

A framework to measure the impact of investments in health research

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Abstract

This paper describes the approach taken by the Canadian Institutes of Health Research (CIHR) to develop a framework and indicators to measure the impact of health research. The development process included national and international consultations. Key methodology challenges and measurement requirements were identified. The framework that has resulted from this process includes definitions of key concepts, methodology guidelines, identification of the different stakeholders for impact information and the individual concerns of each stakeholder group. Indicators are classified within five categories that encompass a broad range of impacts. Sources of information and issues in attributing research impacts are discussed. An analysis of issues suggests that impact measurement and performance measurement are complementary activities, with the former focused on broad impacts of the health research sector and the latter on the degree of success achieved by funding agencies in contributing to the process of knowledge development and uptake.

Introduction

Accountability and value received for the use of public funds have become high priorities for governments around the world. Quantifying the value of publicly funded health research is a challenge for many countries. This paper describes the approach taken by the Canadian Institutes of Health Research (CIHR), Canada's national health research funding agency, to develop a framework to measure the impact of its investments in health research and to begin to identify robust indicators that can be used to establish benchmarks and track progress through time.

CIHR was created in 2000 with a broad mandate:

'to excel, according to international standards of scientific excellence, in the creation of new knowledge and its translation into improved health, more effective health services and products, and a strengthened Canadian health care system.'

The Government of Canada has increased investments in health research from \$289 million in 1999-2000 (the last year of CIHR's predecessor, the Medical Research Council) to \$700 million in 2005-2006. A description of the CIHR operating model is shown in the text box on page 2. CIHR has taken a proactive approach to foster research that is relevant to important health issues and to anticipate the future demand for health research. In addition, it has committed to actively encouraging collaboration in multidisciplinary research. CIHR consists of a central office that sets strategic directions, engages in national initiatives and administers peer review for grant funding; and 13 Institutes, each with a unique research focus. Each Institute is headed by a scientific director and hosted by an academic or research institution. Each Institute provides a nexus for researchers in specific fields to collaborate and identify research priorities. CIHR funds both investigator-initiated (open) and strategic research. The Institutes play

a pivotal role in identifying strategic research priorities and launching funding opportunities in priority areas.

Background and Development of the Framework

While CIHR now regularly evaluates its individual programs and has documented the benefits of individual CIHR-funded research projects, there has not yet been any comprehensive or overall assessment of their outcomes in terms of scientific, social and economic impacts. In early 2005, CIHR convened a group of international and Canadian experts to review the present state of knowledge about measuring the impact of health research and to provide advice on the creation of a conceptual framework. The framework that resulted from this process was vetted at a consensus conference of high-level stakeholders in May, 2005. The framework identifies the key expected impacts of health research as well as a set of preliminary indicators and processes for evaluating impact. It includes dimensions that address the concerns of identified stakeholder groups and identifies potential sources of information.

The framework and draft indicators were published on the CIHR website in January 2006.¹ Since that time CIHR has been experimenting with populating some of the indicators. This has led to some refinements and updates, which are included in this paper.

This paper provides a brief description of the conceptual framework and then discusses specific indicators. The discussion centres on the potential use of each indicator, availability of data and approaches that can be used to develop data that are not presently available. Illustrative examples for specific indicators are included, where possible. The next section includes a brief review of methodology challenges in measuring impact. The third section describes the CIHR framework and the last section discusses indicators chosen for the initial years of an ongoing development process.

CIHR Operating Model

<u>CIHR Institutes</u>	
Aboriginal Peoples' Health	Human Development, Child and Youth Health
Aging	Infection and Immunity
Cancer Research	Musculoskeletal Health and Arthritis
Circulatory and Respiratory Health	Neurosciences, Mental Health and Addiction
Gender and Health	Nutrition, Metabolism and Diabetes
Genetics	Population and Public Health
Health Services and Policy Research	
<u>Research Themes (Pillars)</u>	
Biomedical research	Health services and policy research
Clinical research	Population and public health research

Core Outcomes

Research & the creation of new knowledge
Translating research knowledge into applications
Training & career development

Mandate – overall goals

Improved health for Canadians
More effective health services and products
Strengthened Canadian health care system

Objectives of health research funding and measurement challenges

Experts from funding agencies in the UK (Wellcome Trust) and Australia (National Health and Medical Research Council) participated in the expert review, which identified similarities in the major objectives of funding agencies. Although the language used to describe objectives varies, the three most important objectives for the UK, Australian and Canadian funding agencies are shared: knowledge creation, knowledge translation and human resource development. The first two of these objectives also align with objectives of the US National Institutes of Health.

