CSPC 2017
9th Canadian Science Policy Conference
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3rd Annual Science Policy Awards of Excellence - Youth Category

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CSPC is proud to present its 3rd Annual Science Policy Awards of Excellence—Youth Category which follows in the spirit of our 2013 Young Generation Award.

This award recognizes a young individual (student, postdoctoral fellow, researcher, entrepreneur, etc.) under the age of 35 who developed an innovative and compelling evidence-based policy that will make a positive difference to Canadians. Proposals were to be connected to one or more of the themes for the 2017 CSPC Conference. This award is designed not only to highlight innovative, evidence-driven policy ideas, but also to encourage innovative young people who may not currently be studying, or working on, public policy to develop and share their policy ideas.

2017 Winner: Sierra Clark,
MSc Candidate, Department of Epidemiology, Biostatistics and Occupational Health, McGill University

The Selection Committee was so impressed by the quality of the submissions and the dedication of the applicants that they wanted to share the best of these innovative evidence-based policy proposals with the CSPC community.

Please join us in congratulating our 2017 winner Sierra Clark for her proposal "Residential wood-burning in Canada: Health and climate effects and intervention strategies" and our runners-up, Dr. Deena Hamza and Meagan Grabowski.

We are honoured to have **The Honourable Kirsty Duncan**, Minister of Science with us to present the 2017 Award during the CSPC Evening of Celebration and Inspiration on November 1, 2017.

2017 Runner-up:
Dr. Deena Hamza
Postdoctoral Fellow, Department of Family Medicine, University of Alberta
"A Proactive and Cost-Effective Approach to Reducing Mental Illnesses"

2017 Runner-up:
Meagan Grabowski
Researcher, Yukon Government
"Modernizing the Yukon Scientists and Explorers Act"

http://sciencepolicy.ca/cspc-2017-science-policy-excellence-award-youth

This year, the CSPC Awards Committee was happy to see that more than double the applicants to the Science Policy Award of Excellence – Youth Category since last year (16 in total for 2017) and that the proposals were of high quality.

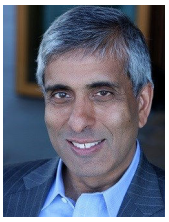
2017 is also the first year that CSPC invited several meritorious Award applicants to take part in our first CSPC Science Policy Poster Session at the Conference on Thursday, November 2, 2017.

CSPC would like to extend very warm thanks to the distinguished members of our 2017 Awards Selection Committee for their valuable time, commitment and enthusiasm for encouraging young people to consider how they might contribute to evidence-based policy. A special thank you to Charles McIvor of Innovation, Science and Economic Development Canada, and Jenna Kara of the CSPC for all of their work on making this Award possible.

Proposals are reviewed blind and the Committee enjoyed learning about the incredible diversity and passion of the young people who applied to the Award once the winners had been selected and the applicants were revealed. We received applications from four provinces and one territory and the majority of them were from women. Many of the applicants were graduate students and postdoctoral fellows but that did not deter our youngest applicant, an impressive grade 12 student from British Columbia.

2017 CSPC Awards Selection Committee

Karine Morin
Former Executive Director, Platforms, Alberta Innovates



Dr. Arvind Gupta
Founder, Mitacs
Professor, University of British Columbia

Dr. Ted Hsu
Former Member of Parliament and Critic for Science &Technology Policy

Paul Dufour
Principal, PaulicyWorks and Adjunct Professor, University of Ottawa

Cynthia Robinson
Former Director, AAAS S&T Policy Fellowships

Sandra Noël
Chair, CSPC Awards Committee
Senior Policy Analyst, Innovation, Science and Economic Development Canada

Impact of the Award

In this, the Award's third year, the CSPC followed up with previous winners and runners-up to ask them about the impact that the CSPC Science Policy Awards of Excellence have had on their lives. It is inspiring to see these bright young people continue to pursue their passion for evidence-based policy.

Past Award Winners

1st CSPC Award Winner (2013)—Ari Cuperfain

Ari Cuperfain was the inaugural recipient of the CSPC Award of Excellence, Young Generation Award in 2013. He has since completed an MSc in Chemistry and is currently a medical student at the University of Toronto. His research interests are in neurogenetics with a focus on both aging and personalized medicine. With respect to science policy, Ari was one of two Canadian delegates selected to attend the Global Biotech Revolution 2016 Leaders of Tomorrow GapSummit, where young professionals from over 30 countries met to address the most pressing global challenges in biotechnology expected over the next several decades. Ari is active with the Canadian Blood Services OneMatch program where he works to recruit the most needed registrants to join the registry as potential stem cell/bone marrow donors. He is passionate about geriatric medicine, geriatric psychiatry and models of healthcare delivery for older adults.

2nd CSPC Award Winner (2016)—Amani Saini,
"Using Genetic Tests to Prevent Adverse Drug Reactions"

"Years after my sister nearly died from an adverse drug reaction (ADR), Canada's 4th leading cause of death, I was still fueled by anger at the lack of resources available to Canadians to prevent ADRs. Therefore, I decided to develop a policy solution to prevent them from happening. In 2015, I had an idea which I thought would make a positive difference to Canadians and wanted to act on it, but I wasn't sure how my idea would be perceived and whether it was plausible. Receiving the 2016 Canadian Science Policy Award of Excellence – Youth Category really opened the door for my policy idea to flourish. The win meant that my policy proposal now had credibility and was backed by Canada's science community. This gave me the assurance and confidence I needed to start a national organization, Adverse Drug Reaction Canada (ADR Canada) (www.adrcanada.org) and my winning proposal became the foundation of the organization, which advocates for genetic testing to identify gene variants that causes ADRs, the creation of a national database to monitor and record ADRs, and the creation of an electronic medical record system. The Canadian Science Policy Award of Excellence is one of the primary reasons ADR Canada exists and it is the reason that one day, lives will be saved."

Impact of the Award

Past Runners-up

2016 Runner-up—Robert Gooding-Townsend,
"Using a Modified Lottery to Select Among Meritorious Grant Applications"

"Following the success of my proposal at CSPC, I wrote to the authors of one of the main studies advocating random review of grant applications. To my surprise, the response I received was essentially "that's nice, let us know if you publish a paper," which is a pretty ironic statement on incentives in science. However, my award at CSPC was helpful for my applications to PhD programs. Next fall, I will begin a PhD in modeling the dynamics of scientific communities at the University of California Merced -- and then I can publish that paper."

