIBUTION

Healthy, Wealthy and Wise, the title of a recent report of the National Advisory Board on Science and Technology (NABST), captures the links that exist between the health of a country's population, the strength of its culture and social fabric, and the soundness of its economy. The health of Canadians and their capacity to sustain an internationally recognized quality of life and productivity make a pivotal contribution to a successful jobs and growth agenda.

From every perspective, health-related science and technology (S&T) is critical to developing a national system of innovation, one that emphasizes new relationships and the co-determination of priorities. For example:

- Healthy people are productive people in the economy, creative people in cultural pursuits, active people in sports, and happy people in families, relationships and communities. Sixty-seven percent of Canadians have reported that the single most important factor in improving their health is more knowledge about health risks. Such knowledge is the direct output of health S&T.
- The health sector is important to the Canadian economy. Statistics for 1994 indicate that this sector represents \$73 billion or 9.7% of the Canadian Gross Domestic Product (GDP). Gross expenditures on research and development (R&D) in health were \$1.5 billion in 1994. Health services employment represents about 5.1% of the Canadian labour force.
- Health research generates jobs. Every million dollars invested provides an estimated 62 new jobs, most of which allow young Canadians to acquire experience and skills in emerging technologies. The health research

sector encompasses universities, hospitals, institutes, businesses and government laboratories. It engages an estimated 7500 principal researchers, 11 000 graduate students and post-doctoral researchers, and 29 500 research assistants and technicians.

- Health S&T supports Canada's ability to sustain the relative economic advantages of our health system compared to that of our major competitor, the United States. In fact, a difference in employer health costs alone has been a major factor in drawing automotive and other companies to Canada as a place from which to do business.
- Health S&T is also critical to improving the effectiveness and affordability of Canada's health care system. Direct health care in Canada cost \$40 billion in 1994, a \$16 billion increase over eight years. Yet preventive steps and new treatment therapies emerging from health S&T can and do result in major savings. Cervical cancer screening programs are only one example of such highly leveraged investments.

1.2 KEY CHALLENGES FOR HEALTH S&T

The measurable and remarkable successes of Canada's health system have made it clear that health S&T is critical to advancing a Canada-wide health agenda and to all other aspects of federal leadership. We cannot rest on our laurels, however. The context within which health S&T is being conducted is shifting. There are urgent issues and drivers for change that require adjustments in health S&T strategy if Canadians are to sustain a national health S&T capacity and quality of life:

- The Health Portfolio is experiencing much the same fiscal pressures as other government

sectors. Activities of all Health Portfolio organizations were reduced in the Budget of February 1995. Universities and other organizations involved in health research are facing similar pressures. The need to improve the cost-effectiveness of health S&T activities can be expected to continue.

- The average age of the Canadian population is increasing year by year. With it, there is the rising likelihood of chronic diseases associated with aging and higher health care costs. Even though Canada has some of the healthiest and most active senior citizens in the world, rates of some diseases associated with an older population are increasing.
- Persistent inequalities remain which demand stronger and more focused national strategies targeted at groups most at risk. For example, the failure to correct substandard housing and living conditions in some rural, remote and northern First Nations' communities across Canada has contributed to the reemergence of diseases, such as tuberculosis, which are several times higher than the Canadian average.
- Innovation in such areas as biotechnology and new reproductive technologies creates opportunities while raising new and complex ethical and regulatory issues. As noted in the Medical Research Council's Strategic Plan, *Investing in Canada's Health*. "Our potential for understanding the genetic bases of health and disease has never been greater. The prospective diagnostic and therapeutic benefits of molecular biology, including the evolution of stunningly creative frontiers of biotechnology, seem practically boundless."
- The health system is also under pressure. Major issues include sustainability of the system as a whole; that is, maintaining universal access to health care within a sound national

risk assessment and risk management infrastructure. *Affordability*, or easing spending pressures on both public and private health care sectors, is also an important issue.

Finally, the health system needs to increase its *emphasis on results*, achieving a better balance among efforts and resources for health care, protection, prevention and promotion to improve the health of Canadians, especially groups most at risk. Evidence resulting from S&T is required to support efficient and effective decisions throughout this system.

Across all of the previous areas are concerns relating to our ability to sustain a resilient world-class capacity in health S&T in Canada: people, ideas, facilities and investment. Innovation and adjustments are needed to meet the challenges, notably:

- sustaining, under tight fiscal constraints, the national bedrock of health sciences innovation in both biomedical and non-biomedical research;
- increased emphasis on understanding underlying causes of poor health and related social problems which will expedite anticipation, prevention and more effective program design;
- broadening of health S&T efforts nationally to encompass all areas of health research, including population health, health economics, health care delivery system and health determinants; and
- increased S&T support for a health system in transition, including additional research that is relevant to policy and explores a range of determinants of health, such as societal factors, economic changes and the composition of health services.

1.3 STRATEGIC OBJECTIVES FOR A NEW ENVIRONMENT

The Quality of Life Task Force proposed a vision for federal S&T that favours “anticipate and prevent” rather than “react and cure.”

Both this Task Force and the Advancement of Knowledge Task Force recommended support for a broad spectrum of S&T that can provide a national base for innovative action on a range of determinants. A new, more powerful vision for health S&T has emerged from these consultations and the work of the Health Portfolio partners:

To mobilize and capture the benefits of national and international S&T partnerships (ideas, people, facilities and investment) to maintain and improve the quality of life of Canadians.

This vision of federal health S&T is set in the broader context of a Canadian system of innovation that goes far beyond the stimulation of jobs and growth, though it is a key contributor to that objective as well. It sees the federal effort as part of a larger national health S&T effort that includes the capacity found in Canada’s universities, hospitals, research institutes, private sector companies and government organizations. It looks toward stimulating the advancement of knowledge in all key areas of health and leveraging investments to produce maximum results for the health and quality of life of Canadians.

In this context, and based on a wide range of stakeholder consultations and business planning exercises conducted by all Portfolio members, the following *strategic objectives* have been developed to light the path to the future:

- to work toward national health S&T priorities that address critical knowledge gaps,

focusing particularly on the “upstream” portion of health prevention, promotion, maintenance and care where key choices are made;

- to strengthen the Health Portfolio’s commitment to excellence, continuous renewal and cost-effectiveness;
- to sustain a dynamic and internationally competitive health S&T capacity, composed of ideas, people, facilities and investments. This is an absolutely essential component of the proposed innovation system;
- to capture the benefits and opportunities of national and international health S&T partnerships more effectively; and
- to mobilize S&T information more fully for results with particular emphasis on capturing the benefits of communications technology.

Each of these strategic objectives will be illustrated in the following descriptions of achievements and initiatives. In working toward this vision, Health Portfolio members increasingly see themselves as generators of knowledge, coordinators, consensus builders and change agents. These emerging roles strengthen their work with other government and non-governmental stakeholders in exploring the potential for a Health Research Agenda for Canada, and in initiating and implementing more innovative approaches to strategic health research investments.

The end objective is to marshal the benefits of our national health S&T capacity toward more effective treatments and care; better prevention; more effective management of risks associated with food, drugs, medical devices and environmental hazards; better health intelligence; and more effective health promotion. Additional beneficial effects will filter throughout the entire Canadian economy.

2. Current Activities and Future Directions for the Health Portfolio

2.1 SCOPE AND SCALE OF THE HEALTH PORTFOLIO S&T INVESTMENT

S&T in the Health Portfolio is highly diverse. The Portfolio funds or performs S&T through a broad range of organizations with different mandates, structures and contributions. Together, however, these organizations represent a powerful synergy of S&T leadership across the entire spectrum of health research, care, prevention, promotion and protection.

The potential impact is enormous. As already noted, health is a major sector of the Canadian economy, representing \$73 billion, or 9.7% of the GDP in 1994. Gross expenditures on R&D in health were over \$1.5 billion in the same year. Applications of health technology represent an increasingly important area for international trade. In this context, investment in health S&T — as the primary source of evidence to support decisions and innovation across the entire sector — is critical.

The federal contribution to this national R&D investment, set out in Diagram 1, has to be seen within a broad national context. Federal development of the Canadian health research infrastructure over the last 40 years is now paying off. Canada's capacity has never been as dynamic or as full of potential as it is today. According to data from Statistics Canada, national health research activity increased by 13.7% between 1990 and 1993, a rate well above the increase of 6.3% in the economy as a whole. Growth has been accomplished during the period through increased private sector participation.

The federal S&T contribution involves a range of instruments: R&D targeted to the

advancement of health knowledge and related science activities (RSA) that provides the analytical underpinnings for the application of this knowledge to a broad range of responsibilities. Federal S&T activities seek to balance investment in extramural S&T performed by institutions and individuals across the country with intramural S&T related directly to government responsibilities for the national health infrastructure.

Diagram 2 shows a breakdown of the 1995-96 federal S&T investment of \$440 million between extramural (\$300 million) and intramural S&T (\$140 million). The Medical Research Council (86.1%) funds most of the extramural research while the Health Protection Branch of Health Canada performs most of the intramural S&T.

The Health Portfolio also contains two small agencies with specialized mandates: the Patented Medicine Prices Review Board and the Hazardous Materials Information Review Commission. We now consider each component of the Portfolio in more detail.