There was also agreement about the main challenges in identifying the impacts of health research.

- Linkages between health research outputs and outcomes are difficult to trace where knowledge develops incrementally over time.
- Health research outcomes are often intangible, e.g. improved health, longevity and the capacity to achieve human potential.
- Attribution of credit for research accomplishments can be difficult as impacts often result from a number of research projects carried out either collaboratively or independently in different countries.
- Priorities differ across stakeholder groups – for example, commercial returns are important to industry and government but may play a subordinate role in the value systems of researchers and the public.

A number of methodology requirements for an appropriate framework and indicators were identified:

- New methodologies for measuring impact should build on existing performance measurement work in order to produce a continuum between the two types of activity.
- A variety of approaches and measures are required to address CIHR's mandate and research themes.
- Methodologies should consider short term and long term impacts of research.
- Where appropriate, methodologies should distinguish between social and commercial rates of return.

- Indicators should be updated regularly.
- Involvement of other research funding agencies, both domestic and international, is desirable in order to maximize insight, achieve efficiencies available by pooling efforts, and allow for comparative analysis.

Framework Structure

The impact framework builds on a base of ongoing performance measurement activities that measure success in achieving corporate objectives. New indicators will seek to understand how research contributes to health, social and economic progress. Dimensions of the framework include definitions of key concepts, methodology guidelines (above), identification of the stakeholders for impact information and the concerns of each stakeholder group.

Stakeholders

The stakeholders for health research impact information are summarized in Table 1. Some concerns are unique to particular stakeholders while others are shared across many or all sectors. For example, academic excellence is a concern found mainly in the higher education sector while improved health status is a concern shared by all stakeholders.

The framework first identifies generic types of impact information to address stakeholder concerns and then seeks to identify indicators to measure benchmarks and progress. For example, health status impacts will be oriented to a system of health status indicators that has been developed during the last decade and will be tracked annually.^{2,3}

Table 1
Cross Classification of Stakeholders for Impact Information and Concerns

Stakeholders	Concerns
Higher education sector	<ul style="list-style-type: none"> • Academic Excellence • Knowledge production • Capacity building
Health professionals & administrators	<ul style="list-style-type: none"> • New treatments and diagnostic potential • Productivity of resources used in health systems
Society	<ul style="list-style-type: none"> • Improved health status • New treatments for disease • Response to public health threats • Efficiency and sustainability
Business sector	<ul style="list-style-type: none"> • Commercial potential
Government	<ul style="list-style-type: none"> • Public health and responses to health threats • Health status • Contribution to macroeconomic growth and productivity • Efficiency and sustainability of both public and private health systems

Types of impact

There are five categories within which to measure impact in the framework. These categories were adapted from the *Payback Framework* developed by Dr. Martin Buxton and colleagues at the Health Economics Research Group, Brunel University, UK. Dr. Buxton was an active participant in development of the CIHR framework. The impact categories, as adapted for the CIHR framework, consist of:

- *Knowledge Production*, usually measured through contributions to the scientific literature.
- *Research targeting and capacity*, in which targeting is defined as the ability of research projects to inform subsequent research agendas and methods and target future research. Contributions to capacity can be defined as development of research skills, including the capability to use existing research.
- *Informing Policy* includes impacts of research in the areas of clinical, administrative and government policy.
- *Health and health sector benefits* measure impact in terms of advances in prevention of ill health, improvements in public health and treatment.
- *Economic benefits* are defined within four categories developed in a recent literature review by Dr. Buxton and colleagues.⁴ The economic categories define benefits to the economy from commercialization of discoveries, direct cost savings to the health care system, human capital gains and the value of life and health.

Social benefits are not included as a separate category. The framework categories of health and health sector benefits and economic benefits have been identified as important measures of social benefit.^{5,6}

Indicators

Indicators within each framework category are shown in Table 2. Their merits, data availability and approaches to developing data sources are subsequently discussed.