2016 Runner-up—Jessica Ross, "*Rethinking Phosphorus: Contaminant or Commodity? Securing Food for Our Future*"

Jessica has had a busy year since last year's conference! Her research focusing on a cost-effective phosphorus capture process was presented by the Phosphorus Lab team at the 2017 University of Ottawa Faculty of Engineering Design Day, and she is proud to report they were awarded the Top Overall Prize for this novel process. She also won First Place as the Top Female Presenter at the 2017 Graduate Poster Day for "Closing the Phosphorus Loop: Our Future's Food Security." Her thesis, "Phosphorus and carbon capture from synthetic municipal wastewater by carbonate apatite precipitation" was accepted this past July, and she will receive her Master's of Applied Science in Chemical Engineering with a Specialization in Science, Society, and Policy this November. She also recently learned that her science-policy manuscript "Canada: Playing Catch-Up on Phosphorous Policy" has been accepted for publication in FACETS. Jessica is working as a Project Manager in the Department of National Defence.

We look forward to seeing the impact of the Award on this year's winner and runners-up to following up with the 2017 winners to see where their interest and drive takes them.

We hope that you enjoy the Awards Committee's 2017 selection of top Awards proposals on the following pages.

@sierraclark2

2017 WINNER - SIERRA CLARK

Residential Woodburning in Canada: Health and Climate Effects and Intervention Strategies

Theme 1:
What are Canada's likely challenges in the next 50 years, and how can scientific knowledge be used to solve them?

BIOGRAPHY

Sierra Clark attended McGill University for both her Undergraduate Bachelor of Arts Degree (honours) in Geography and Geographic Information Systems and her Masters Degree in Epidemiology. During her Masters, Sierra was also a graduate program member at the Institute for Health and Social Policy at McGill, a National Geographic Young Explorer, and a Mitacs Canada Globalink International Intern. Sierra is passionate about finding evidenced-based solutions to address preventable environmental exposures, such as air pollution, which are harmful to human health and contribute to climate change. Sierra is passionate about science outreach, communication, and translation, and is a volunteer with the Science-Policy Exchange at McGill.

INSPIRATION

"While working with Indigenous communities in Uganda and China, I was overwhelmed by the fact that the simple act of cooking a meal or heating one's home with solid fuels (i.e., wood, coal), could result in daily exposure to high levels of toxic pollution. When I visited the homes of community members, I immediately reacted to the smoke; my eyes burned, my throat closed up, and I had a persistent cough. While my reactions were acute, half of the world's population is chronically exposed to household air pollution (HAP), which claims the lives of 2.8 million people yearly[1]. Exposure to HAP is mostly concentrated in low-income countries[2], but also prevalent in rural and northern communities in countries like Canada[3,4]. I am inspired to write this policy proposal on effective interventions to reduce HAP in Canada because cooking should be health sustaining, not harming."

OPPORTUNITY FOR ACTION

Half of the world's population still cooks with solid fuels (i.e., wood, coal, crop residues) in inefficient stoves or open fires[2]. Through incomplete fuel combustion, this practice results in high concentrations of pollutants released inside the home[5], which are a mixture of aerosols and gases that contain many hazardous chemical compounds, including teratogens, mutagens, carcinogens (i.e., polycyclic aromatic hydrocarbons (PAHs)) and free radicals[6]. This practice is common in low-income countries, but is also prevalent among rural populations in high-income countries, such as among Canada's First Nations, Metis, and Northern Inuit communities[3,4,7,8]. Poor supply networks and affordability of gaseous fuels and electricity, local abundance of raw biomass resources, and traditional cooking practices, contribute to the choice of households to use solid fuels to meet every day energy demands[9,10]. Among Canada's rural and Indigenous communities, particularly in the North and Arctic regions, residential wood burning for cooking and heating is common[11].

Previous studies have linked exposure to HAP to a range of chronic and acute health events and cause-specific mortality, including, respiratory infections, chronic obstructed pulmonary disease (COPD), exacerbated asthma symptoms, cardiovascular diseases, breast and lung cancer, eye irritation and cataracts, and low birth weight[5,12,13] and similar associations were found among rural communities in Canada and the USA, where residential wood burning is common[8,14,15] . For example, in three rural and semi-rural communities in British Columbia, an increase in daily pollution levels of fine particulate matter (PM2.5) from residential wood burning was associated with an increased risk of hospitalization for Myocardial Infarctions (MI) among elderly adults[3]. Furthermore, many respiratory conditions, such as childhood asthma[16], are more prevalent among Canada's first nations, Inuit, and Metis communities, compared to the general Canadian population. Thus, interventions that can reduce HAP in these communities are likely to reduce persistent health inequalities.

Household air pollution from burning solid fuels in inefficient stoves also contributes to ambient air pollution conditions; in Canada this contribution is around 10%[17]. Ambient air pollution from residential solid fuel burning is also a major contributor to climate change[18] from the release of black carbon, also known as soot[19]. When black carbon is released into the atmosphere and later deposited on the surface of snow and ice, the dark particles absorb incoming and scattered heat from the sun. Due to black carbon's albedo reducing effects, it is also a major contributor to glacial melting, particularly in high latitudinal regions like the arctic circle in Canada[19]. Interventions to reduce emissions of climate forcing pollutants, such as black carbon, should be a key priority in Canada's actions against climate change[20], particularly among Canada's Northern and Inuit populations who are experiencing the most rapid and extreme changes to their local environments, and traditional ways of life[21,22,23].

PROPOSED ACTION

Household air pollution from inefficient wood burning is preventable. Improving household infrastructure to effectively ventilate smoke from stoves outside the home, and block polluted air from coming back inside, has proven effective from previous intervention trials of air cleaners and filters[24,25]. For example, a study conducted in rural communities in Montana and Idaho, found that household concentrations of PM2.5 were reduced by 68% among homes that received an air filtration unit[26], and by 40% from a study in Vancouver[27]. Also in lower- and middle-income countries, there are large scale efforts to design and distribute millions of higher efficiency advanced combustion solid fuel burning cooking and heating stoves[28,29,30]. A global review found that interventions of improved solid fuel burning stoves with chimneys and advanced-combustion gasifier biomass burning stoves, reduced household concentrations of fine particulate matter (PM2.5) by 62% (range: -89,-14) and 41% (range: -49, -29), respectively[31]. While few interventions have been carried out in Canada, most of the strategies related to providing incentives for changing-out old heating units for newer ones. For example, Natural Resources Canada provided financial support of $375 (1st system) and $190 (2nd system) for single-family homes to encourage Canadians to replace their conventional wood-burning appliance with a certified wood-burning or indoor wood pellet-burning appliance[11].