Medical Research Council of Canada (MRC)
According to a recent NABST evaluation, MRC is a highly innovative agency, rated as one of the best federal S&T organizations in terms of both knowledge and technology development. Building upon its success as the developer of a world-recognized national capacity for biomedical research, the MRC is engaged in strengthening research competence across the entire health spectrum. The agency has the capacity to achieve this goal effectively and efficiently. Through its close ties with research organizations in other sectors, MRC is able to lever four dollars of Canadian health S&T for every one that it invests.

**GROSS EXPENDITURES IN RESEARCH AND DEVELOPMENT
IN THE HEALTH FIELD² IN CANADA
(1994 - TOTAL EXPENDITURES - \$1,519 M)
(In dollars)**

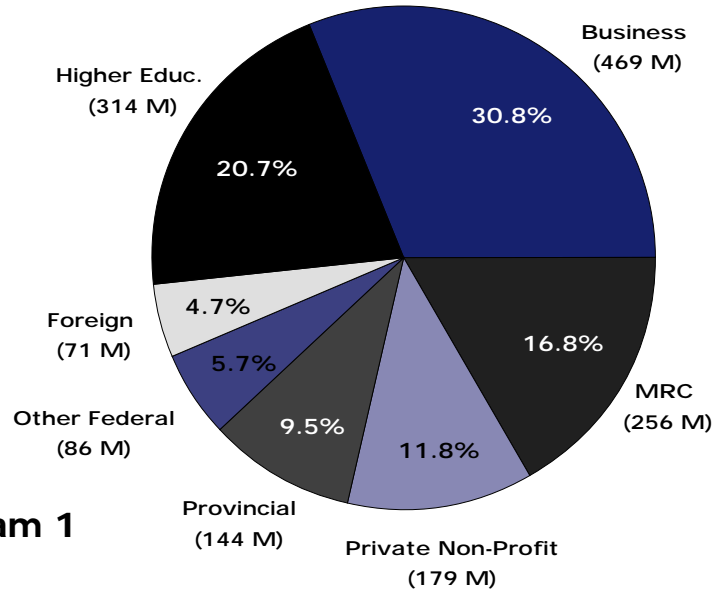
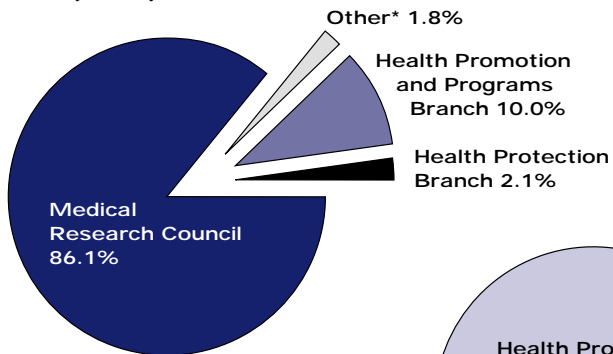


Diagram 1

**HEALTH PORTFOLIO S & T EXPENDITURES (1995-96)
(In dollars)**

**Extramural S & T
(300M)**



**Intramural S & T
(\$140M)**

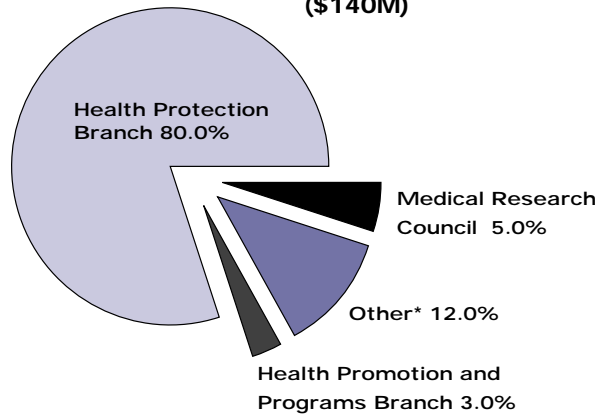


Diagram 2

Source: Statistics Canada

* Medical Services Branch / Policy and Consultation Branch, Health Canada

²Based on Statistics Canada's estimation for funding sector. The "higher education" sector is based on a percentage of the total expenditures of post-secondary institutions estimated to be devoted to R&D in the health field.

With a budget of \$250 million, MRC is the federal government's major extramural instrument for supporting the national foundation of knowledge upon which health innovation depends. MRC-supported research ranges from studies of fundamental processes in human cells to research into the effectiveness of information technologies in the health sector. MRC grants and scholarships ensure a Canadian capacity for research in all areas of health in a network of laboratories in universities, hospitals and research institutions across Canada. They also ensure a sustainable research system by supporting the training of the next generation of scientists, researchers and technologists.

Over the past 35 years, funding delivered through MRC has established a cadre of university-based researchers and the laboratories and equipment required for world-class research. In addition to its tremendous impact on health maintenance and the treatment of illness, MRC-funded research has made a significant economic contribution by providing thousands of knowledge-intensive jobs and through the creation of businesses built on the findings from scientific investigation.

Federal S&T funding through MRC has helped develop a world-recognized Canadian health S&T infrastructure, supported by government in partnership with universities, research institutes, non-profit agencies and industry. In international comparisons, Canadian health science proves its excellence, especially in clinical sciences and cardiology where Canadian impact is exceptional. Strengths in neurosciences, bacteriology, genetics, protein engineering and respirology have led to the development of Canadian Networks of Centres of Excellence in these areas. The value of Council-supported research

is demonstrated daily as researchers achieve breakthroughs in Alzheimer's disease, muscular dystrophy, biotechnology and genetic engineering, and develop new approaches to fighting cancer, nerve damage and heart disease.

The MRC action plan continues a focus on partnerships and development of strategic research areas to maximize benefits of the federal investment in health research. Descriptions of major partnerships with outstanding potential for social and economic benefit appear later in this report. The \$200 million MRC-PMAC Health Program and the Canadian Medical Discoveries Fund (CMDf) represent MRC's determination to increase the leverage of federal resources through as many funding pathways as possible. Also appearing throughout the report are descriptions of MRC's special initiatives, many conducted in partnership with Health Canada: in breast cancer, AIDS, genetics and areas, such as health determinants, of very high relevance to the control of health care costs.

Health Canada

Canadians look to Health Canada for strong national leadership to "help them maintain and improve their health." The federal decision in 1993 to create Health Canada as a distinct federal Department recognized the importance of this sector to Canadians and set the stage for a more focused and collaborative approach to leadership in health.

This decision also resulted in a streamlined, health-focused organization that now comprises five branches: Policy and Consultation Branch, Health Promotion and Programs Branch, Health Protection Branch, Medical Services Branch and Corporate Services Branch. These branches

all work collaboratively to deliver on key objectives and priorities under each of four core business lines:

- Health System Support and Renewal, which involves partnering with the provinces and territories on maintaining access of all Canadians to affordable health care;
- Population Health Strategy, which addresses persistent health inequalities, particularly those that affect population groups most at risk;
- Management of Risks to Health, which involves assessing and managing risks to the health of Canadians in food, drugs, medical devices, consumer products, disease threats and the physical environment; and
- Delivery of Services to First Nations, Inuit and Yukon — ensuring the availability of and access to health services and supporting action on health inequalities.

One of the priorities of the refocused department is to connect its science with its policies, programs and decisions more effectively than ever before. New directions include exploration with the MRC, the provinces, territories and stakeholders of the potential for a Health Research Agenda for Canada. Innovative funding options that will allow critical health S&T requirements to be addressed collectively will also be developed. Health Canada will also undertake a strategic re-orientation of the National Health Research and Development Program, to guide and support action to maintain and improve the health of Canadians.

The Department decided under Program Review to strengthen Canada's Health Intelligence Network. This project is designed to address critical blind spots in our ability to track threats such as drug resistant bacteria and emerging

viruses. Provinces, territories and stakeholders are enthusiastically supporting this endeavour. S&T information is also being marshalled from all sources, including the Prime Minister's National Forum on Health, to inform the development of policies with an impact on future directions of Canada's health system, with particular emphasis on maintaining universal access by Canadians to affordable health care. Leadership in population health strategies, such as those dealing with women's health, Aboriginal Head Start, family violence, seniors or tobacco, is also being refocused to make better use of S&T evidence.

These initiatives are visible. However, it should not be forgotten, as noted by a former Clerk of the Privy Council, that success is sometimes measured by "what does not happen" as much as by "what happens." In this context, the Department is connecting science to decisions by strengthening the knowledge base for risk assessment and risk management in all key areas: foods, drugs, medical devices, civil aviation medicine, consumer products, use of pesticides and so on. The Department's risk-based approach to regulations, developed by the Health Protection Branch, is increasing Canada's international reputation as one of the best places in which to live and do business. It has also proved to be highly effective in dealing with major health issues such as AIDS or with sudden threats such as the emergence of the Ebola virus.

Hazardous Materials Information Review Commission (HMIRC)

The Commission is an independent agency charged with providing the trade secret mechanism within the Workplace Hazardous Materials Information System (WHMIS). The goal of WHMIS is to ensure the protection of Canadian

workers who use hazardous materials in the workplace by providing information while minimizing the economic impact on industry and the disruption of trade.

Accountable to Parliament through the Minister of Health, the HMIRC is governed by a Council of Governors representing workers, suppliers, employers and the federal, provincial and territorial governments. The Commission must ensure a balance between industry's right to protect confidential business information and workers' right to know about the hazardous materials they are exposed to and the corresponding preventive health and safety measures. It has a 1995-96 budget of \$1,202,000 and a staff of 14.6.