Table 2
Preliminary Indicators of Health Research Impact and Potential Sources of Information

Knowledge Production	
<ol style="list-style-type: none"> 1. Number and impact of publications resulting from CIHR-supported research. 2. Citation Impact Analysis. 	<p>Bibliometric Studies End-of-Grant reports</p>
Research Targeting and Capacity	
<ol style="list-style-type: none"> 1. Extent to which Institutes have influenced the research, policy and/or practice agendas in their communities. 2. Percentage of Research Chairholders attracted or retained in Canada. 3. Number and types of PhD graduates in Canada by year 4. % of PhD graduates in Canada planning postdoctoral fellowship or research associateship in health 	<p>Evaluations every 3 – 5 years. End-of-Grant reports</p> <p>Canada Research Chairs database.</p> <p>Statistics Canada</p>
Informing Policy	
<ol style="list-style-type: none"> 1. Public policies influenced by CIHR and CIHR-funded research 2. Clinical practice guidelines by disease area influenced by CIHR-funded research. 	<p>Case studies.</p> <p>End-of-Grant reports</p> <p>Evaluations every 3 – 5 years.</p>
Health and Health Sector Benefits	
<p>Public health: Strategic research initiatives and their outcomes.</p> <p>Health impacts: Impact of health research on Potential Years of Life Lost (PYLL) for target disease categories (e.g. cancer, circulatory disease).</p>	<p>Case studies</p> <p>End-of-Grant reports</p> <p>Statistics Canada data. Special studies to establish links to health research.</p>
Economic Impacts	
<p>Commercialization:</p> <ol style="list-style-type: none"> 1. Number and nature of patents, spin-off companies and licenses for intellectual property (IP) generated from CIHR-funded research. 2. Income from IP commercialization. 3. Case studies and follow-up surveys of commercial use of research funded by CIHR's commercialization programs. 	<p>End-of-Grant reports</p> <p>Statistics Canada</p> <p>Statistics Canada</p> <p>Special studies</p>
<p>Cost savings: Estimates of the value of high impact innovations developed through health research in Canada.</p>	<p>Technology assessment. Special studies</p>
<p>Human capital: Reduction in productivity lost through illness or injury due to innovations from research.</p>	<p>Collaborative studies with Health Canada and Statistics Canada</p>

Several of the indicators identified in Table 2 will need to be developed further through special studies as the information required is not routinely collected. These studies will vary in complexity and the degree of collaboration required from other agencies. Case studies of strategic research initiatives, for example, can be carried out by CIHR Institutes at suitable intervals following the completion of a strategic research project. Other indicators will be addressed in end-of-grant surveys and external reviews. Still other indicators will need a research oriented approach. The immediate importance of the approach illustrated in Table 2 is to clarify the types of information that are desirable, identify how they fit within a conceptual framework and identify potential sources of information.

Attribution Issues

Credit for the direct benefits of research can rightly be claimed by individual researchers or research teams that develop new knowledge. Research funding plays an enabling role in knowledge creation and its subsequent impacts. The question of how much credit for beneficial impacts can be claimed by funding agencies involves special challenges. Funding agencies can assume either an active or passive role in terms of shaping the national research agenda. CIHR plays a very active role, using its resources and insights to encourage research that has a high priority from scientific or national policy perspectives. CIHR allocates approximately 30% of its research funding for strategic competitions

CIHR is not the only source of health research funding in Canada, a fact that introduces additional complexity to efforts to identify impacts from funded research activities (see text box page 8).

Finally, many of the impacts of health research (for example changes in health status) are long-term and are the results of a combination of factors, including application of new research knowledge and, for example, environmental factors.

In view of these issues, it seems impractical to identify the impacts of any single agency, except when dealing with specific examples. Instead, agencies have tended to establish performance measures that track success in achieving intermediate outputs rather than final impacts. Key CIHR performance measurement indicators are summarized in Table 3.

Health Research Funding in Canada

Canada has three federal granting councils to fund and promote research. CIHR is responsible for health research, although some health research funding is also provided by the other two granting councils and national agencies dedicated to health or innovation¹. Funding for research infrastructure and a share of indirect costs are provided by two separate agencies.