SIERRA CLARK

Residential Woodburning in Canada: Health and Climate Effects and Intervention Strategies

Clearly there is a need, for both public health and the climate, to reduce the inefficient burning of solid fuels in Canada, particularly among rural and Indigenous communities in Canada's Northern regions where the burden of associated health effects and vulnerability to climate change is high. Canada therefore needs to create a rural household energy policy for improving combustion of solid fuels and improving household ventilation practices in affected communities.

STEP 1: Identify affected communities. Hong and colleagues recently developed a tool to identify communities impacted by residential wood smoke through the quantification of historical satellite imagery[32]. Commercialization and use of such tools by planners and public health experts could be a cost effective means of identifying communities that may benefit the most from household energy interventions in Canada.

STEP 2: Consult with local communities on household and community preferences for cookstove design and features. Past research has clearly shown that top-down cookstove design and distribution efforts do not work and "cleaner" technologies need to be designed with the local cooking needs as a design priority[9,10,33]. In Canada, policy makers, public health experts, and an advisory board of local community members, can partner with engineer researchers specializing in building science and combustion science to design effective, efficient, but contextually appropriate stoves and air filtration units for a combined package intervention.

STEP 3: Consult Generate demand for cleaner cooking technologies. Local demand for cleaner household energy options and air filtration units must be fostered prior to intervention in order to ensure long-term exclusive and sustained use. For example, implementers can first hold public education forums, hold community filter training days (where people can come and test out the technologies), create radio advertisements, and partner with influential members of the community to support the intervention.

STEP 4: Ongoing monitoring of the intervention package will be key to informing future implementations and provide an on-going interface between community members and implementers. As well, local members of the community should be trained in the maintenance and up-keep of the intervention stove and air filtration unit in order to respond to immediate maintenance issues as they arise.

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RUNNER-UP - DR. DEENA M. HAMZA

A Proactive and Cost-Effective Approach to Reducing Mental Illnesses

Theme 1:
What are Canada's likely challenges in the next 50 years, and how can scientific knowledge be used to solve them?

BIOGRAPHY

Dr. Deena M. Hamza is a Postdoctoral Fellow in the Department of Family Medicine, at the University of Alberta, Canada in a joint position with the College of Family Physicians of Canada. Her Mitacs funded Postdoctoral Fellowship focuses on improving the quality of medical education to ensure the social accountability of future physicians. Social accountability includes provision of services and access to care, particularly for mental health, rural/remote settings, and Indigenous populations. In addition, Dr. Hamza's doctoral research focused on models of care in the Department of Psychiatry, at the University of Alberta. Much of her research focused on using available resources to provide increased access and support for mental health prevention and early intervention initiatives, particularly for youth. Paired with technology, Dr. Hamza's aim is to bring SBIRT (screening, brief intervention, and referral to treatment) to the forefront, integrating into primary care clinics and schools.

INSPIRATION

"I have always been curious as to why people behave in certain ways, particularly the transition from adaptive to dysfunctional behaviors. My doctoral research in psychiatry, focusing on addictions, depression, suicidality and anxiety, played a significant role in increasing my interests in these areas. My work experience, as an intervention researcher in primary care clinics, allowed me to view the reality Canadians face when they seek support for symptoms of mental illnesses. Paired with media coverage of tragedies, including those in Indigenous and rural/remote communities, it became increasingly evident that the lack of access to mental health care was drastically cutting the potential of Canadian youth and young adults short. The more I understood about the topic, the more dedicated I became to models of care, specifically prevention and early intervention initiatives. My proposal outlines short and long-term goals that aim to enhance the mental wellness of Canadians."

OPPORTUNITY FOR ACTION

The World Health Organization has identified mental illnesses as the #1 disease burden globally[1], and evidence suggests that 70% of mental illnesses have their onset during childhood or adolescence[2]. Although there are policy statements indicating the importance of mental wellness, including the right to immediate access to treatment once needs arise[3], nearly 75% of Canadian youth do not have access to specialized treatment[2,4].

DR. DEENA M. HAMZA
A Proactive and Cost-Effective Approach to Reducing Mental Illnesses

Evidence suggests that symptoms of mental illnesses that have their onset in childhood can continue well into adolescence and adulthood[2,3]. Left untreated, this results in increased severity of symptoms and the need for more cost-intensive resources, such as the creation and access to increasingly specialized services[5]. More importantly, overlooked symptoms have a profound negative impact on the future potential of every Canadian.

Canada is currently behind other countries when it comes to resource allocation for mental wellness: Only 7% of public health resources in Canada are spent on mental health care, compared to 10 -11% in the UK and New Zealand[6]. Further, mental illnesses during childhood cost the Canadian government an estimated $200 billion dollars each year[7], and optimal opportunities for cost-saving prevention and early intervention approaches are often missed[8,9]. Although there are mental health initiatives planned for 2017 onwards, these plans often describe long-term system changes, and do not incorporate immediate or short-term goals using available cost-effective and evidence-based resources[10].

These findings support the need for effective, cost-effective tools to reduce, and optimally prevent, the onset of mental illnesses. Of particular concern is the lack of prevention and early intervention approaches created specifically for adolescents, as well as access to care challenges for Indigenous and rural/remote communities.

PROPOSED ACTION

The proposed action is a culmination of evidence-based approaches appropriate for youth for the prevention and early intervention of mental illnesses. The approach is known as SBIRT: screening, brief intervention, and referral to treatment.

1. **Screening**: The first component of SBIRT begins with screening of individuals for risk of developing a mental illness.[8,9,11,12]. Screening tools are validated for use with youth, and can assess risk of suicidality, depression, anxiety, and substance misuse through the use of technology, and in record time[13-22]. Further, this screening process should happen opportunistically – during sick and well visits to primary care; during health class or flex/spare time in schools to reach the largest number of youth[13,14]. All individuals with risk of developing a mental illness should be provided the opportunity to participate in a brief online intervention, many of which are existing and evidence-based[23-28].

2. **Brief Online Intervention:** This online intervention should be customized to the individual through a computer algorithm which considers factors, such as age, gender, specific symptoms, culture, and personal preferences to streamline options for the user. In addition, the online intervention should be accessible from any location – an electronic device as the only requirement. This has significant positive implications for rural/remote settings, and overall personal needs and preferences. After completion of the brief online intervention, individuals are screened once again to determine changes in symptomology.