As part of its regulatory activities, the HMIRC makes decisions on the validity of claims for exemption and the compliance of product labels and material safety data sheets with WHMIS requirements. It also convenes independent boards to hear any appeals on its decisions and orders. Although the Commission is not directly an S&T organization, nor does it conduct S&T programs or activities, it makes extensive use of S&T in carrying out its mandate. In particular, the Commission relies heavily on the scientific expertise of its screening officers, its toxicologist, and Health Canada's biologists and chemists.

Patented Medicine Prices Review Board (PMPRB)

The PMPRB is an independent quasi-judicial body that reviews prices of patented medicine. In 1995-96, the five-member Board had a budget of \$3.138 million and a staff of 35. In 1994, sales of patented medicines regulated by the Board totalled \$2.39 billion, approximately one half of the \$5.94 billion factory gate sales of all medicines in Canada. The PMPRB represents a strategic component of federal policy to balance

trade and industrial development objectives of pharmaceutical patent legislation with consumer protection and affordable health care.

In its regulatory activities, the PMPRB applies an "excessive price" standard set out in the *Patent Act* that implicitly recognizes the importance of R&D. Thus, it encourages drug research while fulfilling its primary role of ensuring that patented drug products are fairly priced. The Board also undertakes RSA analysis required to categorize new medicines based upon their therapeutic and physical characteristics. It provides a public accounting of the quantity and nature of R&D spending by the patented drug industry based on such information as the type of R&D performed (e.g., basic, applied, other); who performs the R&D (is it done internally, by universities and hospitals, other companies); and where in Canada is R&D performed. In 1994, the patented drug industry reported total R&D expenditures of \$561.1 million.

2.2 ADAPTING FEDERAL S&T PRINCIPLES TO HEALTH

The Health Portfolio Action Plan recognizes the interplay between quality of life and wealth creation. Put simply, without a solid economic base, a society cannot provide the food, shelter, job challenge, interaction, safety and health care that together provide for a good life. Equally important, unless used to ensure quality of life, wealth creation and technological innovation are barren concepts.

The Health Portfolio's new directions adapt and apply the seven principles of the federal S&T Policy Statement:

- Health S&T will provide even better value for money, by *increasing the effectiveness of federally supported research and training.*

- A key element of greater effectiveness is leveraging federal resources by *capturing the benefits of partnerships with others* engaged in the same work, whether inside or outside of government. Partnerships are a major way of further developing the health S&T infrastructure which undergirds Canada's international competitiveness, through improved working and living conditions.
- Also intrinsic to greater health S&T effectiveness are *approaches and strategies that emphasize prevention and sustainable development* of Canada's human and natural resources. Prevention and sustainable development are key components of a greater focus on "upstream action" and on "anticipation and prevention" across the entire health system.
- *Policies, practices and regulatory approaches supported by health S&T encourage innovation*, and ensure that Canada provides a welcoming environment for investment in all forms of health-related science, technology and product development. A positive regulatory climate nurtures a health system, creating opportunities for Canadian individuals and industry while maintaining strong risk management protection for Canadians.
- Innovation necessitates *extended information networks to move new knowledge resulting from S&T quickly into the hands of users*. An effective health system scans and rapidly applies the best from international and Canadian S&T to improve decisions and innovation, ultimately reducing health costs.
- Rapid innovation must therefore be based on *strengthened international S&T linkages*, because Canada alone produces and consumes only a small fraction of the world's health S&T.
- To enlist Canadians in applying health research for promotion, prevention, risk management and care, and to increase their

awareness of the value of S&T in this field, efforts are also needed to *promote a stronger science culture*.

By pursuing these principles in its own work, the Health Portfolio contributes in a major way to advancing the overall federal agenda on health, as well as all other major agenda areas. It also acts as a flag-bearer for the health S&T system as a whole, laying the groundwork for a Health Research Agenda for Canada.

2.3 ACHIEVING THE PRINCIPLES THROUGH HEALTH S&T

2.3.1 PRINCIPLE: INCREASING THE EFFECTIVENESS OF FEDERALLY SUPPORTED RESEARCH

Portfolio strategies outlined above recognize the need, consistent with this principle, to reaffirm and strengthen the commitment to excellence and to improving the resilience and effectiveness of health S&T in Canada. Efforts focus on selection of high quality investments, clear targets for achievement, and an improved ability to derive maximum efficiencies from Canada's highly diverse health S&T infrastructure (people, ideas, facilities and resources), whether they occur in federal, industry, university or non-profit sectors.

Both the MRC and Health Canada make extensive use of peer review processes to ensure that research chosen for funding is of the highest quality and potential benefit to Canada. This includes:

- a highly effective network of peer reviewers used by the MRC and the National Health Research and Development Program (NHRDP). These networks include more than 500 scientists from universities,

affiliated hospitals and government and industrial laboratories who serve without remuneration³;

- ongoing external peer review of specific programs in Canada on a cyclical basis and inclusion of external reviewers in annual program planning sessions; and
- a broad range of expert advisory and consultative groups to ensure relevance and scientific rigour of programs (e.g., the Advisory Committee on Epidemiology, the Committee on Environmental and Occupational Health, the Blood Regulation and AIDS Therapies Committee, and the Steering Committee on Public Health Intelligence).

For the future, both MRC and Health Canada are evaluating the capacity of their peer review committees to assess proposed projects for their scientific productivity and impact on world knowledge. Added to these factors are expanded measures of relevance, efficiency and effectiveness. A key consideration is that peer review helps to prevent unnecessary duplication and overlap with other health research programs in Canada and abroad. Leverage, economic impact, and incremental effects are also being given increased attention across the Portfolio.

To further strengthen the excellence of Portfolio-funded research, the MRC and Health Canada are also working to develop more formal systems to scan the research environment so that key decision makers and experts are aware of the latest developments in different and fast-moving areas of health S&T in their respective fields. This information is essential in setting future priority research directions for Canada, in identifying international sources of high quality scientific information and in maintaining a

credible place at the international table. Table 1 gives only a few examples of federally funded researchers who have achieved international recognition for the excellence of their work.

In addition to an enhanced emphasis on excellence, the Portfolio is looking increasingly for innovative ways to strengthen the leverage capacity of its investments. It recognizes the need to set clear, even bold targets for achievement and to strengthen its capacity to assess results. One example is the MRC's recent development of specific targets for leveraging its investments with those of other partners.

Portfolio partners are also using the business planning process to stimulate development of targets and performance commitments across all its business lines. In addition, the Health Portfolio is increasing its efforts to develop, apply and make available for scrutiny a variety of performance indicators as a complement to periodic program evaluations. Here too, partnerships across the Portfolio, other federal departments and university-based experts are critical to developing useful benchmarks and performance indicators for health S&T.

Finally, the effectiveness of federal research increasingly depends on the ability to make the most efficient use of our infrastructure of health S&T people, ideas, facilities, instrumentation and funding, wherever these may be located. Advanced S&T is often highly dependent on the availability of complex research facilities and high-technology equipment. This factor is critical in any strategy to increase the effectiveness of federally funded research.

In this context, the MRC makes effective use of the network of thousands of health science researchers in universities and research institutes across Canada. Funding of researchers in these institutions helps avoid costs associated

³ It is estimated that the total time donated to the review of applications for MRC amounts to over 3500 working days, for a total value of \$2 million. This is a key element in leveraging federal investment.

TABLE 1: SUPPORTING WORLD-CLASS INNOVATION

- **Dr. Michael Smith of the University of British Columbia, an MRC-funded investigator since 1966, developed a critical technique used in genetic engineering known as site-directed metagenesis for which he won the 1993 Nobel prize in chemistry. This revolutionized basic research and entirely changed researchers' way of performing their experiments.**
- **Dr. Barry Pless, Member of the Order of Canada, affiliated with the Montreal Children's Hospital, McGill University, is funded through the NHRDP for his nationally and internationally acclaimed research in the fields of chronic childhood disease and childhood injury, which supports world-class innovations.**
- **Dr. Albert Aguayo, an MRC-supported researcher and principal in the Network of Centres of Excellence in Neural Regeneration, is a world leader in the study of repair of damaged nerve tissue.**
- **Dr. Noralou P. Roos, the recipient of an NHRDP Career award, and Director of the Manitoba Centre for Policy and Evaluation, University of Manitoba, is the principal investigator of the study "A Twenty-Year Perspective on the Manitoba Health Care System" which has had significant impact on health planning at the provincial, national and international levels.**
- **A team of MRC-funded scientists at McMaster University may have discovered an entirely new way to fight cancer by blocking a substance that allows malignant cells to multiply widely in the body.**

TABLE 2: STRENGTHENING INTELLIGENCE CAPACITY

THE WINNIPEG LABORATORY

- The pathogenic organisms in our “global village” are adapting faster than our tools to combat them. An efficient and organized strategy is needed to mobilize the scientific networks and expertise required to win the battle. Work on these pathogens requires safety precautions which exist only in the overcrowded and oversubscribed U.S. CDC facility in Atlanta. Level 4 containment is absolutely essential to deal with highly contagious viruses.
- Health Canada has taken a leadership role by supporting a world-class facility in its Winnipeg laboratories and enabling S&T partnerships that will allow Canada to participate as a major contributor to the control and prevention of infectious diseases. The Laboratory Centre for Disease Control (LCDC) will be relocating its Bureau of Microbiology to the \$142 million facility (Health Canada and Agriculture and Agri-Food Canada) in 1997. The new facility will include laboratories which meet biosafety and containment standards for Levels 3 and 4. The new Level 4 laboratory will be the only such facility in Canada (and the second in North America after the much older CDC facility) where high-containment experiments can be conducted. It will also permit the development of diagnostic technologies and laboratory methods for improved surveillance on haemorrhagic fever viruses, yellow fever viruses, drug resistant tuberculosis, hanta virus and other emerging human pathogens.
- The new facility will attract highly qualified scientists to develop such new technologies and will house national and international visiting scientists from industry, universities and other institutions for training and joint research projects of commercial and public health benefit. Such partnerships are expected to provide opportunities for revenue generation and additional resources to sustain Canadian health science.

with duplication of research space and related overhead. MRC grants programs provide researchers with much of their necessary equipment. For large research facilities, the agency offers collaborative funding mechanisms and specific facilities grants to draw researchers together to focus on a common theme using shared resources. It promotes university-industry collaboration to maximize use of industry's facilities for health S&T. In addition, it cooperates with other granting agencies to ensure that major facilities are open to researchers from all disciplines.

