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Canadian Society for Molecular
Biosciences
C/O Rofail Conference and
Management Services (RCMS)
17 Dosssetter Way
Ottawa, ON K1G 4S3
Canada
Tel.: 613 421 7229
Email: Contact@csmb-scbm.ca

Canadian Society for Molecular Biosciences Submission to the House of Commons Standing Committee on Finance (August 4, 2017)

Executive summary

The future success of Canada depends on knowledge generation and its application to improve our society and economy. Fundamental research in the biological, physical, and applied sciences drives the economy of tomorrow. Research generates the foundation of knowledge that both fuels innovation and trains the next generation for jobs in an increasingly knowledge-driven economy. How the Canadian government responds to the urgent need to restore investment in fundamental research will unquestionably shape our prosperity in the coming decades.

Over a 10-year period (2006-2015), there has been a steady erosion of the federal funding base for discovery science placing the wellspring of research productivity that drives innovation in Canada, as well as the next generation of innovators, at great risk. In particular, there is now an acute funding shortfall in investigator initiated fundamental research in all areas of science. This has eroded Canada's research output and its ability to attract and retain top talent, and has stifled efforts to address diversity and gender inequities in Science, Technology, Engineering and Mathematics.

The Canadian Society for Molecular Biosciences (CSMB) greatly appreciates the federal government's stated commitment to research, and the commissioning of the [Fundamental Science Review](#). This arms-length report from a highly distinguished panel of experts, released in March 2017, thoroughly documents the current status of research in Canada and offers an insightful and well justified set of recommendations to restore Canadian science and innovation to international standards of excellence. The CSMB strongly endorses these recommendations in their entirety.

CSMB recommends the following investments, as detailed and justified in the Fundamental Science Review:

1. Increased investment of \$485M over four years to support investigator initiated fundamental research (CIHR, NSERC, SSHRC).
2. Increased investment in scholarship and fellowship programs to an additional \$140M over four years to support trainees.
3. Stable funding, staged in over four years, of the Canadian Foundation for Innovation (CFI) at \$300M per year to support research infrastructure.
4. Increased investment of \$485M in Facilities and Administration costs to host institutions over four years to support institutional costs of research.

Fundamental research provides the knowledge base without which innovation and technological development could not take place. As researchers, we train highly qualified personnel who represent the country's future. Our research grants support solid middle-class jobs with federal support. In addition, a strong fundamental research enterprise is a beacon for recruitment and retention of highly qualified immigrants.

Thus, the impact of federal research funding on Canada's productivity and competitiveness is enormous and should be seen as a national priority.

Introduction

The Canadian Society for Molecular Biosciences (CSMB) represents thousands of the country's biosciences faculty members and students. Our members' research programs are largely dependent on research operating grants from the tri-council funding agencies- the Canadian Institutes of Health Research (CIHR) and the Natural Sciences and Engineering Research Council of Canada (NSERC). Investigator-driven discovery science generates the ideas that fuel innovation and trains the next generation for jobs in the increasingly important knowledge-based economy. If Canada is to play an increasing role in the global STI (science, technology, and innovation) economy, it needs more non-targeted investigator-driven discovery research.

Restoring investment in Canadian science is critical to Canada's future well-being and productivity

The Fundamental Science Review represents a rigorous analysis of Canadian science, and presents a detailed plan for restoring investment into science research and training over the next four years. It also convincingly makes the case for science and inquiry as a key national priority. Innovation is recognized as the ultimate driver of economic growth and prosperity. However, history has shown that the economic and health benefits of innovation are dependent on the body of knowledge and insights that come from fundamental research. Fundamental research is the grist for the mill of innovation generating economic and health benefits.

In addition, we cannot overemphasize the enormous value of research-based science education in establishing the talents, skills, and ambitions of the next generation of innovators and the Canadian citizenry at large. Research-based teaching at the undergraduate, graduate, and postdoctoral levels prepares students to solve problems in their daily lives and future careers, whatever they may be.

In terms of productivity and competitiveness, the potential payoff is enormous, not only for medicine, but also for industry, agriculture and forestry, the environment, and natural resources management. STI offers the potential to add value to Canada's tree stocks, to generate biologically-derived molecules and polymers delivering new classes of materials and therapeutics that will transform Canadian manufacturing, to provide energy for future generations through inexpensive production of biomass and hydrogen, to transform information technology. STI will provide the tools needed to combat climate change, one of the greatest threats to human society.

STI is driving the greatest transformation in medicine in the modern era. The ability to predict disease and to grow cells and tissues by design is leading to a new paradigm of medicine. Within decades, genomic science, combined with technologies provided by advances in robotics, nanofluidics, photonics and laser science, and synthetic bioactive molecules, will permit scientists to repair abnormal biochemical pathways leading to Alzheimer's and Parkinson's disease, to eliminate AIDS and other deadly pandemics, to stave off heart disease, and to control infectious diseases caused by antibiotic-resistant bacteria. Rapid advances in nanotechnology, chemical biology, systems biology, stem cell biology, metagenomics, and functional genomics are leading to the creation of more effective therapeutics for cancer and other diseases that are much more precise and therefore cheaper, while the miniaturization and automation of high-throughput analysis technologies are dramatically reducing

the cost of life-saving clinical assays. Canada must strive to be at the forefront of this research by funding a broad range of fundamental health science.