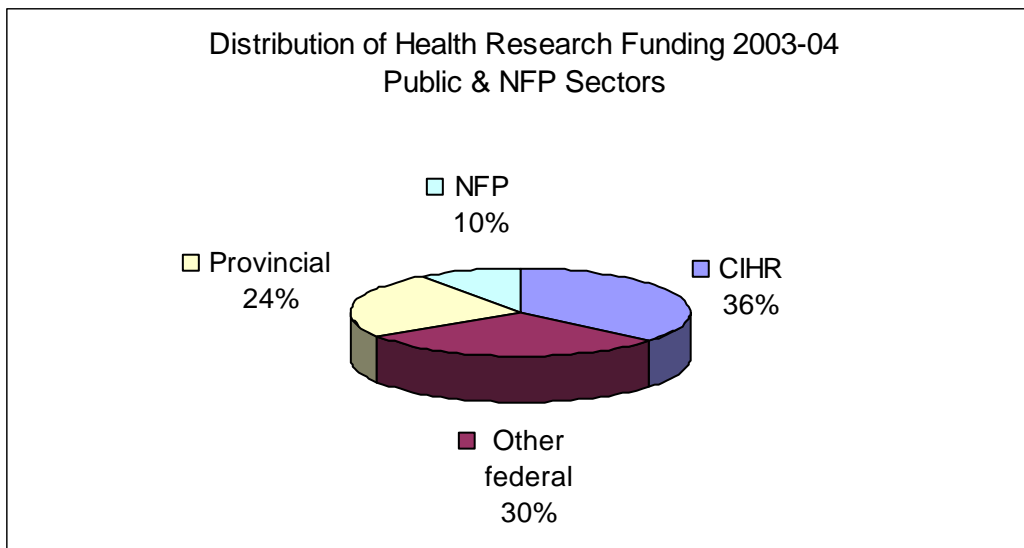
Most Canadian provinces also have health research funding agencies. The not-for-profit (NFP) sector includes many philanthropic and disease-specific agencies. Funding agencies from all three sectors often collaborate to sponsor research within their mandates.

Research grants from the three sectors do not include investigator salaries or indirect costs and most of these costs are borne by research institutions.

The distribution of federal, provincial and NFP health research funding by sector is shown in the accompanying graph.² Estimates of gross expenditures for research and development (GERD), as defined by Statistics Canada, include these three sectors as well as expenditures or in-kind contributions from higher education and expenditures by business enterprise and foreign sources.

¹ Other national agencies that provide some health research funding are Genome Canada Ltd., Health Canada, the National Research Council and the Canadian Health Services Research Foundation.

² Source: *Balance of Funding in Canadian Health Research and Future Funding Requirements*. CIHR, forthcoming



Source: CIHR

Table 3
CIHR Performance Indicators

Indicator topic	Variables
Distribution of budget expenditures	Expenditure by type of funding program by research area, and operating expenses
Institute evaluations	Relevance, effectiveness and delivery of Institute mandates and priorities.
Research grants	Number, value and success rates of grants by research area.
Investigators supported	Number of investigators by type of grant or award.
Collaboration	Percent of grants that feature interdisciplinary research and size of investigator team.
Capacity building	Number, value and success rates for training and salary awards by research area.
Commercialization	Awards and amount of funding by commercialization program. For the POP program annual reports provide #patents, #IP licensed and companies formed.
Partnerships	Number of partners and value of partner contributions by sector.
Knowledge Translation	Percent of grants that include or undertake knowledge translation in their research activities

Notes: Indicators are obtained from CIHR administrative databases, evaluations, surveys of stakeholders and surveys of funding recipients.

Source: CIHR Report to International Review Panel, February 2006.

Impact Indicators

The impact indicators in the CIHR framework (Table 2) include both performance measurement indicators and indicators that measure results achieved by the Canadian health research community. Each type of indicator is discussed below, along with potential sources of information for future activities.

Knowledge Production

Number and impact of publications resulting from CIHR-supported research. CIHR is designing an end-of-grant report to measure knowledge production specifically from grant funds. CIHR currently has data on publications produced by CIHR-funded researchers – recognizing that a portion of these would not have been directly attributable to CIHR funding. General publication trends for health research in Canada overall is being used until more CIHR-specific data is available. A recent study in the UK found that Canada ranks sixth among the nations of the world in its share of total publications and citations in 8,000 journals between 1993 and 2003.^{7,8} Indicators are shown below.