The federal laboratory infrastructure in Health Canada is also located across the country, increasing accessibility and efficiencies of use. For example, the Health Protection Branch offers access to diagnostic reference services, some of which require expensive containment facilities, to provincial agencies and hospitals, and operates a secondary dosimetry laboratory for Canadian researchers and companies requiring calibration facilities. Health Canada has also embarked on a laboratory rationalization project to further increase efficiencies. Various measures are being considered, including elimination of duplication and overlap within the Department and among other federal departments, cost-recovered use of facilities, integration or co-location with other laboratories, and repriorization of activities.

Rationalization is not enough, however. Canada needs more sophisticated laboratory capacity than it now has to deal with emerging health threats that require high-level containment. The new Winnipeg Laboratory, described in Table 2, will for the first time provide Canada with the Levels 3 and 4 capacity required to deal with such demands without relying on the

already overloaded capacity in other countries, notably the U.S. Centers for Disease Control (CDC) in Atlanta.

These and other measures to increase effectiveness will not only help to maintain and improve the health and quality of life of Canadians, they will also provide opportunities for Canadian industry to build on federally funded innovation. Both the MRC and the Department are actively involved in technology transfer and will be looking for further opportunities under the Portfolio's new directions.

The MRC-inspired CMDF provides venture capital for the commercialization of research results and facilitates a critical end stage of technology transfer. The MRC helped draw together fund managers, investment dealers and a sponsoring labour organization (the Professional Institute of the Public Service) to create a fund through which members of the public can invest in new development of products and services resulting from Canadian health research discoveries. The benefits of this program, cited by the Minister of Finance for its innovation in the Budget 1995 speech, are far reaching.

Without funds such as the CMDF, Canadian discoverers of key new technologies had to seek venture capital in other markets, usually in the United States. Thus, the immediate economic benefits of discovery (new jobs, technological advantage and export potential) were not retained in Canada. Even worse, once the health product or service was fully commercialized, Canadians would have to purchase it as an expensive import.

Federal laboratories also play an active role in the development and transfer of innovation. Increasingly, technology transfer of diagnostic reagents to industry for manufacture is improving availability of diagnostic capability to

TABLE 3: SOME PRODUCTS OF HEALTH PORTFOLIO S&T

- A highly sensitive imaging system that will facilitate non-invasive treatment for prostate cancer is being commercialized through the MRC-initiated CMDF.
- Canadian medical researchers have found a new form of acetylsalicylic acid (aspirin) that minimizes the side effects of earlier versions. This opens up use of an inexpensive pain reliever to a huge population of people worldwide who could not tolerate aspirin.
- Physicists at the Health Protection Branch's Medical Devices Bureau have designed and constructed a simple dynamic breathing simulator. This simulator will allow the Branch and manufacturers to evaluate the performance of a wide variety of breathing systems and their components during spontaneous breathing. This should significantly improve the safety of breathing devices.
- Widely publicized problems with some medical device implants have raised concerns about the long-term safety of biomaterials used in such devices. A Health Canada interdisciplinary team is studying the biodegradation of polyurethane used in pacemaker leads, heart valves and feeding tubes. The project includes the development of new *in vitro* test methods for measuring degradation in products and rapidly evaluating the resistance of biomaterials to biodegradation. These tests could be used by manufacturers and regulatory agencies to assess the safety of new medical device implant materials.

(continued on next page)

TABLE 3: SOME PRODUCTS OF HEALTH PORTFOLIO S&T (CONTINUED)

- **Researchers in the Radiation Protection Bureau have developed a calibration device for measuring radio-iodines in the human thyroid. The device has been patented and private companies have been approached for commercialization.**
- **A partnership between the National Biotechnology Strategy and the Network of Centres of Excellence for Respiratory Health (Inspiraplex) has led to the transfer of patented drug research to the private sector for further development and commercialization.**

Canadians. Several patents and licencing agreements have been obtained. Examples include the development of reagents to identify *Bordetella pertussis* and *Hemophilus influenza*. Hybridoma technology has identified important bacterial cell surface components which are being exploited as potential vaccines against bacterial meningitis. Other examples are given in Table 3.

Ultimately, however, effectiveness has to be measured in terms of results for the health and quality of life of Canadians. Areas as yet uncovered, such as gaps in health surveillance and research outcomes, determinants, and health efficiency/effectiveness research (detailed below) are as critical as areas that are subject to current innovation efforts. The Portfolio is actively exploring the options for a research funding initiative that would help reduce health care costs by focusing on the results of health interventions.

2.3.2 PRINCIPLE: CAPTURING THE BENEFITS OF PARTNERSHIP

The Portfolio's vision for health S&T can be achieved only by capturing the synergies of partnerships and joint investments within the

Portfolio itself and with the rapidly increasing range of national and international players in the fields of health science. Strategies developed by Portfolio partners focus on strengthening their ability to:

- act as a hub for creating and mobilizing effective national partnerships across all areas and sectors of health innovation in Canada;
- stimulate training and learning through cross-generational partnerships that will assure future national capacity, particularly in areas of strategic importance; and
- leverage the federal investment in health S&T through a broad range of funding partnerships and pathways such as those put forward by the MRC.

Health S&T is increasingly done through a complex network of national and international players and contributors. These include active work by Health Portfolio partners with key organizations such as the Canadian Coordinating Office on Health Technology Assessment (CCOHTA), the Canadian Institute of Health

Information (CIHI) and the Prime Minister's National Forum on Health. A significant increase has taken place in recent years in the number of provincial agencies involved in research on health care services and on new population health and prevention disciplines. Volunteer organizations have increased the scope and diversity of their research activities as well.

More than 60 non-profit health agencies, most of which focus on improving the prevention, care and treatment of specific illnesses, double the impact of the federal investment in a research platform by supporting research projects in their area of interest. For example, the extensive research programs of the National Cancer Institute of Canada and the Canadian Heart and Stroke Foundation build upon the infrastructure of researchers and facilities that MRC, with the NHRDP, has developed in partnership with the universities. Universities and hospitals have combined forces to develop active research centres and institutes. Centres of Excellence are opening the doors to strategic competencies in critical areas. More recently, industry has shown a striking willingness to enter into creative partnerships with a broad range of organizations. The federal government, as a key contributor to this platform of national health S&T activity, is in a unique position to be able to draw together funders from across the country into dynamic and effective partnerships.

The benefits of partnerships initiated and sustained by the Health Portfolio are tangible, as the following examples (and those in Table 4) illustrate:

- The basic infrastructure of world-competitive researchers trained and developed through federal S&T funding enables research sponsored by the private non-profit sector (e.g., Canadian Cancer Society, Heart and Stroke

Foundation), the Provinces (e.g., Fonds de recherche en santé du Québec) and industry.

- The federal government's role in health research is well accepted by provincial and territorial health authorities. Some provinces, notably Quebec, have made a conscious decision to design health research programs to complement those of the MRC and Health Canada's NHRDP.
- As the federal authority responsible for protecting the health of Canadians, Health Canada, through its Health Protection Branch, often collaborates with other departments and agencies. Some federal statutes, such as the *Pest Control Products Act*, administered jointly by Agriculture and Agri-Food Canada and Health Canada, involve partnerships among various federal government departments. The Health Protection Branch also works with provincial authorities, notably through federal-provincial advisory committees such as the Federal-Provincial Advisory Committee on Environmental and Occupational Health.

The interrelationship among the various S&T components of the national system of health innovation can be illustrated through the following hypothetical story. A researcher funded by the federal government through MRC finds a previously unrecognized hormone that interferes with the development of cancer cells. The discovery prompts researchers in industry to develop a drug that triggers production of the hormone. After extensive testing by Health Canada and the company concerned, the drug is used on cancer patients to slow the growth of tumours. The drug company then funds a group, headed by the original researcher, to continue investigation on the specific function of the hormone. Later, the National

TABLE 4: PARTNERSHIPS AND RESULTS

- Health Canada's Policy and Consultation Branch is leading an effort with other branches and the MRC to explore the potential for a Health Research Agenda for Canada with the provinces and territories, and is also looking at innovative funding options.
- Under the terms of an MRC-PMAC Health Program, member companies of the Pharmaceutical Manufacturers Association of Canada (PMAC) are expected to contribute \$200 million to health research over a five-year period. MRC will contribute \$50 million over the same period. The agreement brings to the research enterprise an infusion of funds which might otherwise have been spent by multi-nationals in other countries. Pharmaceutical companies benefit by being connected with researchers who have relevant expertise and whose projects have been judged to be of high scientific merit by the MRC peer review system.
- The Multicentre Study on Health and Aging represents a partnership between NHRDP, LCDC and 18 centres across Canada to investigate health and aging. The study developed national and WHO standards for the diagnosis of dementia and established prevalence rates for Alzheimer's and other forms of dementia to assist Canadian jurisdictions in health planning.
- The Breast Cancer Research Initiative (a partnership between Health Canada, MRC, the National Cancer Institute of Canada and the corporate sector) is undertaking a broad spectrum of cancer research projects and is expanding into new areas of research relating to prevention, early detection, diagnosis, treatment, rehabilitation and palliation for people with breast cancer.