Government Support Is Vital for Canada's Research Competitiveness

Canada's wealth and well-being is being challenged by devaluation and exhaustion of natural resources, by climate change, and by the rising cost of health services. Accelerating efforts to bolster Canada's economy with new technology sectors and to control the costs of health care in the face of an increasingly aging population is a national priority. Competing countries with research-driven economies recognize the tremendous contributions that fundamental science makes to society. Germany, Japan, Australia, China, and the United Kingdom have responded to this challenge and opportunity with major funding initiatives.

To compete with these efforts on the international stage, Canada must act decisively with significant increases in capital support in a comprehensive national research, training and education program as laid out in the Fundamental Science Review. These investments will deliver dramatic improvements to the wealth and health of Canadians.

OECD data for 2014 indicate that Canada only spends 1.6% of its GDP on Research and Development (R&D), compared to the average OECD nations at 2.4% of GDP. We strongly encourage the Government of Canada to work over a predictable time frame towards increased spending on R&D to 3.5% of the GDP as in the most aspiring nations such as Japan, Korea, Sweden, Finland and Israel as recommended by the [Scientific Advisory Board of the Secretary General of the United Nations](#). Increased funding for R&D in Canada will enable our country to establish a complete and competitive discovery science and innovation pipeline in the natural sciences and in health research – from foundational discovery research to commercialization.

As a result of 10 years of stagnation of tri-council research funding (CIHR, NSERC and SSHRC) under the previous government, the operational funding for fundamental research in Canada has dropped 35% in constant dollars. This has eroded Canada's research capacity that has fallen well below Canada's OECD equivalents. As a consequence, many Canadian research laboratories are downsizing or closing, thereby eliminating skilled jobs and squandering prior investments in research. Canada is therefore at a critical time in which it must re-invest in research funding in order to restore our nation's ability to discover at an internationally competitive level.

Starving fundamental research is a capital strategic error. Operational grants are absolutely essential for innovative research to occur. The human capital (principal investigators) and research infrastructure (facilities and equipment) are in place, however, the grant funding available for operations is insufficient to support the salaries of technicians and research associates, graduate and postgraduate trainees, and the laboratory supplies needed to conduct the research. Restoring investment in investigator-driven operating grants will therefore have immediate impact both in terms of research productivity, maximizing previous investments in human capital and infrastructure, and creating STI-based middle class jobs. Failure to do so will have significant consequences leading to the further erosion of Canada's STI-based economy.

Innovation Built on Inclusivity and Diversity.

Diversity in any field increases innovation. Yet visible minorities and women remain underrepresented in the STEM fields in Canada, especially within academic faculty and in leadership positions. Inequity is even observed in biomedical fields where undergraduate and graduate programs have over 50% of female enrollment, and female faculty remains stagnant at less than 30% and are skewed toward lower academic ranks. If Canada is to truly build a future economy on Innovation it is essential that the leaders that drive innovation reflect Canada's diverse society. Advancements in science truly rely on scientific talent. Canada must address the fundamental reasons for the lack of gender equality and minority representation in STEM to ensure a robust innovation pipeline and unfettered access to

economic opportunities for over half of the Canadian workforce. Restoring investment in investigator-initiated operating grants to internationally competitive levels is the most efficient approach for supporting a diverse cohort of Canadian researchers, ensuring that Canada has the broadest range of voices competing in the idea marketplace.

Recommendations

We strongly support the recommendations made in the Fundamental Science Review.

These include:

1. **Increased investment in fundamental discovery research.** We recommend increased investment of \$485M over four years to support investigator initiated fundamental research at CIHR, NSERC and SSHRC. The current amount of operational support at the tri-councils is insufficient to support the current cohort of Canadian researchers. The erosion of the funding base has led to hundreds of our best biomedical research laboratories across the country to contract their research efforts or close.
2. **Increased investment in training.** We recommend increased investment in scholarship and fellowship programs to an additional \$140M over four years. This will boost the numbers as well as the diversity of trainees and ensure a stable pipeline of innovators for the future.
3. **Stable investment in infrastructure.** We recommend recurring stable funding, staged in over four years, for the Canadian Foundation for Innovation (CFI) at \$300M per year to support research infrastructure. This will allow for critical renewal of instrumentation and facilities to keep Canadian scientists internationally competitive.
4. **Increased investment in Facilities and Administration costs.** We recommend increased investment of \$485M in Facilities and Administration costs over four years to support institutional costs of research. This program constitutes an essential foundation for all research operations and should successively be expanded from currently around 20% to a more realistic value of 40% in order to properly support all areas of research.

Our country is positioned to be a key driver of an era of unprecedented bio-innovation and to reap the associated economic, health, and social benefits. However, an essential component is sorely limiting, namely the operating grants that fuel the day-to-day expenses of research and pay personnel (students, postdocs, technicians). Increased investment in operating costs is desperately needed to support the Canadian research ecosystem that generates the fundamental knowledge and training needed to maintain internationally competitive research and innovation. We urge the federal government to restore discovery research and the training of the next generation of STI experts with significant investments into the open competitions at CIHR, NSERC, and SSHRC in the 2018 and future budgets so that Canada does not lose further ground.

On behalf of the CSMB board, I thank the committee for the opportunity to provide our input.

Sincerely,

Philip Hieter, PhD, FCAHS, FRSC
President, CSMB
Professor, Medical Genetics
University of British Columbia
Tel. 604-822-5115
hieter@msl.ubc.ca