

Securing Canadian Leadership in Research and Innovation

Research Canada's Submission to Canada's Fundamental Science Review

Executive Summary

Research Canada is grateful for the opportunity presented by the Fundamental Science Review to provide recommendations that will strengthen Canada's fundamental science leadership.

It is essential that Canada's approach to supporting fundamental science recognizes the central position of fundamental science within the larger system of innovation. Fundamental science fuels the research and innovation engine and is therefore critical to Canada's competitiveness in the global knowledge economy and to our ability to benefit from our investment in health research and innovation.

Excellence in fundamental science is pivotal to Canada's knowledge leadership, commercialization leadership and healthcare leadership and Canada's support for fundamental research must remain coherent, effective and agile.

Having carefully considered the Panel's questions, Research Canada is pleased to submit a response organized according to four themes—fragmentation, funding, future talent and flexibility—that reflect the collective views of our diverse membership and that we think address the spirit and substance of the Panel's remittance.

Our Recommendations

1. In order to address fragmentation within Canada's current system of research funding, we recommend that:
Canada align, integrate and, where appropriate, consolidate its portfolio of research and innovation support mechanisms in partnership with Government, Academic, Industry and Not-for-profit (GAIN) stakeholders and in consultation with provincial and federal policymakers. This ongoing process of alignment—which might be enabled by a new, multi-stakeholder National Research and Innovation Board to oversee all federal funding agencies—should promote an integrated view of all funding vehicles and platforms, enable ongoing review and optimization of strategies across agencies/programmes, and monitor performance to ensure that Canada's fundamental research system achieves balance across operating, infrastructure, training/career development and commercialization priorities.
2. Canadian investment in fundamental science over the past decade has eroded its value and diminished the flexibility and predictability of the vehicles through which it is administered. If Canada is to remain competitive as a global centre of health research and innovation, we recommend that:
Canada restore baseline funding across granting councils to a level that places us in the top tier of knowledge-based economies globally—which, by most relevant comparative measures, will require a two to three times greater investment than the current status quo.
3. Scientific, technological and social innovation is placing new and challenging demands on the workforce and institutions responsible for their training and preparation. If Canada is to diversify opportunities for science-based graduate students, help them to explore, embrace and compete for non-academic careers in order to capitalize fully on the talent and energy of our trainees, we recommend that:

Canada improve partnerships among universities, colleges, Canadian industries and the health sector to increase the opportunities for trainees to participate in cooperative and internship programs. We should support new interdisciplinary training programs for universities and colleges at the intersection of biomedical science, engineering, business and law. And, in partnership with industry, we should create opportunities for graduates to pursue certification in core business skills (e.g., entrepreneurship, business development and project management) which are critical to future employability.

4. Canada's prevailing funding model challenges the development of promising talent and productive academic careers. In order to address this challenge, we recommend that:

Canada ensure that the funding rate for early- and mid-career investigators—those within the first five to ten years (excluding leave) of their academic career—match the average of senior-career scientists.

5. Canada's funding system must be forward looking, dynamic and nimble in order to anticipate and adapt to the rapid pace of scientific, social and technological change. In order to accomplish this, we recommend that:

A revised governance model for Canada's investments in science and innovation be established that will coordinate and increase the accountability and integration of Canada's funding matrix. The Canadian government should also adopt the principles of organizational parsimony and flexibility when creating new funding opportunities aimed at addressing current scientific, technological, social or policy priorities and where possible, adapt existing mechanisms best positioned to integrate the opportunity strategically and operationally.

About Research Canada

Research Canada is a national, broad-based alliance dedicated to advancing health research and health innovation through collaborative advocacy. Our mission is to improve the health and prosperity of all Canadians by championing Canada's global leadership in health research and innovation. Our key goals are to ensure that health research is a high priority of the Federal Government and to increase investments in health research from all sources.

Introduction

As a national alliance of cross-sector stakeholders committed to advancing health research and innovation in Canada, Research Canada brings a uniquely integrated perspective on the strengths, challenges and opportunities that will shape the future of Canada's health research and innovation system.

We feel strongly that **Canada's approach to supporting fundamental science must recognize the central position of fundamental science within the larger system of innovation.** For us, the Fundamental Science Review affords an important opportunity to: rethink and recalibrate the federal funding system toward achieving a balanced portfolio and economies of scope and scale across the spectrum of science and innovation; align and coordinate the deployment of resources among stakeholders; and fulfill the scientific, social and economic potential of our investment in science and innovation.