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TABLE 4: PARTNERSHIPS AND RESULTS (CONTINUED)

- The MRC is supporting the Canadian Genome Analysis and Technology Program in conjunction with Industry Canada, the National Cancer Institute of Canada, Natural Sciences and Engineering Research Council (NSERC) and Social Sciences and Humanities Research Council (SSHRC). It will assist in the understanding, treatment and prevention of more than 4000 genetic diseases that afflict humans as well as the multifactorial diseases in which genetic predisposition plays an important role. The Council is contributing \$5 million in research grants to this program over five years.
- Partnerships have been established between provincial health authorities, Health Protection Branch and NHRDP to carry out provincial food consumption surveys. Both expertise and costs are shared. A national food consumption reference database will be established. The data will be used for public health education programs and are also essential in assessing potential health hazards from chemical contaminants and additives in foods. This also supports the Heart Health Initiative.
- A joint Canada-U.S. review of new drug submissions, Pulmozyme and Taxol, provided Canadian patients with early access to effective new drug therapies where few alternatives had previously existed.

Cancer Institute invests in the work of the group and the cycle of innovation continues at an increased rate. The group subsequently finds that production of the hormone is enhanced by a low-fat diet. Health Canada then promotes dietary adaptation by Canadians to improve resistance to the disease. The innovation benefits Canadians in many ways. It produces a treatment that is more effective and less expensive than

others. It stimulates economic activity and generates jobs, not only in production but also in research. It reduces pressure on the health care system and improves the overall quality of life of Canadians.

This example illustrates the interdependencies of the innovation system in the health field. The initial research could not have been accomplished without federal support through the

MRC. The researcher's idea would not have been developed without a strong scientific capability in the Canadian pharmaceutical industry. The new drug would not have been rapidly tested and brought to market if the federal government lacked the necessary scientific expertise in its Health Protection Branch. The discovery would not have led quickly to new thinking about healthy lifestyles were it not for the capacity of the non-profit sector to target its resources on research of relevance to public donors.

In addition to supporting the generation of new knowledge to fuel the innovation process, the Portfolio supports the training of the next generation of Canadian scientists and technologists. Consider, in the example, the group of researchers that was jointly funded by industry, the non-profit sector and the MRC. Besides the principal researchers, the group would include technicians, master's degree students, doctoral students and postdoctoral fellows who would be both assisting in the research and gaining practical experience in the pursuit of knowledge. It is these students who will sustain the system of innovation by later moving into positions in universities, government laboratories, industry research departments and research institutes. Federally supported health science provides a continuous production of new scientists and technologists, without which the system of innovation will not function.

Investment partnerships are becoming increasingly important in the current fiscal context. The two major Portfolio partners, Health Canada and the MRC, have significantly increased the leveraging potential of their investments and are constantly looking for ways to improve current performance. Within Health Canada, revenues from cost recovery are increasingly used to support regulatory-based research

on foods, drugs and medical devices — an approach that recognizes the potential benefits of this research to industry (e.g., technology transfer) as well as to the Canadian population.

One such initiative that deserves particular mention is MRC's new "funding pathways" approach illustrated in Figure 1.

- The *first funding pathway* involves the five-year direct federal funding to MRC for medical and health research to maintain the research platform the national health science efforts depends on, as described above.
- For the *second funding pathway*, partnerships and networks, the MRC has set a target of \$500 million over a five-year period. To date, 80 percent of this target has been committed through federal support for the Networks of Centres of Excellence, an agreement with PMAC and partnerships with non-profit health agencies.
- A goal of \$600 million in five years has been set for the *third pathway*, commercialization and technology transfer funding. Half of the targeted funding is expected through investments such as the \$102 million placed with the Neural Regeneration Network by the Royal Bank, MDS Health Ventures, Caisse de dépôt et de placement du Québec, and others. The other \$300 million is to be generated by the previously described CMDF that will provide venture capital for the development of new products and processes stemming from health science discoveries. In its first year of operation, the CMDF received \$16 million from Canadian investors, an amount that will be at least tripled by other participants in CMDF-funded projects.

HEALTH RESEARCH FIVE PATHWAYS OF FUNDING (MRC TARGETS AND COMMITMENTS TO DATE)

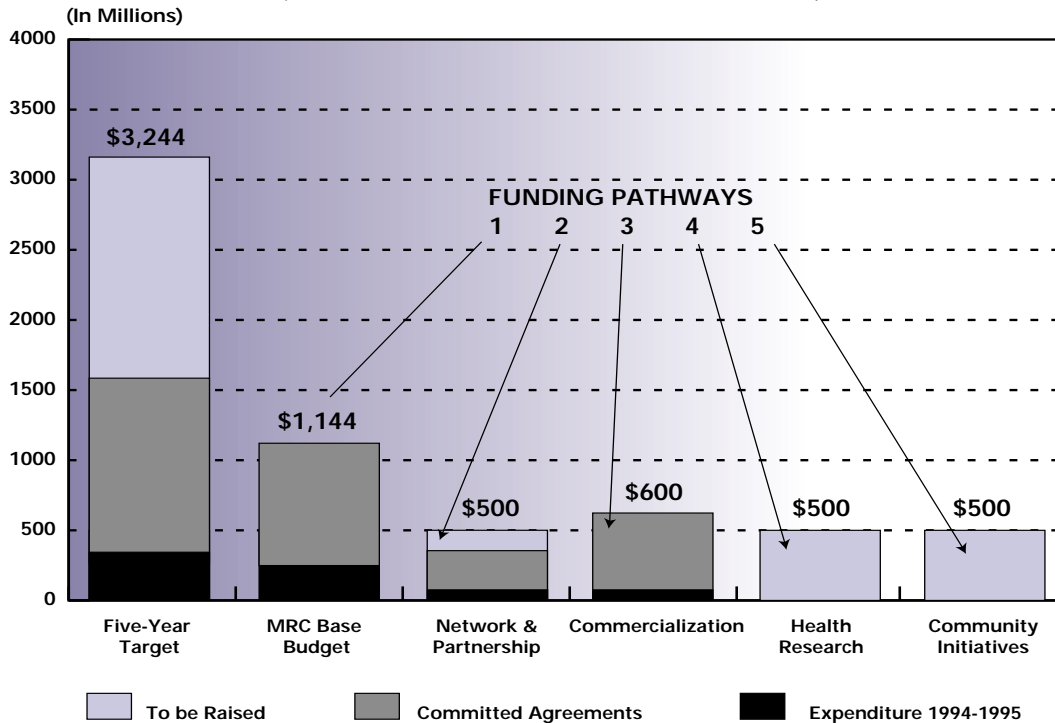


Figure 1

- Through a *fourth funding pathway* would flow funds targeted at health system improvements, as recommended by NABST in *Healthy, Wealthy and Wise*. The target is \$500 million, or \$100 million per year.
- A *fifth funding pathway* recognizes the considerable investment in health research in the form of contributions by private individuals, firms and various levels of government to campaigns for funds for major initiatives, such as the building of new research institutes. The target is \$500 million.

2.3.3 PRINCIPLE: EMPHASIZING PREVENTIVE APPROACHES AND SUSTAINABLE DEVELOPMENT

The Portfolio strategies outlined above require an approach increasingly focused on the “upstream”

dimension of health — on “anticipate and prevent rather than react and cure.” These include preventive and sustainable development approaches highlighted in this principle as well as two other equally critical areas from a health perspective. These strategies focus on:

- strengthening our health intelligence and risk assessment capacity, emphasizing gaps and use;
- improving our capacity to understand the determinants of health, to anticipate and prevent illness and to promote sustainable economic development; and
- stimulating increased research on health system efficiency and effectiveness and on the outcomes of alternative approaches, and the more rapid development of cost-effective tools for health care and healing.

First, it has become increasingly evident that Canada needs a stronger and more focused health intelligence and risk and outcomes assessment capacity if it is to effectively manage health impacts, and anticipate and prevent ill effects before they occur. These include tracking emerging strains of disease viruses, determining the extent to which exposure to environmental pollutants affect health, and assessing the benefits, quality, safety and effectiveness of drugs and devices.

The globalization of disease and the emergence of more virulent antibiotic resistant strains have led to major gaps in coverage and capacity in our national health intelligence and analysis system. This has created concerns about sufficient investment in our surveillance and monitoring capacity, the “hurricane watch” of disease prevention and protection.