3. **Referral to Treatment:** Individuals who continue to be at risk of developing a mental illness are referred to more specialized treatment. The computer algorithm matches the individual to the appropriate services based on their symptomology and they are provided with appropriate resources. In addition, available clinicians of specialized services receive a notification to follow-up; however, this is a long-term goal requiring buy-in from healthcare professionals.

Summary of **immediately enactable short-term strategies**:

1. There should be policies in place to incorporate SBIRT in two settings youth frequent the most – primary care clinics and schools
   - Ideally in all areas in which opportunistic screening can be incorporated, and for all ages
2. There should be policies in place to ensure all Canadians have access to the SBIRT program free of charge and in any setting
   - The provision of this SBIRT program should be made available on a public health website that is easy to access from any location across Canada
   - Ideally the program would be offered in multiple languages to ensure access from the largest number of Canadians

Recommendations for **long-term goals**:

1. Enhance the medical education curriculum to ensure future primary care physicians are competent and willing to provide support for symptoms of mental illnesses and in diverse settings [29, 30]
   - According to Pan-Canadian findings in 2016, only 64% of Family Medicine graduates intend to provide comprehensive care within 3 years of formal practice [College of Family Physicians of Canada, in press]. *Note: comprehensive care includes mental health as one of its clinical domains
   - Further, only 40% of Family Medicine graduates across Canada intend to provide care to Indigenous populations; and 51% report intending to provide care to rural communities or marginalized/disadvantaged/vulnerable populations [College of Family Physicians of Canada, in press]
2. Encourage the categorization of Continuing Medical Education (CME) credits to reflect comprehensive and holistic updating of knowledge
   - Areas in which the provision of socially accountable services are deficient, enhanced training bound by CME credits should be incorporated.
   - This is a proactive step towards prevention and intervention initiatives for mental illnesses that will contribute to the wellness of our youth, better organize the need and access to care, while decreasing the burden on specialized services.

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RUNNER-UP - MEAGAN GRABOWSKI

@meagangrabowski

Modernizing the Yukon Scientists and Explorers Act

Theme 3:
How do we strengthen the environment for the production and integration of new scientific knowledge?

Theme 4:
How can we more effectively bring new and existing scientific knowledge to bear on Canada's challenges?

Theme 5:
How do we engage the public in Canada's science system?

BIOGRAPHY

Meagan Grabowski was born in Dawson City, raised in Whitehorse, and continues to live in the Yukon Territory. She completed a B.Sc. Natural Resource Conservation and an M.Sc. Zoology at the University of British Columbia. Megan is interested in alpine and Arctic science, and how this science is communicated to the people who live where it takes place. Her work experience includes over eight field seasons of ecological research in the circumpolar regions, including southwest and Arctic Yukon, Nunavut, and Svalbard. With the Jane Glassco Northern Fellowship, Meagan completed policy research and analysis on modernizing the Yukon *Scientists and Explorers Act*.

INSPIRATION

"After finishing my MSc, I had questions around how research was conducted in my home territory, the Yukon, which led me to study researcher-community relationships through the lens of legislation. Despite being born, raised, living and studying in the Yukon, I often felt out of place when working on my MSc. I wondered: what is the impact not just of my research but of my presence as a researcher? When I first started working in science I felt like the only Yukoner in many groups, which is why I wanted to pursue science: to prove that Yukon youth can get to the same level as anyone from down south. It surprised me how challenging it can be for grad students from the "outside" working in rural Yukon to navigate ethical research principles and build relationships. This led me to wondering the impact of science policy on relationships and power. "

OPPORTUNITY FOR ACTION

Problem definition: In its current form, the *Scientists and Explorers Act*, RSY 2002, c.200, does not account for modern government-to-government relationships between First Nations governments and the Yukon Territorial Government. There are overlapping issues of communication, capacity, ethics and control. Yukon residents see an annual abundance of researchers collecting data from the land and the people. Approximately 80 research permits are granted annually in the Territory. Some Yukon communities see more than their population's worth of researchers within three years. Only a handful of these researchers are interacting directly with residents for a number of reasons, including logistics and a lack of funding for communication[1]. Building relationships between researchers and communities is therefore a challenge. There is a perception that a lot of research is going on but little awareness among northerners of who conducts research and why.

MEAGAN GRABOWSKI
Modernizing the Yukon Scientists and Explorers Act

The *Scientists and Explorers Act* licenses people who "enter the Yukon for scientific or exploration purposes"[2]. The Act itself no longer represents the actual procedure of licensing, especially with regard to who reviews applications and how decisions are made. The Act requires review and modernization, given the tripartite agreement-based First Nations, Territorial and Federal government structures in the Yukon. Modernization of the Scientists and Explorers Act will advance reconciliation in research[3].

Due to limitations from all sides, the current licensing process is a "black box" for those who participate. The academic community and First Nations governments dedicate valuable time and resources to research and review license applications and receive little to no feedback in return. This is leading to distrust between governments and institutions, resulting in conflict, changes in scope, and in some cases legal intervention[4].

The *Scientists and Explorers Act* has not been significantly changed since 1954[5]. If the research licensing process is not actively updated to reflect current Yukon realities, issues will continue and First Nations governments may choose to draw down territorial government powers of research licensing to the First Nations governments. However, multiple layers of permitting can create a disincentive to research and researchers and reduce Yukoners' access to benefits. The Yukon Liberal Party was elected with a majority in November 2016, with a platform commitment to review the *Scientists and Explorers Act*[6].

I conducted background research and interviews for the following purposes: to better understand the process and explore issues that have arisen related to the *Scientists and Explorers Act* and permits; to analyze policy options moving forward; and to address linkages between this policy, research relationships, and reconciliation.

PROPOSED ACTION

Recommendation: A co-management board for research approval and liaising would address both the procedural and authority-related issues in research permitting. If First Nations governments are not actively accommodated in the approval or denial of permits, based on trends identified by this research I anticipate that individual governments will continue to create their own permit processes as resources allow.