For Research Canada, fundamental science fuels the research and innovation engine, and unstinting commitment to fundamental science is therefore critical to Canada's competitiveness in the global knowledge economy and to our ability to realize sustainable dividends from our investment in health research and innovation.

Excellence in fundamental science is pivotal to Canada's **knowledge leadership**—our ability to develop, attract, train and retain the brightest minds, to contribute to our understanding of health and disease and to make the discoveries that will become the healthcare solutions of tomorrow. Investment in fundamental science is crucial to Canada's **commercialization leadership**—our ability to generate and exploit intellectual property, to attract industry partners and investors and to develop a flourishing life sciences sector that supports high-quality jobs. Commitment to fundamental science is inseparable from Canada's **healthcare leadership**—our ability to invent, translate and apply the solutions our healthcare system needs, to improve precision in healthcare practice and to harness clinical data and experience to propel future science and discovery.

Theme 1: Fragmentation

Integrate fundamental science research and innovation by strengthening research governance.

Optimizing Canada's support of fundamental science cannot be divorced from a broader conversation about a full and integrated system of innovation if we are to achieve the knowledge, commercial and healthcare returns a strong fundamental science foundation can deliver. Our approach must reflect the interdisciplinary nature of fundamental science, its dependency on the other pillars of health research (clinical, health service and population health) and the interests of diverse stakeholders—Government, Academia, Industry and the Not-for-profit sector (GAIN)—in unlocking scientific potential within the context of a functional innovation system.

However, our current system of funding fundamental science, nurturing scientific talent and capitalizing on scientific output has become increasingly fragmented.¹ Within Canada's constellation of funding agencies, programmes and streams, we are losing coherence, creating redundancy and forfeiting opportunities to excel. Programmes designed to support investigator-driven inquiry are spread haphazardly across funding agencies. Programmes aimed at translating and commercializing science often create perverse incentives to monetize intellectual property before it achieves a value inflection point—effectively jettisoning socioeconomic potential. Infrastructure investments are made with little consideration for the long-term funding prospects of the faculty who will occupy these spaces and utilize the cutting-edge equipment they house.

Overcoming these challenges will require rationalization of the federal funding apparatus—but Research Canada is of the view that integrating, dissolving or reimagining funding agencies, programmes and streams will fail unless we first address the research governance deficit that has allowed fragmentation to prevail.

Recommendation 1.

The Federal Government should *align, integrate and, where appropriate, consolidate its portfolio of research and innovation support mechanisms* in partnership with stakeholders across the GAIN continuum and in consultation with provincial and federal policymakers. This ongoing process of alignment—which might be enabled by a new, multi-stakeholder National Research and Innovation Board to oversee all federal funding agencies—should promote an integrated view of all funding vehicles and platforms, enable ongoing review and optimization of strategies across agencies/programmes, and monitor performance to ensure that Canada's fundamental research system achieves balance across operating, infrastructure, training/career development and commercialization priorities.

Theme 2: Funding

Enhance baseline funding for granting councils to remain globally competitive in fundamental science.

Research Canada recognizes that the Federal Government may face fiscal headwinds in the foreseeable future and that enriching the support for **fundamental science will require a strong underlying social and business case**. However, we must also recognize that the material erosion of Canada's investment in fundamental science over the past decade—both in

1 Canadian Institutes for Health Research. International Review Panel Report 2005–2010. June 2011. P. 1–2.

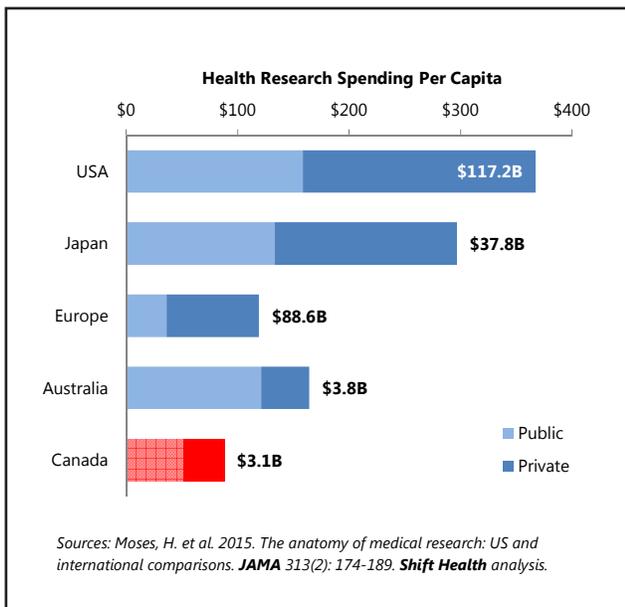
terms of the real (inflation-adjusted) value of the investment and the diminished flexibility and predictability of the vehicles through which it is administered—has bucked the trajectory of our global peers and jeopardizes Canada’s competitive position.