In this context, Health Canada, with the full and enthusiastic support of the provinces, is working to strengthen Canada’s health surveillance and analysis capacity. Investment focuses on priority “blind spots” that relate to some of the highest ranked causes of illness, disability, death and cost in Canada (outlined in Table 5). These gaps have been identified through consultations and consensus meetings with provincial, national and international experts, federal advisory bodies, academics, private and non-governmental agencies. They are also based on federal and provincial priorities and health goals.

Closely related to increased attention to health surveillance is the equally strong emphasis on improving knowledge and action on health determinants.⁴

Health care is only one of many contributors to good health. Social and physical environments,

TABLE 5:
HEALTH INTELLIGENCE REINVESTMENT
PRIORITY PUBLIC HEALTH GAPS
BEING ADDRESSED

- Cancer
- Nosocomial Infections
- Bloodborne Pathogens
- Food and Water Borne Illness
- Perinatal Health Surveillance
- Vaccine Preventable Disease
- Cardiorespiratory Illness
- Surveillance Systems
- Infectious Respiratory Diseases
- Development and Support
- International Surveillance
- Information Dissemination
- Sexually Transmitted Diseases
- Health Effects of Environmental Contaminants

human biology and genetic endowment, economic status and individual behaviour are also key determinants of how healthy people will be.

Table 6 illustrates only one area where prevention, or the lack thereof, can have significant long-term societal and individual health

⁴ *Strategies for Population Health: Investing in the Health of Canadians*, Federal, Provincial and Territorial Advisory Committee on Population Health, 1994.

TABLE 6:

ACTION ON HEALTH DETERMINANTS: LOW BIRTH WEIGHT (LBW) BABIES

- The prevention of LBW has become one of the most pressing issues in infant health in Canada and the world. Canada's LBW rate (5.7%) is higher than in many other developed countries and is highest in Quebec (6.5%). Minimal reduction in the LBW rate has occurred over the past two decades, unlike the infant mortality rate which has decreased significantly.
- Reducing LBW would prevent 75% of neonatal mortality and a range of physical and mental deficiencies in children which, in many cases, cannot be corrected after birth. LBW babies are more likely to have chronic health problems, lower IQs, learning disabilities, impaired cognitive development and behaviour problems.
- Low-income mothers and malnourished mothers have a higher incidence of LBW babies. It is estimated that 20% of pregnant women are poor. Whereas LBW babies from higher income families tend to "catch up" in their development, LBW babies from poor families do not. Other factors associated with LBW are the use of tobacco, alcohol and drugs, which is more prevalent among poor Canadians.
- LBW babies also generate high costs to the health care system. The cost of neonatal care per LBW infant is \$60,000. The Health Canada Prenatal Nutrition Program, a program to help prevent LBW and other problems, is based on a cost of \$400 per high-risk pregnancy.

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ACTION ON HEALTH DETERMINANTS: LOW BIRTH WEIGHT (LBW) BABIES (CONTINUED)

- Long-term or chronic disabilities as a result of LBW generate even greater social costs for society. The results of studies show that LBW babies are more likely to experience delayed language expression and development, and are at increased risk for school failure. They will likely require more resources to assist them through the school system. There is also mounting evidence that adults involved with the criminal justice system are more likely to have experienced a variety of health and social problems in early childhood.
- The health effects of LBW have a social impact on the family which must often deal with added emotional stress and financial concerns.

impacts. Both the Department and the MRC are strengthening their efforts in this direction. The MRC is marshalling increased resources for determinants-related funding under its new strategic directions. Within Health Canada, the NHRDP is building on its long-standing successes in this area. There are numerous examples of NHRDP projects in population health strategies and health determinants research that have had a significant impact on health policy at all levels of government. NHRDP project highlights include the Evans-Stoddart model of health determinants; the Canadian Task Force on Periodic Health Examination and Clinical Health Practices guidelines; and a Multi-Centre Study of Childhood Injuries.

The Health Portfolio is working to integrate determinants knowledge into all areas of its business. These include redesigning a broad range of population health strategies to ensure more targeted use of determinants and outcomes evidence. In the risk management sector, Health

Canada's efforts range from long-term work on risk factors to the development of concrete prevention initiatives, such as development of new acellular pertussis vaccines to combat whooping cough and new technologies and methods for assessment of risks in biotechnologically grown or prepared foods. Prevention of risks to children from allergic reactions or improper food handling and preparation (i.e., dangerous food-borne pathogens such as verotoxigenic *Escherichia coli* or "hamburger disease") is another high-profile issue.

Determinants that underlie some of the persistent health inequalities affecting Canada's First Nations communities are the focus of a number of studies. Such studies include tobacco use, the effects of northern and Arctic pollution, and safe drinking water. Many of these involve participatory research with Native communities themselves. One example is the Drinking Water Safety Program, in which 40 First Nations communities are managing community-based S&T programs that involve the testing and analysis

of community and private water supplies. Approximately 25 other communities have expressed interest in this initiative. The potential impact on health and quality of life is significant. So too is the potential reduction in costs to the health care system for treating illness related to drinking water.

Another example of determinants-based research is the Tobacco Demand Reduction Strategy. Tobacco kills 40 000 to 45 000 Canadians each year. S&T to deal with this major health threat includes statistical analyses of trend data, cohort analyses of knowledge, attitudes and beliefs, and the application of this knowledge in developing regulatory and programmatic strategies.

In the broader context of health determinants, Health Canada has played a major role developing the second theme of this principle: sustainable development. Health Canada was instrumental in gaining broad acceptance for the view that economic development has to take human health into account. Health Canada is building on this contribution. Specifically, the Environmental Health Directorate of the Health Protection Branch is addressing research gaps that are critical in managing environmental impacts on health. Examples include developing test protocols necessary for assessing the infectivity, toxicity of and exposure to new biotechnology products; assessing the potential health effects of new substances, including 5000 transitional substances; and in association with the Medical Services Branch, assessing the health risks faced by residents living in the Great Lakes basin.

The third area for increased strategic investment noted previously is work on health outcomes and evaluation. The MRC Strategic Plan, *Investing in Canada's Health*, highlighted the importance of broadening our national research capacity. A number of consultations and review exercises conducted by Health

Canada and more recently the work of the National Forum on Health noted this importance as well. Heightened efforts in this area are critical if Canada is to maintain over the long term a national health care system that conforms with the principles of the *Canada Health Act*. This research would be directed toward assessing “what works” and developing more cost-effective approaches to diagnosis, treatment and administration.

2.3.4 PRINCIPLE: POSITIONING CANADA COMPETITIVELY WITHIN EMERGING INTERNATIONAL REGULATORY STANDARDS AND INTELLECTUAL PROPERTY REGIMES

Innovation thrives in a climate in which policies and regulations promote skills and learning, support competition and are sensitive to rapidly changing market needs. The Health Portfolio stimulates health innovation through a broad range of extramural and intramural research programs. It also does so by ensuring that regulatory activities to protect the health of Canadians are based on sound risk assessment and risk management practices.

In broadening its role in the health sciences area, MRC is opening up new avenues for agency-funded cross-disciplinary innovation. Researchers in health services, population health, determinants of health, health economics, environmental health and health policy can now compete for MRC research funds with investigators from the biomedical sciences. Over the next three years, MRC also intends to maintain its traditional focus on scientific excellence and innovation by investing in research career development for trainees of outstanding promise and established researchers with proven ability to surpass expectations.

Within the Department, policy and priority shifts are stimulating and increasing the use of innovative research in health system economics, administrative efficiencies, outcomes evaluation and in rapidly emerging areas such as biotechnology. These are meant to provide the basis for policy development and health system decisions to meet today's challenges, including difficult ethical issues such as those relating to end-of-life, new reproductive technologies or biogenetics.

One of the greatest challenges, however, is in the regulatory area. Canadians face risks to their health every day. The number of Canadians affected annually by food-borne illness range up to two million; increased health care costs, reduced productivity and lost markets are estimated to amount to over \$2 billion annually. Environmental hazards, drugs, medical devices and other consumer products also present potential risks as well as benefits. In addition to protection responsibilities, the Department, notably the Health Protection Branch and the Medical Services Branch, must be able to rapidly assess threats to the health of Canadians, as with the Ebola virus or the earlier mussels crisis, and mobilize effective emergency response.

To effectively carry out its mandate in this area, the Department will use S&T resources more effectively to enhance and improve its science base, as well as to move toward better and smarter regulation and compliance, better disease monitoring and surveillance, and more effective management of risks. It will focus its S&T on core businesses, strengthen "front-end" analysis and improve its ability to scan both the technological and the socioeconomic environments, through improved data gathering and shared networks. The laboratory rationalization project mentioned previously will help to contain costs and free up resources for emerging and priority areas.

TABLE 7: S&T AND THE HEALTH

PROTECTION INFRASTRUCTURE

- 1000 new medical devices are subject to pre-market review each year.
- Over 2900 field inspections of food and drug facilities were carried out last year, resulting in 14 000 analyses of food, drugs and medical devices in regional laboratories.
- 21 disease outbreak investigations, including tuberculosis, hepatitis B, hanta virus, cholera and "hamburger disease" were conducted by departmental epidemiologists over the past 12 months.
- More than 77 000 analyses of suspected illicit drugs were carried out in support of criminal procedures.

The Health Protection Branch has taken the lead in developing a health protection policy framework that stresses risk assessment and risk management. S&T is a key source of evidence for this approach. Through the systematic collection, analysis and interpretation of selected health-related data, the Department obtains

evidence on population health and risk factors. It then uses this information to select the most appropriate strategy (ranging from regulation to

prevention to consumer education and the development of recommendations, guidelines and standards, as illustrated in Table 8).