In order to relieve pressure on the current process to make final decisions and promote further reconciliation, a co-management board could be created to review and grant multi-year licenses. The board would grant licenses based on consensus of the board and the First Nation government on whose traditional territory the research is proposed to take place. It would convene as necessary and have representatives from multiple Yukon research stakeholders such as Yukon Territorial Government, First Nation governments, Yukon College, and resident researchers (Yukon Research Centre, Arctic Institute of Community-Based Research, Yukon Government researchers, etc.). It would remove the licensing from the Department of Tourism and Culture and create a new body, which may enhance transparency and accountability. It could potentially develop Yukon-customized standards for ethical research for all disciplines and create space for more communication and conditions under the license.

MEAGAN GRABOWSKI
Modernizing the Yukon Scientists and Explorers Act

The introduction of co-management to science licensing would allow for a consensus-based process in approving or denying projects, rather than the current process which assumes First Nation governments are compliant if they haven't replied in 60 days. By making space and supporting capacity to review through a co-management board, the process would further reconciliation and trust in northern research relationships. It is also possible to adapt from other co-management board models that have been in place in the Yukon and incorporate any lessons learned. By addressing the issue head on an establishing a more collaborative model, long-term costs may be reduced (i.e. First Nation governments avoid administrative costs of running their own licensing program, and Yukon Territorial Government avoids any potential legal costs of future disagreements).

Co-management would also produced challenges, such as costly initial set-up and maintenance (i.e. increase from one staff person regulating). To mitigate costs, board members would only meet as necessary, and licenses would be multi-year (granted for the duration of a research project) rather than renewed annually. There are many stakeholders in northern research, so deciding who would best serve on the board may be a challenge. Therefore, decisions on participation should be made by Yukon Territorial Government and First Nation governments in collaboration with some research community or university administration representatives.

This recommendation is based on 24 full interviews and several information conversations with individuals including permit regulators, Yukon and First Nation government reviewers, researchers from the natural and social sciences who apply for permits, and other stakeholders in Yukon research. Please see http://sciencepolicy.ca/sites/default/files/webform/policy_final_draftforcspc.pdf for further information.

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HONOURED PARTICIPANT - DR. GIANNI CASTIGLIONE

Canadian Innovation requires Online Collaboration between Experts and the Public

Theme 2:	Theme 3:	Theme 5:
How does Canada get the new scientific knowledge it needs?	How do we strengthen the environment for the production and integration of new scientific knowledge?	How do we engage the public in Canada's science system?

BIOGRAPHY

Dr. Gianni Castiglione is a postdoctoral fellow at the University of Toronto working with Professor Belinda Chang, where he has also been managing her laboratory and personnel during her medical leave. His research centers around protein evolution in the visual system, where he uses evolutionary approaches to understand how the retinal light detector rhodopsin can create human disease, as well as underlie organismal adaptation to different environments. He recently published the first of his PhD research projects in PNAS (http://www.pnas.org/content/114/28/7385.abstract) which has had substantial media attention since. He officially graduated in June 2017, and is currently pursuing postdoctoral funding opportunities at Princeton and Harvard. He was President of a large political organization at the University for several years during his Ph.D. In this capacity, he was an invited speaker in debates, panels and lectures across the country.

INSPIRATION

"We have a wealth of expertise in Canada- how can this be best leveraged towards translational research? It is a characteristic of modern times that even though we idolize science, researchers have very little influence in government policy. Similarly, business leaders often complain about the lackluster economic and financial validity supporting large government initiatives. Why does outside advice appear to be ignored by the government? As a scientist, I felt compelled to turn my political frustration into action. I wondered if there was a way to allow experts across fields to collaborate, and to better leverage Canadian talent in both science and business in an open-access and transparent fashion. Could such a framework also involve the lay-public in a way that builds democratic legitimacy for projects? Could this therefore also be used to provide government decision-makers with expert opinions from public and private spheres?"

OPPORTUNITY FOR ACTION

Canada produces above average output in higher education[1], yet this has not translated into increased business expenditures into research and development[2]. Instead, we continue to lag behind other major countries in key innovation indicators[3]. In response to this, Scientists have been challenged to have more applications of their research, requiring direct collaborations with business and industry[4].

DR. GIANNI CASTIGLIONE

Canadian Innovation requires Online Collaboration between Experts and the Public

However, it is far from clear logistically, how this relationship is to be spontaneously forged between experts from different fields. Furthermore, dedicated reviews from expert panels, such as the Naylor report[5], appear to be ignored by federal political decision-makers[6]. Meanwhile, social capital (i.e. public support) required to give these projects political momentum[5], continues to plummet as citizens' faith in economic and political decision-makers dwindles[7]. The Federal Innovation Superclusters Initiative (ISI) is a commendable attempt to catalyze Canadian science innovation by bringing diverse stakeholders together toward a shared goal[8]. Yet, the potential for the ISI to spur innovation has been critiqued from economic angles[9], and the bar for potential applicants has been set stunningly high, with applicants responsible for organizing diverse industry-led consortia within a very short time frame[10].

How do we move beyond the "review-report-ignore" model that is paralyzing our society's decision-making ability? How do we strengthen Canadian society's ability for experts to discuss, plan and execute collaborative projects? Without meaningful and productive communication between experts and the public, the same short-term political manoeuvring that has prevented Canada from developing deeper capabilities in industries will continue to hold back innovation[11].

PROPOSED ACTION

We argue that innovation is best optimized by open-access, transparent, and participatory discourse between experts and the lay-public.

This has been demonstrated by the computer sciences for decades in the LINUX-GNU projects specifically[12], and is now being adopted by life science sectors such as the Structural Genomics Consortium[13]. Meanwhile, open-access online peer-reviewed journals such as PLoS and eLife are directly influencing science policy despite their relatively recent arrival[14,15]. Adopting this open-access framework for science policy and innovation faces unique challenges: multiple fields of expertise need to be synthesized[1,5,13-16]. This requires a systematic avoidance of private languages and closed discourse, and an embrace of a more jargon-free community oriented discourse based on the shared value of interdisciplinary collaboration[16]. It also requires a common space, online, where open-access and participatory discourse between experts can take place. Importantly, the discussion must move beyond summarizing problems, and instead directly propose actionable solutions that are relatable to the public.

We have created an online platform for collaboration in the 21st century- www.eParliament.ca which publishes academic ideas in simple language. Our goal is to create a new institute that will facilitate the engagement of citizens and experts. eParliament is particularly well suited to tackle big-policy ideas, such as those in the Federal Innovation Superclusters Initiative where multiple fields of expertise must be leveraged in order to achieve common goals for Canadian society. Synthetic biology is on the forefront of translational research, and has the potential to reshape many areas of the Canadian economy through the collaboration of a diverse set of experts[137]. Therefore, supporting Canadian synthetic biology research and industry requires an integration of business and science-based policy, for which eParliament is uniquely suited to facilitate.