Indicator Definition	Results
Canadian publications / Total publications	Canada produces about 5% of the world's health research literature at an annual rate of 14,000-15,000 publications. In 2004 this was roughly 6.7% of total health publications in the G8 nations. ⁹
Citation intensity (Citations/GDP) compared to wealth intensity (GDP/population)	Canada is among the top 8 countries in citation intensity, all of which are above the curve that defines citation intensity as a function of wealth intensity. Canada and the UK are the only two G8 countries above the curve. ¹⁰

The two indicators above vary in terms of sophistication. We would expect the second to be a more powerful measure of scientific output since it takes into account a country's level of economic development. But sophistication can come at the cost of reduced comprehension to a broad audience. More sophisticated bibliographic indicators can be used for an academic audience, for example, the *ISI Journal Citation Reports impact indicators*¹¹ for specific journals to weight publications.

Research Targeting and Capacity

Extent to which Institutes have influenced the research, policy and/or practice agendas in their communities. Case studies will be the most usual form of analysis for this indicator. Follow-up surveys or focus groups can be designed to determine how well specific research has informed policy. These activities will be complementary to ongoing efforts to determine how effective knowledge translation has been in affecting practice or policy.

Researchers attracted or retained in Canada. Sources of information include Statistics Canada surveys and periodic evaluations of the Canada Research Chairs program (CIHR is responsible for 700 chairholders under the program).

Indicator Definition	Results
Extent to which Institutes have influenced the research, policy and/or practice agendas in their communities	<p>A recent survey of funded researchers found:</p> <ul style="list-style-type: none"> • broad agreement that the Institute with which they are affiliated has contributed to developing capacity in terms of people (84%), the research environment (82%) and research excellence (91%), • 93% of funded researchers believe CIHR has succeeded in setting a national research agenda and that this agenda is the appropriate one.
<p>Number and types of PhD graduates in Canada by year.</p> <p>% of PhD graduates in Canada planning postdoctoral fellowship or research associateship in health</p>	<p>Canada ranks fifth for proportion of the population with PhDs¹.</p> <p>A Statistics Canada survey (July 31, 2003 to June 30, 2004) found that 64% of graduates in the life sciences planned to pursue a postdoctoral fellowship²</p>
<p>¹ 2004, King, Scientific Impact of Nations (average for 1998-2000).</p> <p>² Data taken from Gluszynski, Tomasz and Valerie Peters, <u>Survey of Earned Doctorates: A Profile of Doctoral Degree Recipients</u>, Statistics Canada and Human Resources Development Canada, p.14.</p>	

Informing Policy

The two indicators listed in the policy section of the Framework (policies and clinical practice guidelines affected by CIHR and CIHR-funded research) will need to be put in context. In other words, *what policies* were affected and *how important were they* in public policy formation? Similar questions can be asked regarding clinical practice guidelines. The box below describes two recent examples of CIHR activities that have informed important medical policy issues in Canada.

Indicator Definition	Results
Evidence based standards for medical waiting times	CIHR commissioned a series of research syntheses in 2005 to establish evidence-based benchmarks for medically acceptable wait times in five priority areas that were agreed to in the 2004 federal, provincial, territorial Health Accord.
Scientific and public policy guidelines	<ul style="list-style-type: none"> • Guidelines for Human Embryonic Stem Cell Research • Privacy and Confidentiality in Health Research

The types of information in the examples above are *qualitative indicators of success* in meeting policy requirements. Success in changing policy or practices can be viewed as a form of intermediate outcome. Final outcome can be defined at successively higher levels depending on the policy issue that is being addressed. For example, adoption of minimum wait times achieves an important public policy objective. Beyond that there are concerns about the degree of compliance by regional institutions with minimum wait times and ultimately the extent to which wait-time standards affect overall health status.