TABLE 8: APPLICATION TO GUIDELINES, STANDARDS AND RECOMMENDATIONS

URANIUM IN DRINKING WATER

- Uranium is a natural element known to be both chemically and radiologically toxic. It can occur at elevated concentrations in certain drinking water supplies, especially from deep wells that penetrate uranium-rich rock formations. Questions have arisen as to whether the current guideline provides a sufficient margin of safety for humans.
- A two-part study was done in a community where uranium in well water exceeds the current guideline by a factor of seven. The results of this study will assist Health Canada in determining an acceptable level of uranium in drinking water. It will also enable users of well water with high levels of uranium to take corrective actions before they experience overt symptoms.

SUDDEN INFANT DEATH SYNDROME (SIDS)

- Health Canada has been instrumental in the development and dissemination of standard information about SIDS. Surveillance findings have determined that the most common cause of death in infants between the ages of one month and one year in Canada is a result of SIDS, also known as "crib death." On average, 350 Canadian infants die from SIDS each year. The risk to Aboriginal infants is three to four times higher than to non-Aboriginal infants. These deaths are sudden, unexpected, and remain unexplained even after a full investigation.

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TABLE 8: APPLICATION TO GUIDELINES, STANDARDS AND RECOMMENDATIONS

SUDDEN INFANT DEATH SYNDROME (CONTINUED)

- Health Canada co-sponsored an expert scientific workshop on reducing the risk of SIDS with the Canadian Paediatric Society, the Canadian Foundation for the Study of Infant Deaths and the Canadian Institute of Child Health. Recommendations from the workshop addressed modifiable risk factors such as sleeping position, smoke in the environment (maternal smoking during pregnancy or smoking in the household after birth), and overheating.
- In September 1993, a Joint Statement on Reducing the Risk of SIDS in Canada was released by this scientific expert committee followed by wide distribution of educational material. A national survey of public awareness, and knowledge of SIDS and risk factors has just been completed to assess the impact of this intervention. Liaison among the partner organizations is continuing through a SIDS scientific working group.

HARMONIZATION OF STANDARDS FOR DRUG APPROVALS

- Harmonization of drug standards means strengthened linkages with our trading partners in Europe, Japan and the Americas. This is needed to ensure a level regulatory playing field for the pharmaceutical industry and timely access to safe and effective drug products. This is good business and good health care. Canada is a major player in harmonization of technical requirements for drug reviews through participation on the International Committee on Harmonization, development of Mutual Recognition Agreements on specific standards and processes, and collaboration with WHO and others in the development and evaluation of science-based methods, standards and process for emerging new technologies.

TABLE 8: APPLICATION TO GUIDELINES, STANDARDS AND RECOMMENDATIONS (CONTINUED)

SAFE AND ETHICAL MEDICAL RESEARCH

- The MRC has led the way in developing guidelines for safe and ethical medical research. It produced national guidelines for research using biologically hazardous materials. Other MRC work covered research involving human subjects. The Council is now working with NSERC and SSHRC on guidelines for ensuring integrity in science.

This approach allows the Department to protect the health of Canadians, ensuring that they continue to enjoy safe food, drugs, medical devices and other consumer products, while minimizing negative impacts of regulation on the international competitiveness of the Canadian industry. It addresses the need for a responsive, flexible and open approach to risk management, to be implemented cost-effectively in cooperation with other stakeholders, including other levels of government, industry, interest groups and the Canadian public. It also promises to continue to make Canada one of the best places in the world to live and do business in.

Risk assessment and risk management also provide a basis for reducing the regulatory burden on Canadian business and individuals. Proposed changes to the regulatory system should allow industry to be more responsive to market demands. Consultation documents will continue to be published over the next one to two years to provide details of regulatory change proposals.

To give only one example, the Drugs Directorate in the Health Protection Branch, as the federal drug regulator, has just implemented

the first major overhaul of its operations and organization in 30 years. Its goal is to respond to current and predicted consumer needs for access to safe and effective drugs, and industry needs for a regulatory climate that provides timely access to markets and encourages investment. The overhaul is producing results. The time-to-approval for drug submissions has dropped over the past several months; performance targets are being met and are now being adjusted to international levels; unnecessary duplication is being eliminated through harmonization with other governments. Similar efforts are under way in other key areas, such as work on risk-based classification of medical devices.

2.3.5 PRINCIPLE: BUILDING INFORMATION NETWORKS — THE INFRASTRUCTURE OF THE KNOWLEDGE ECONOMY

The focus of the Health Portfolio is less on building information networks themselves than on providing practical guidance and applications for their use to improve dissemination and utilization of health knowledge and increase benefits to Canadians. At the moment, as the information

highway continues to expand, there are islands of health applications across the country that are proving extremely successful. Already, in several Canadian provinces, health data are moving from the most isolated communities to hospital specialists on digital lines, saving transportation problems for patients and curtailing costs for the health care system. The potential is enormous, but a much more concerted effort is required to maximize the health, social and economic benefits to Canadians.

The specialization of the material and the difficulties involved in “translating” it in a

user-friendly way for a broad group of disparate users makes this area challenging. Hard-to-reach groups that might benefit most from this information also are not often connected into the information highway. As it moves forward to tap into the potential of the highway, the Portfolio is also promoting improvements in more traditional forms of communication to ensure that technology, or the lack thereof, does not produce knowledge gaps between socio-economic groups.

The intention of the Health Portfolio in the coming months is to develop an Information

TABLE 9: DISSEMINATING HEALTH S&T INFORMATION

- **Development of WHMIS, which has produced significant financial savings to the Canadian health care system, workers’ compensation payments and lost productivity.**
- **Prevention of Adverse Drug Reactions: the Health Protection Branch collects, assesses and disseminates information on drug product risks through a national network of adverse drug reaction (ADR) reporting centres. Information submitted by health professionals is assessed by the Drugs Program at the National Centre and when necessary, disseminated back to health professionals and consumers through electronic and print media. This provides Canadians with an early-warning system for serious or unexpected adverse events. For example, the ADR program identified previously unreported cardiovascular and respiratory reactions associated with a widely used headache medication; this finding resulted in a notice to Canadian practitioners in the *Canadian Adverse Drug Reaction Newsletter*, a change in labelling instructions to consumers, and an alert to WHO.**

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TABLE 9: DISSEMINATING HEALTH S&T INFORMATION (CONTINUED)

- Providing more information to consumers and workers about hazards posed by medical devices they use or are exposed to, and how to protect themselves from these hazards.
- Shared decision making and decision rules: using interactive videodiscs for patient empowerment is an NHRDP-funded project to evaluate and improve the process of shared decision making between patient and hospital, and to enhance patients' ability to make informed decisions about care.
- Organizing workshops on HIV, alcohol and other drug use, HIV-TB risk reduction strategies and development of a HIV/AIDS curriculum for Grades 7 to 12 which was incorporated into First Nations schools.
- Providing information to consumers on food safety. Areas of particular focus are prevention of allergic reactions and avoidance of "hamburger disease" through safe food handling practices. In this context, Native foods present special health issues, and their cultural importance warrants special health protection efforts. These foods are susceptible to environmental contaminants that can pose significant health risks (e.g., food in northern and Arctic environments).
- The Heart Health Initiative has been an excellent example of research being translated into preventive knowledge, linking Health Canada with provincial departments and over 300 community organizations. The Initiative has given international leadership to Canada as attested by the Victoria Declaration on Heart Health which has been endorsed by WHO and published in 12 languages.

Technology Strategy to bring together isolated efforts more cohesively and cost-effectively with those of other federal, provincial, territorial, private sector or jointly funded organizations (e.g., CANARIE). Of particular importance is the need to use technology to ensure cost-effective accessibility to health services in the most remote areas of the country. Work is also under way internationally on a G-7 health application initiative, "Global Healthcare Applications", which is developing health applications in such areas as heart health, cancer, telemedicine and the use of data cards. A clear need also exists for a national network that will link various databases required for health science research and the management of the research enterprise. Health Canada and MRC are currently exploring the feasibility of a national health research information network to facilitate linkage between industry, university and government R&D activities. The NHRDP is also working with Statistics Canada on a jointly sponsored

initiative to analyse data from the National Population Health Survey. Health Canada has a need for analysis and access to large data banks and has availed itself of this opportunity to cooperate in funding analyses that contribute to our knowledge of population health and assist in policy and program planning.

A concerted effort is also being made to link up electronically with research institutions in other parts of the world, particularly with countries with which we already have strong health information exchange agreements. In the past, many different technologies and social innovations have been adapted from Great Britain, France, the United States and other countries to meet Canadian needs. For example, we have adapted childhood development programs from France and Italy and environmental regulations from the United States.

Examples of current and future use of technology are shown in Table 10.