We can feel enormously proud of the stature of Canadian researchers on the global stage. Based on 2014 data compiled by Scimago, Canada’s published health research is among the most impactful in the world, ranking among the top five countries in six of the eight health research categories Scimago tracks (and in the top ten in all categories).² Canada punches above its weight—but the performance we’re seeing today reflects the investments of a decade ago and if current funding trends continue, we will certainly relinquish this advantage.

Among industrialized countries, **Canada’s per capita investment in health research is the lowest in the world**—and in absolute dollars, our total investment is now less than that of Australia, a country with two-thirds of our population.³ The US National Institutes of Health’s \$32.3B budget is more than three times the size (per capita) of CIHR’s \$1B annual investment. And, drawing on the Kirby Commission’s seminal 2002 report on the Canadian healthcare system, our investment in CIHR

Global Impact Ranking (H-index)	
Medicine	3 rd
Psychology	3 rd
Health Professions	3 rd
Neuroscience	4 th
Nursing	4 th
Pharmacology, Toxicology & Pharmaceuticals	5 th
Biochemistry, Genetics & Molecular Biology	6 th
Immunology & Microbiology	9 th

Source: SCImago Journal and Country Rank (www.scimagojr.com)



is currently less than half of the one percent health research spending benchmark believed to distinguish an innovative, adaptable and sustainable healthcare system.⁴ In addition, Canada’s spending on health research is far below corporate spending on research and development.⁵ **No enterprise can compete and thrive without sustained investment in innovation** and our healthcare system is no exception.

If Canada expects to be taken seriously as a nexus of science and a leader in the knowledge economy, **we must address our acute funding deficit.** While the targeted funding programmes that were favoured by the previous government have allowed Canada to recruit exceptional talent in strategically important domains, these programmes systematically fail to contemplate the long-term sustainability of the research enterprises they enable. As a result, we run a real risk of diminishing the vibrant community of scholarship in Canada.

- 2 www.scimagoir.com.
- 3 Moses, H. et al. 2015. The anatomy of medical research: US and international comparisons. JAMA 313(2): 174-189. Shift Health analysis.
- 4 The Standing Senate Committee on Social Affairs, Science and Technology. The Honourable Michael J. L. Kirby, Chair. The Health of Canadians: The Federal Role. Final Report. Volume Six: Recommendations for Reform, October 2002.
- 5 Sources: Research Infosource – Canada’s Top 100 Corporate R&D Spender 2014 (Corporate R&D spenders); Canadian Institute for Health Information – National Health Expenditure Trends, 1975-2014 (public health research expenditures).

Recommendation 2.

If Canada is to remain competitive as a global centre of health research and innovation, we must **restore baseline funding across granting councils** to a level that places us in the top tier of knowledge-based economies globally—which, by most relevant comparative measures, will require a two to three times greater investment than the current status quo.

Theme 3: Future Talent

Ensure diverse opportunities for science-based graduates and improve support to early- and mid-career investigators.

In the context of a global knowledge economy, Canada and other developing nations are experiencing unprecedented change in the areas of education and healthcare practice. The rapid rate of change brought about by scientific, technological and social innovations is placing new and challenging demands on the workforce and institutions responsible for their training and preparation. **New models of healthcare education and practice are required** to ensure the workforce is able to respond to ever-increasing competitive local and global marketplaces.

In particular, the past ten years have witnessed a significant shift in employment opportunities for graduates of universities and colleges, including the biotechnology, pharmaceutical, medical device, digital health and related technology industries. As well, many highly qualified health professionals are developing careers across the health sector, including community-based care.⁶ However, traditional training programmes, supported by fundamental science, continue to focus on institution-based academic research careers. Training of researchers and health professionals at universities and colleges must include additional skills and experiences to increase the opportunities for employment in the growing Canadian technology industries and community-based health sectors, ensuring that Canadians are highly competitive for the world market and expanding opportunities.