DR. GIANNI CASTIGLIONE

Canadian Innovation requires Online Collaboration between Experts and the Public

Motivated by the Federal Innovation Superclusters Initiative, eParliament is hosting a collaborative proposal for the creation of a Canadian synthetic biology institute (https://eparliament.ca/main-st). Our evidence-based approach features financial and policy analysis in simple language to solicit support from the public. Most importantly, eParliament is encouraging everyday-Canadians to investigate for themselves the potential of synthetic biology to bring our economy into the 21st century.

We hope that in this way, eParliament can demonstrate how political initiatives of massive economic value need not be exclusionary; rather, we aim to prove that innovative ideas emerge through accessibility, diversity and collaboration within a modern, online space.

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HONOURED PARTICIPANT - DR. BART DE BAERE

The Case for an Innovative Canadian Scientist-Entrepreneur National Support Framework

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Theme 2:
How does Canada get the new scientific knowledge it needs?

Theme 3:
How do we strengthen the environment for the production and integration of new scientific knowledge?

Theme 4:
How can we more effectively bring new and existing scientific knowledge to bear on Canada's challenges?

BIOGRAPHY

Dr. Bart De Baere is a Postdoctoral Teaching and Research Fellow at the University of British Columbia Department of Earth, Ocean and Atmospheric Sciences in Vancouver. His research centers around applying new laboratory testing instrumentation that he developed during his PhD to assess the carbon storage potential in mine waste, a pathway that may allow for carbon-neutral mining. Given this potentially commercial application of his research, Bart recently completed a Graduate Certificate in Science and Technology Commercialization at Simon Fraser University. In parallel, he teaches introductory undergraduate courses covering the Earth's past, present, and future climate. Bart – a proud Canadian citizen since late 2015 – completed his undergraduate and Master degrees in Oceanography at the University of Southampton in the United Kingdom (focusing on aqueous geochemistry). After a brief period at Oregon State University, he settled in Vancouver where he completed his PhD in Oceanography.

INSPIRATION

"Over the course of my PhD studies, I designed new, innovative laboratory testing instrumentation. With the support of my graduate advisor, I attracted the necessary financial resources to develop a working prototype, the first of its kind in Canada. As we iterated towards identifying new, promising applications of this innovative new technology, the focus of my PhD studies was repeatedly adjusted. As a result, I was only able to produce conventional research output (peer reviewed publications) during the final few years of my graduate studies when the most promising applications were verified. This put me at a significant disadvantage when applying for postdoctoral funding given the existing metrics used to allocate tri-council postdoctoral funding. Using an innovative Canadian Scientist-Entrepreneur National Support Framework, I hope to remove existing funding barriers, thereby encouraging risky, possibly disruptive scientific research by entrepreneurial early-career scientists and engineers."

DR. BART DE BAERE
The Case for an Innovative Canadian Scientist-Entrepreneur National Support Framework

OPPORTUNITY FOR ACTION

The Naylor report[1] revealed "very low success rates in competitions and a sense of futility on the part of young scholars and researchers." Referred to as "a valley of death between early career scientists and more established researchers," this attrition should be addressed, both because HQP are being lost south of the border and because we are underutilizing many who decide to stay in Canada. In parallel, according to the report, peer review committees "favour proposals using proven techniques, in areas that have been productive in the past." In other words, innovative, high-risk research is inherently discouraged. Where does this leave our most innovative, entrepreneurial early-career scientists and engineers? The status quo is inherently discouraging innovative research – particularly by young scholars and researchers – even though it has the potential to introduce transformative technologies benefiting all Canadians.

The 2016 Canadian National Postdoctoral Survey[2] found that entrepreneurship is increasingly of interest to postdoctoral fellows. Yet, Canada lags other OECD countries on science entrepreneurship. The absence of a dedicated Canadian Scientist-Entrepreneur Support Framework represents a missed opportunity. While salary support is essential for these young scientists-entrepreneurs iterating towards viable market solutions, no federal postdoctoral fellowship stream considers this need as a selection criteria. The ideal time to launch an academic science spinoff is in the years directly following the completion of a PhD. These newly graduated scientists are idea-rich and risk-tolerant but cash-poor. Beyond this, success rates for obtaining 'conventional' tri-council postdoctoral fellowship have been steadily decreasing[1]. This not only prevents Canadian scientist-entrepreneurs from crossing the "Valley of Death" between science invention and market adoption, it leaves entrepreneurial R&D hinging on uncertain postdoc supervisor support. As this high-risk, innovative research negatively impacts traditional research output metrics (disclosure via peer-reviewed publication may negatively impact intellectual property protection), the existing framework is simply unsuitable. If we want a thriving knowledge-based economy, we need to remove constraints from scientist-entrepreneurs.

Thus, a clear opportunity exists to cater to our early-career scientist-entrepreneurs within the federal science funding framework. Providing this group of currently underserved researchers with the necessary funding and training will not only improve retention of highly-qualified personnel (HQP) (merely 38% of graduating international PhD students are employed in Canada according to the UBC PhD Career Outcomes 2005 – 2013 Survey[3]), it will help create sustainable, knowledge-based career opportunities. In parallel, complementary know-how and/or services necessary to bring a product to market will contribute towards the creation of innovative research clusters. Therefore, tending to the needs of our early-career, innovative scientist-entrepreneurs will help create a thriving knowledge-based economy and national innovation system.

Major policy changes are urgently needed to enable scientist-entrepreneurs by aligning their incentives with that of regional and national systems of innovations. To this end, I outline three science policy suggestions: (1) a dedicated stream of scientist-entrepreneur postdoctoral fellowships, possibly administered by tri-council agencies and/or the National Research Council (NRC); (2) subsidized science and technology commercialization skills training programs and networking opportunities; and (3) more accelerator programs geared towards the commercialization of "hard science" inventions.

DR. BART DE BAERE
The Case for an Innovative Canadian Scientist-Entrepreneur National Support Framework

PROPOSED ACTION

1. **Scientist-Entrepreneur Postdoctoral Fellowships**

   One of the most fundamental requirements to keep scientist-entrepreneurs focused on their innovation ideas is salary support. Some initiatives in Canada have aimed to support postdoctoral fellows engaged in university science commercialization. The Impact Centre at the University of Toronto has introduced an 'Innovation Fellowship' award that is made available to individuals who are in the early stages of developing a startup based on a new technology[4]. These awards not only provide crucial financial support but also intensive coaching. Although similar awards have been introduced in Ontario, in total less than ten awards have been awarded per year[4]. In contrast, a program with Berkeley Lab funded by the U.S. Department of Energy (Cyclotron Road) funded 20 two-year fellowships in its first cohort[5].