TABLE 10: BUILDING AND USING INFORMATION NETWORK CAPACITY IN THE HEALTH SECTOR

- **The Portfolio is actively using the Internet. Through tools such as Health Promotion On-line, Health Canada shares information through electronic networks to help develop strategies for healthier Canadian communities. There is also a broad range of departmental Bulletin Boards. For example, LCDC is expanding surveillance and outcomes research content on Health Protection Branch electronic Bulletin Board Service (BBS) and developing home pages of timely surveillance, risk assessment and research information on priority health issues.**

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*TABLE 10: BUILDING AND USING INFORMATION NETWORK CAPACITY IN
THE HEALTH SECTOR (CONTINUED)*

- Electronic communications are also being used to disseminate research results from the NHRDP, technical drug review submissions and other applications within the Department. The Portfolio is also using new software such as GIS and employing advanced communications technologies (LCDC Satellite Seminar Series), video conferencing, Fax-link and Internet conferencing for training, education and communications purposes.
- Health Canada's LCDC is working in collaboration with the G-7 nations to improve worldwide cooperation in public health by bridging developments in public health telematics networks in the G-7 countries and international health-related organizations. Two areas have been selected for initial collaboration: public health "early warnings" and vital statistics. The first two emerging networks are the Pan American Public Health Information Network (PAPHIN) led by CDC and the European Union Public Health Information Network (EUPIN) led by the European Commission.
- Within Canada, LCDC is working to develop an infrastructure linking provincial medical officers of health, creating a network of health regions within the Provinces and supporting the development of a three-way, Western hemisphere, electronic health network, linking LCDC with the CDC in Atlanta in the United States and the Pan American Health Organization (PAHO).
- The Medical Services Branch is working in partnership with First Nations to determine how information should be shared. As a first step, a system has been set up whereby First Nations communities in Quebec can dial into our Local Area Network and access information regarding their water quality.

2.3.6 PRINCIPLE: EXTENDING SCIENCE AND TECHNOLOGY LINKAGES INTERNATIONALLY

The role of national and international catalyst, broker and leader is not a new one for the federal government or the Department in the health research and applications field. Canada's Health Portfolio has always played a pivotal role in bringing together international partners on a broad range of health S&T initiatives. The Health Portfolio is strengthening its efforts in this direction in order to maintain its international status as a world-class contributor to health S&T and, above all, to deliver cost-efficient health results for Canadians from S&T developments, wherever these occur.

Health Canada has traditionally maintained strong science-based international linkages. For example, Health Canada:

- influences and works closely with the health science programs of the major international health organizations — WHO and PAHO;
- supports and works closely with the International Agency for Research on Cancer;
- participates in the Council of Europe Committees on Organ Transplantation and Blood Safety;
- has taken a leading role in creating the International Forum on Chemical Safety;
- works on tri-lateral agreements between Canada, the United States and Mexico;
- is a Canadian participant on international standards committees (ISO; Codex Alimentarius);
- conducts international health threat surveillance and coordination (e.g., recently Ebola); and

- works with other G-7 countries on health technology applications.

Health Intelligence Networks are a primary area for attention. Whether we are dealing with Ebola or hitherto almost unheard of diseases in Canada, such as tropical Lassa fever, malaria or dengue fever, linkages to international organizations such as WHO or contiguous organizations such as the North American CDC in Atlanta are coming increasingly to the forefront.

The span of time in the transmission of health threats and diseases from country to country is becoming increasingly short. The emergence of drug-resistant strains requiring high-containment laboratory research (e.g., Levels 3 and 4 as in the new Winnipeg laboratory) is also calling for increased international collaboration. In this respect, Canada has some major gaps in both coverage and facilities which it is striving to address collaboratively with other Canadian and international partners. Some of the future initiatives, most notably those relating to a strengthened Health Intelligence Network in Canada, seek to address this challenge.

Health science is international. The thousands of researchers supported by MRC and funding partners in their quest for new knowledge are linked by common interest to colleagues around the world by telephone, e-Mail and Internet. This vast international network may be viewed as an active market where the currency is ideas, moving in and out of our national innovation system with the frequency that rivals the exchange that takes place in international money markets.

The MRC is actively pursuing greater collaboration with similar funding agencies around the world. It is already a key participant in the international Human Frontiers of Science

Program and the Human Genome Project. In October 1996, MRC will host an international meeting of health research agencies. The potential impact of increased international collaboration is high. In 1994, Canadian Health Science received \$71 million in research funding from foreign sources, primarily from the U.S. National Institutes of Health and a range of private foundations.

2.3.7 PRINCIPLE: PROMOTING A STRONGER SCIENCE CULTURE

The new strategic directions of the Health Portfolio are designed to make an increasingly significant and innovative contribution to the development of a stronger science culture in Canada. This health contribution goes beyond increasing general awareness of the relevance and importance of S&T to the direct, practical involvement of Canadians in the application of S&T knowledge to their day-to-day decisions. Management of health risks and action on determinants of health can succeed only with the user-friendly transmission and application of S&T knowledge to decisions by all Canadians on specific lifestyle factors (e.g., stress management, smoking or non-smoking) and health treatment options (which symptoms warrant medical consultation or high-tech diagnostics and which do not).

The nature of the Health Portfolio's contribution varies from support for specialized instruction in Canada's universities to community-level participation in S&T projects, as illustrated in Table 11. Interest in health S&T is being stimulated by extramural research grants, primarily through MRC and Health Canada's smaller NHRDP, which involve students and future health professionals at all levels in health S&T. Extramural funding to universities for post-doctoral fellows, and opportunities provided to the next generation of health researchers to work in federal laboratories is another critical area in developing science culture.

TABLE 11: CONTRIBUTING TO BUILDING A SCIENCE CULTURE

- An MRC-sponsored plan to deploy unemployment insurance funds to create jobs in research, successfully pilot tested in Winnipeg, provides young women and men with an opportunity to gain work experience, skills and knowledge through employment in the research programs of established health scientists.
- The EAGLE Project involves a participatory research partnership between the Assembly of First Nations, Health Canada's Medical Services Branch and more than 100 000 people in the 63 First Nations communities in the Great Lakes Basin. The goal of the project is to assess the extent of the exposure of Native people living in the Basin to environmental contaminants and any risks to health and well-being that may be involved. The majority of representatives on the Steering Committee and all of the project staff are First Nations people who are gaining experience in managing and carrying out research programs with First Nations communities.
- Participatory research supported through NHRDP, such as the North of 60^o Initiative, and its Aboriginal Diabetes Special Initiative, help to develop an understanding of science and how it can be applied within a community context to help community members make decisions that are right for them.
- The NHRDP, MSB and MRC in their support of activities, such as the International Workshop on Ethical Issues in Health Research Among Circumpolar Indigenous People, foster the development of a science culture that draws from, and is respectful of, the diversity of the Canadian population.

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TABLE 11: CONTRIBUTING TO BUILDING A SCIENCE CULTURE (CONTINUED)

- In conjunction with the Canadian Youth Science Foundation, the MRC offers prizes for posters prepared by young people on medical themes. By allowing young contestants to match their creative and imaginative activities and skills with their investigation of medical issues, the MRC is helping to dispel the image of science as an intellectual exercise detached from real life experience.
- Under the Drinking Water Safety Program, the Medical Services Branch is undertaking a variety of projects to develop S&T knowledge and solutions in partnership with First Nations communities regarding water quality issues. Through this program, 40 First Nations communities are managing community-based S&T programs that involve the testing and analysis of community and private water supplies. Approximately 25 other communities have expressed an interest in this initiative. They will have their people trained by the Split Lake people and will be able to implement their own community-based water safety laboratories. Through this initiative, First Nations communities will be active participants in the performance of S&T analysis and in the concrete application of the knowledge derived through this analysis to their day-to-day lives in their communities, which are experiencing serious, and internationally recognized, health inequalities. The potential impact in terms of health and quality of life of these communities is significant, as is the potential reduction in costs to the health care system of treating of drinking water-related illness.

3. Conclusion

The Health Portfolio played a leadership role in the review of federal S&T, particularly in examining federal activities related to quality of life and the advancement of knowledge in all areas of endeavours. We strongly endorse a united effort to improve the effectiveness of federal S&T. Our vision of health S&T is in harmony with the view of federal S&T as an essential component of the Canadian system of innovation. We see federal health S&T as part of a complex system of institutions, individuals, ideas and investments linked by a common goal of increased health, wealth and wisdom. We are strongly convinced of the benefits of close partnerships, better coordination and sharing of agenda among all sectors: higher education, federal, provincial and territorial governments, industry and non-profit.

The Action Plan of the Portfolio aims to increase the effectiveness of the federal investment through even greater targeting of the federal S&T effort to those areas in which it will have the highest impact. To a large extent, this will mean focusing on gaps in knowledge within the innovation system. These gaps must be filled if we are to ensure that Canadians are protected from causes of ill health, whether they are unhealthy lifestyles, dangerous substances or pathogenic organisms. We need to maintain our health care system so that when illness does occur, we can respond not only with the effectiveness that has gained Canada a worldwide reputation for quality care, but with an efficiency that reflects a constant recognition of the importance of controlling costs.

Partnerships, coordination and targeting are essential elements of increased effectiveness of health S&T. So too are critical review processes, to ensure that S&T investments are well placed, and fast, worldwide communication links to ensure that information moves quickly to those who can use it to improve health innovation.

Equally important, we as a nation must be culturally receptive to S&T to ensure that it is used effectively for achieving a healthier, more satisfying life for all. Action plans move federal health S&T toward an even better review system than is now in place. We are well along the road to fully exploiting the health potential of the information highway. Mechanisms are being enhanced to increase awareness by Canadians of the knowledge that can lead to healthier and happier lives.

The Portfolio's carefully placed investments yield health, social and economic benefits, often all three from one S&T activity. The Portfolio Action Plan aims to ensure that benefits are maximized and that they continue to be used to improve the health, wealth and wisdom of all Canadians.