The Organization of PhD Education in Biomedicine and Health Sciences in the European System (ORPHEUS) is a network of biomedical and health science institutions that is committed to developing and disseminating best practice within PhD training programs. ORPHEUS diversifies career opportunities for science graduates and provides an excellent model we could use to harmonize standards in medical faculties and schools.

<http://www.orpheus-med.org/index.php>

Recommendation 3.

Canada needs to diversify opportunities for science-based graduate students, helping them to explore, embrace and compete for non-academic careers in order to capitalize fully on the talent and energy of our trainees. To this end, we **must improve partnerships** among universities, colleges, Canadian industries and the health sector to increase the opportunities for trainees to participate in cooperative and internship programs. We should **support new interdisciplinary training programs** for universities and colleges at the intersection of biomedical science, engineering, business and law. And, in partnership with industry, we should **create opportunities for graduates** to pursue certification in core business skills (e.g., entrepreneurship, business development and project management) which are critical to future employability.

6 Canadian Institutes for Health Research. Canada's Strategy for Patient-Oriented Research: Improving Health Outcomes Through Evidence-informed Care. August 2011, Section 2.3.2, Gaps in Human Resource Training and Career Support.

At the same time, we need to ensure that talented research trainees who aspire to pursue a future in scholarship can envision a viable career path. One of our foremost obligations—and challenges—in sustaining Canada's knowledge leadership is to ensure that early-career investigators are allowed to flourish and excel. The current system, however, stacks the deck against early- and mid-career investigators. The prevailing funding model imposes punitive hurdles to developing promising talent and cementing productive academic careers; funding rates are demoralizingly low—and many investigators stand little chance of breaking through a system that disproportionately rewards the experience and track record of senior investigators (mentors) with whom they must directly compete. We need to create a system of supporting investigators that is rooted in an apples-to-apples comparison of track record and potential: one that offers a plausible chance of building the scientific foundation and experience needed to compete in the highly competitive global funding environment.

The current funding situation discourages the pursuit of careers in academia and rather encourages some of our most promising and creative minds to pursue careers outside of Canada.

*Natalie Galant, PhD Candidate
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Recommendation 4.

Canada needs to ensure that the funding rate for early- and mid-career investigators—those within the first five to ten years (excluding leave) of their academic career—**match the average of senior-career scientists.**

Theme 4: Flexibility

Reinforce a discipline of strategic co-ordination, accountability and integrative, “big picture” planning across Canada’s funding matrix.

If we are to anticipate and adapt successfully to the rapid pace of scientific, social and technological change, our funding regime must be **forwarding looking, dynamic and nimble**. Indeed, Canada's ability to harness the potential of and assume a position of early leadership in emerging fields of science and technology often require **a willingness to take strategic risks, mobilize dedicated resources and experiment with models that may not fit neatly within the prevailing funding paradigm** (e.g., the Strategy for Patient-Oriented Research, which championed innovative partnerships among researchers, healthcare providers and policymakers).

However, as noted above, the proliferation of funding agencies, programmes and streams at the federal level has encouraged the development of **artificial silos**. In the US, the full spectrum of health research investments—across disciplines, across research pillars, across the continuum from discovery to commercial to applied, across intra- and extramural boundaries, and across operating, training, infrastructure, platform and “big science” mechanisms—is overseen by a single agency, the US National Institutes of Health. In Canada, CIHR, NRC, CFI, NSERC, Genome Canada and NCE (among others) have segmented (often overlapping) mandates in the context of a much more modest funding pie. Moreover, there is evidence that funding mechanisms, such as Genome Canada, originally created to harness Canada's contribution to an emerging science/technology or place a spotlight on a neglected field, have become organizationally entrenched long after the science/technology has “emerged”.

Recommendation 5.

A **revised governance model** for Canada's investments in science and innovation will certainly help to enforce a discipline of strategic co-ordination, accountability and integrative, “big picture” planning across Canada's funding matrix. Beyond strengthened governance, however, the Canadian government should also adopt the **principles of organizational parsimony and flexibility** when creating new funding opportunities aimed at addressing current scientific, technological, social or policy priorities and where possible, **adapt existing mechanisms best positioned to integrate the opportunity strategically and operationally.**