   Policy suggestion #1

   Establish 2-year tri-council and/or National Research Council (NRC) funded postdoctoral 'innovation fellowships'. Selection criteria should include the potential and traction of the innovative technology and/or service offering.

2. **Science and Technology Commercialization Skills Training Programs**

   In the "hard sciences" science and technology commercialization skills training programs need to address the unique challenges faced by scientist-entrepreneurs. Unlike other sectors, such as consumer software, innovation in the "hard sciences" involves addressing unique challenges related to combined technology and market uncertainty[6]. Here in Canada, an exemplary part-time graduate certificate program has been developed at the Simon Fraser University Beedie School of Business entitled "invention to innovation."[7] Over the course of a year, scientist-entrepreneurs are provided with the theory, frameworks, skills, and professional network to commercialize their inventions. This program stands in stark contrast to more widely available university entrepreneurship initiatives in that it addresses the unique commercialization challenges faced in the "hard sciences." Similarly, as part of the Cyclotron Road program south of the border, participants receive intensive training and mentorship to address the challenges of "hard science" innovation.

   Policy suggestion #2

   Establish a subsidized curriculum geared towards "hard science" scientist-entrepreneurs, available to scientist-entrepreneurs across Canada. Curriculum development should draw from expertise available from visionary initiatives such as those at Simon Fraser University, University of Toronto, and Berkeley Lab.

3. **Encouraging "hard science" accelerators**

Visionary accelerators geared toward "hard science" innovation in Canada and south of the border provide exemplary frameworks that could be implemented on a national scale. Due to the unique challenges faced during the commercialization of "hard science" inventions (e.g. high cost, lengthy R&D, technology and market uncertainty), few accelerators cater to scientist-entrepreneurs, leaving young scientist-entrepreneurs in a vulnerable position. Nevertheless, a select few promising Canadian initiatives need to be highlighted. The Centre for Drug Research and Development (CDRD), at the University of British Columbia, lowers technological uncertainty of promising new therapeutics. In advanced materials and nanotechnology R&D, 4DLabs – a research facility based at Simon Fraser University in Burnaby, British Columbia – has partnered with NRC-IRAP (National Research Council Industrial Research Assistance Program) to provide facility and equipment access for up to $10K per project to SMEs (JumpStart program). Other university facilities supporting nanotech innovation include the "nanofab" fabrication and characterization centre at the University of Alberta, the "Toronto Nanofabrication Centre" at the University of Toronto, and the "3IT" Interdisciplinary Institute for Technological Innovation at the Université de Sherbrooke.

Policy suggestion #3

By allocating start-up funds to scientist-entrepreneurs, "hard science" accelerators could be more easily leveraged to help jumpstart product / service development. Funds could be administered by tri-council granting agencies. These funds would not only speed up R&D by providing access to specialized equipment and expertise, they would provide sustainable, long-term HQP support, which will contribute towards the creation of innovative research clusters.

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HONOURED PARTICIPANT - JOEY LI

Implementing a Federal Organ Donation Registry and Switching to a Presumed Consent Model

Theme 1:
What are Canada's likely challenges in the next 50 years, and how can scientific knowledge be used to solve them?

Theme 4:
How can we more effectively bring new and existing scientific knowledge to bear on Canada's challenges?

BIOGRAPHY

Joey Li is a grade 12 student at Crofton House School in Vancouver, British Columbia. She has always been interested in medicine and has enhanced her understanding of the field by attending the Cardiothoracic Surgical Skills Summer Internship at Stanford University this past summer. Having gone to school in Canada, China, and England, she is passionate about learning various medical practices around the world. Adapted to an international environment, Joey wishes to pursue a career in the future that integrates international relations with medicine. As she completes her final year of high school, she hopes to continue not only excelling in her studies within school, but continue improving the many projects she is involved with in her community. Some projects include developing a startup that helps high school and university students have easier access to academic assistance and being part of the executive team of various youth-run non-profit organizations such as STEM Fellowship and Operation Med School.

INSPIRATION

"This past summer, I was exposed to the world of surgery through a surgical internship at Stanford University. This program opened my eyes to medicine through discussions of its role in the past, present, and future. Returning to Vancouver, I continued researching the many aspects of medicine I learned during my internship, in which included the discussion of organ donation practices around the world. From analyzing the statistics involved with organ donations in countries that employ the two models, I learned that an presumed consent practice has brought the death rate of patients on an organ transplant waitlist significantly lower than the rate in countries that follow the conventional opt-in practice. I hope that Canada will follow the footsteps of the many countries switching to an opt-out service and remain on the frontier of innovative medical practices."

OPPORTUNITY FOR ACTION

In 2015 alone, 3,000 Canadians were actively waiting for an organ transplant, which excluded 242 patients who passed away while waiting and 400 who withdrew before receiving a transplant."[1] A comparable minimal number of 2,058 patients that year received either a single or combination organ transplant.[1] A clear, disproportionate ratio of patients who have received a transplant to those who were left in the shadow of the conventional practice of voluntary organ donation.[1] As the 400 Canadians withdrew from the waitlist, many went to seek alternative options - a substantial crowd desperately led to the doors of overseas black market trades.[2]

JOEY LI
Implementing a Federal Organ Donation Registry and Switching to a Presumed Consent Model

Findings have shown that obtaining an organ overseas is three to four times more risky for patients than obtaining a transplant within Canada.[3] The most recent study proved that roughly 20 percent of commercial transplant patients died, and 30 percent of the patients began to experience organ failures.[3] However, it is understandable that many patients are willing to take the risk than wait for a transplant that is likely not going to happen in time.[3]

For many, for instance, a patient named Matin Khan in Toronto suffered through dialysis for many years waiting for a kidney to become available.[2] Deciding to take matters into her own hands, this patient decided to spend $10,000 to buy a kidney from an illegal organ trade in Pakistan.[2] Unfortunately, as she returned back from her transplant in Pakistan, symptoms revealed that she was experiencing organ failure.[2] Despite a near death experience, Khan still persisted and returned back to Pakistan to purchase a second kidney.[2] Khan's case is clearly demonstrating the faults of the current organ donation system in Canada, which is in need for a new practice to prevent the increasing deaths from the annual prolonged wait times and dangerous/illegal trades overseas.[2,3]