Health and Health Sector Benefits

Health and health sector benefits fall into two broad groups in the framework: public health and health impacts. The impacts of research in public health can often be related to strategic initiatives. For example, at the height of the SARS epidemic in 2003, CIHR launched a three-part strategic research initiative, which involved (1) funding research on the causes and consequences of SARS; (2) funding research on Canada's health system preparedness and response to the SARS outbreak; and (3) the creation of the Canadian SARS Research Consortium to coordinate, promote and support Canadian research on SARS and newly emerging infectious diseases. Success in containing SARS was achieved through this balanced and coordinated approach and through adherence to sound public health principles.

The second dimension of health and health sector benefits includes impacts on both life expectancy and quality of life through medical advances. Attribution of credit for these impacts can be even more difficult than for public health advances. Successful treatment results from a chain of circumstances, beginning with: 1) new knowledge about how to prevent or treat illness and proceeding through 2) the development of optimal treatment guidelines, 3) training of professionals in the use of new innovations and 4) widespread adoption of best practice protocols for prevention and treatment. The latter three steps of this process involve knowledge translation, a major priority in health research.

The four step process illustrates two key points in understanding the impacts of health research on population health:

1. New knowledge will not, by itself, have widespread impacts on health.
2. Research is pervasive – it plays a key role in each step of the process that links discovery to gains in health status.

In these circumstances many actors will be able to claim some credit for success. An attempt to apportion credit to any agent, or even any one step in the process, seems inappropriate since no single link in the chain would, by itself, be sufficient to bring about the end result. It is typically a complex process involving multiple funders, multiple institutions, and long time lines.

This reality calls for an approach to impact measurement that focuses on health status gains and their causes rather than specific contributions. There is a growing realization that those responsible for research and knowledge translation should 'celebrate' success rather than attempt to divide up credit for it.⁸

The logical approach to impact measurement in these circumstances is to seek ways to measure health gain and to describe the processes that led to that gain. In this context, individual organizations, such as CIHR, can point to the fact that they have effectively contributed to health status improvements both by funding and encouraging appropriate

research that created the right environment to either advance and/or implement a necessary research discovery. In effect, organizational claims to impact include demonstrating both the ultimate impacts of new knowledge and the organization's effectiveness in contributing to that process. This approach brings together impact measurement and performance measurement.

The health impact measure suggested in Table 2 is *Impact of health research on Potential Years of Life Lost (PYLL) for target disease categories*. This type of indicator is not suggested as a single best measure; the choice is based on more pragmatic considerations. PYLL is an objective measure and it is part of an ongoing series of health status indicators compiled by Statistics Canada. Approximately 460,000 potential years of life were lost to cancer and 250,000 to circulatory disease in 2001¹², indicating that a large potential exists to reduce losses through mortality from these conditions. In a more advanced evolution of health status measurement, it would be desirable to add a dimension of quality as well as life expectancy - e.g. health adjusted life expectancy (HALE) or quality adjusted life years (QALYs). Widespread population-based measurement of these indicators has yet to be developed.

Reductions in PYLL can be related to advances in knowledge although there will usually be a margin of uncertainty, especially where several factors contribute (e.g. prevention, non-health determinants and treatment). In the case of cardiovascular disease, CIHR is considering a qualitative approach used in the UK¹² called a witness seminar or narrative approach, which brings together a range of experts to discuss the key influences that contributed to an advance in a health outcome.

Economic Impacts

The classification of economic impacts in the CIHR Framework follows a categorization scheme in a recent critical review of the economic benefits of research by Buxton and colleagues³. Economic impacts are closely related to the concept of return on investment. In the case of funding for health research, however, the two concepts differ in important respects.

- The economic benefits from research tend to be diffused throughout society, for example enhanced earnings and productivity as the result of gains in workforce health.
- In many cases, research produces public goods, which are not patented and not traded in economic markets – enhanced understanding of the health benefits of exercise and diet are examples, as are new medical and surgical procedures adopted into publicly financed health care systems.
- Where discoveries or intellectual property results in patented products and spin-off companies, financial benefits will usually accrue to the researchers who made the discoveries and the institutions that hosted the research [in Canada, usually public universities or hospitals], as well as the downstream industries that use them and persons employed in spin-off companies. Research funding agencies in Canada receive no direct financial benefit from successful commercialization of intellectual property.

These considerations argue for an approach to measuring economic impacts that is conceptually similar to the approach recommended for health impacts: measure the overall economic impacts of research and then demonstrate that a funding agency has contributed effectively by encouraging research.

Commercialization

Statistics Canada conducts surveys of intellectual property commercialization¹³ and biotechnology.¹⁴ The latter are part of an effort by the Canadian Biotechnology Strategy group to develop a set of biotechnology statistics for Canada. CIHR, Statistics Canada and other organizations are partners in the Strategy. Statistics produced to date show impressive results in terms of the number of new biotechnology companies and annual earnings, almost half of which are in the health field. Two papers on biotechnology indicators are to be presented at the Bluesky Conference.

While there are no comprehensive measures at present of value added from the discovery and adoption of new technology in Canada, issues of how to do so are being considered.^{15,16} CIHR plans to monitor and when possible participate in these activities with a view to collaborative development of appropriate indicators of commercialization.

CIHR also has targeted commercialization programs such as The Small and Medium-Sized Enterprise Research Program (SME) and Proof of Principle (POP) grants. The SME is a partnership between CIHR and biotechnology companies that supports university spin-off companies and new commercial ventures. The POP program supports university based researchers to establish the marketability of an invention or discovery and then move it toward commercial viability. Follow-up studies of the results of these programs can be carried out and documented to obtain direct measures of commercial results from funding initiatives. For example, since 2001, more than 160 projects have been funded by the POP program. Of the projects that have matured sufficiently to be evaluated, 63%, or 49 projects, resulted in new patents being funded; 21%, or 16 projects had intellectual property licensed; and 14%, or 11 projects, contributed to new company formation.

Direct cost savings

Health technology assessments have the potential to document savings from the use of specific technologies. The Canadian Agency for Drugs and Technologies in Health (CADTH) provides a national focus for the study of cost-effectiveness of new technologies and medications. Collaboration with CADTH appears to be a promising approach to defining indicators of cost savings as a result of the adoption of new technologies that, for example, arose from CIHR-funded research.

Human Capital

The human capital approach to economic valuation measures the value of potential earnings lost through ill health or accidents. Health Canada has published estimates of the burden of disease in Canada using a human capital approach.¹⁷ Work to update the estimates is currently being pursued by Health Canada, Statistics Canada and the Canadian Institute for Health Information. Once the work is complete, it seems feasible to extend the estimates to provide measures of the value of illness or accidents avoided, or disability periods shortened as a result of advances made possible by research.

Value of life and health

Recent work in the US and Australia has sought to measure the value of medical advances in terms of the value of life or potential contributions to GDP.^{18,19} The expert group that discussed this Impact Framework thought that such an undertaking would be beyond the scope of CIHR's framework. From a conceptual point of view, the group pointed out that GDP is affected by many factors and there is a well established system

in place to classify and measure the economic determinants of GDP growth. The contributions of indirect factors, such as a healthy population, are not measured in present accounting systems.

Conclusions

It is feasible to develop indicators to measure the impacts of health research and health research funding. A conceptual framework is important to identify the stakeholders who require impact information and understand the nature of evidence that will be appropriate for each stakeholder group. Indicators can then be identified within this framework.

The framework developed by CIHR facilitates the identification of areas where specific initiatives can be evaluated to identify impacts and areas where a more nuanced approach is required. In broad areas, particularly health impacts and economic benefits, the most promising approach to impact measurement will be to measure the value to society of innovations in prevention or treatment. Often, credit for breakthroughs will be shared by many researchers and by those who support them, including the institutions in which they operate and the agencies that fund their work. Funding agencies, such as CIHR, can demonstrate that they have played an integral part in success by assuming a leadership role in encouraging appropriate research, by recognizing the potential of discovery in its early stages and by undertaking and encouraging the ongoing assessment of impacts. This approach brings together impact measurement and performance evaluation.

National and International collaboration between agencies and organizations that have stakes in health research and national statistical and evaluation agencies are the most promising route to continue the development and population of a robust and credible suite of indicators.

This paper has emphasized the complex challenges in devising credible approaches to the measurement of both impact and performance. This complexity means that no single approach will satisfy all stakeholders or be sufficient to cover all the activities of an agency with a broad mandate, such as CIHR. Nevertheless, as a publicly funded organization, we have an obvious and clear responsibility to demonstrate both high performance and high impact in everything that we do.

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