Currently, there is a patchwork of provincial organ donation registries which itself is posing many problems for the insufficient organ donation practice in Canada.[4] Conservative MP for Edmonton-Manning, Ziad Aboultaif, experienced himself the Canadian organ donation process as his son endured through the wait times of three liver transplant operations.[4] In 2016, Aboultaif rose in the House of Parliament to table a bill for a more collected national strategy for organ services in Canada.[4] A professor of medicine at the University of Alberta, Dr. Philip Halloran further highlighted this issue as he expressed his opinion that Canada is "underperforming as a country and our deficiency is lack of federal activity."[4] Experts of organ and transplants responded with great approval and that the "idea could save hundreds of lives annually and incalculable suffering and torment."[4]

Public opinion has shown that approximately 95% of Canadians approve of organ donation; on the contrary, only 51% of Canadians are registered to donate their organs after death.[5] With the evidence of statistics and experts, a reform needs to take place as soon as possible on a federal level to replace the existing scattered provincial registries for voluntary organ donation.

PROPOSED ACTION

The combination of practices within the general organ donation service in Canada is in need for an organized, structured reform. With the current system leaving many families out of options and in search for international black market solutions, Canada should first address the failure to meet demand for organ transplants. Without a reason for families to look elsewhere for illegal organ trades, Canada can then set a federal ban on the Canadian purchasing power of organs internationally. Transplant tourism is a very real issue and should have a legislation preventing from Canadian engagement. The change process, therefore, is recommended in the order of the following:

1. **Opt-out, not opt-in**: Federal presumed consent for organ donation rather than a voluntary registration practice

JOEY LI

Implementing a Federal Organ Donation Registry and Switching to a Presumed Consent Model

- The federal government is in need of a federal organ donation registry* that overlooks all provincial registries* (*registries work with refusal, rather than donation, registrations)
- Easy access to refusal registration
  i. Online Portal
  ii. Family Physician

2. **Ban on transplant tourism**: With expected declining numbers of Canadians seeking for transplants overseas, a legislation can then be put in place to prevent citizens from buying organs overseas that involve high-risk, infectious procedures.

Some may suggest remaining as an elective donation model due to the insignificant impact for countries such as Brazil that previously explored this option but reverted back to an opt-in practice.[6] However, with the statistics in Canada of 95% of its citizens willing to be an organ donor, an opt-out model would very likely be successful.[5] It should be noted that every country is different in culture, people, and tradition; Canada is known to be a front-runner in technology and has a diverse population with an liberal mindset. This change from an opt-in to an opt-out policy, despite not being effective in countries like Brazil, could very well be the key to revolutionize Canadian transplant services.

As of January 1st this year, France has made the switch to a presumed organ donation practice.[7] As France explores this option for the better of its national medical services, Canada needs to follow France's footsteps in deciding whether the change in practice is effective for itself. The World Health Organization, for one, has conducted research that has proven that presumed consent is in fact very successful in increasing donation rates.[7] Ultimately, an effective opt-out system will not only decrease death rates from patients on wait lists, but decrease the rate of deaths of Canadians seeking subpar transplant procedures abroad.

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HONOURED PARTICIPANT - DR. NATALIA MYKHAYLOVA

It's time to stop holding our breath

Theme 1:
What are Canada's likely challenges in the next 50 years, and how can scientific knowledge be used to solve them?

Theme 2:
How does Canada get the new scientific knowledge it needs?

Theme 3:
How do we strengthen the environment for the production and integration of new scientific knowledge?

Theme 4:
How can we more effectively bring new and existing scientific knowledge to bear on Canada's challenges?

Theme 5:
How do we engage the public in Canada's science system?

BIOGRAPHY

Dr. Natalia Mykhaylova has a background in engineering, chemistry and design. A graduate of Etobicoke School of Arts, she has a B. Sc. in Pharmaceutical Chemistry and a PhD degree in Chemical Engineering from the University of Toronto. Her PhD work involved the development of novel devices and adaptable wireless networks for air pollution monitoring and targets a major unmet need - access to a reliable, low-cost and high time resolution device for measuring the air we breathe. She co-founded two social ventures and helped ensure the success of two start-up companies and 5 non-profit organizations. Her research work has been recognized by UofT Magazine, Phys.org, UofT News, Metro News, CTV News. She enjoys coming up with elegant solutions to big problems, transforming current systems and our future in the process.

INSPIRATION

"When completing my PhD degree, I developed a new, portable device that can accurately measure air pollutants at a fraction of the cost of existing devices. While using the device to study air pollution in Toronto neighborhoods, many parents approached me for advice on ways they can protect the health of their children. Some parents were concerned about the dust and idling pollution from construction in many local neighborhoods. Other parents had toddlers with respiratory conditions and could not spend time outdoors because it increased the severity of their condition. Many of the children had to use respirators and several different types of medications on a regular basis but the families did not have the means to move away from the highly polluted city core. I became very passionate about this issue because I felt that given my findings, I have a duty to raise the awareness."

OPPORTUNITY FOR ACTION

A recent study in Canada has revealed that even modest levels of air pollution contribute to effects on health and increased annual emergency room visits[1]. Air pollution has also been linked to heart disease, stroke, cancer, diabetes and chronic lung disease, the major killers in most countries. While all age groups are affected by poor air quality, children are most impacted[2]. Young children are especially vulnerable because their lungs and immune system are still developing. They also breathe a greater volume of polluted air relative to their body mass and their exposure is often higher outdoors due to a high concentration of vehicle exhaust at their low elevation from the ground.

DR. NATALIA MYKHAYLOVA
It's time to stop holding our breath

Much of this burden falls on low-income families[3], who often live in areas close to pollution sources such as traffic and industry. These families are more vulnerable because they cannot afford effective air purification devices to protect the health of their families. Parents of children who have conditions like asthma, environmental allergies and cystic fibrosis often do not have good options to protect their child. Some parents try to protect children by keeping them indoors. While this reduces exposure to outdoor sources like traffic, indoor pollution (i.e. cooking emissions, paint off-gassing) in many cases can be worse than outdoor pollution. Air pollution is very variable across time and space, requiring local monitoring to understand the extent of risk. Since air pollution impact is often long-term and not immediately apparent, there are many misconceptions about air pollution and the effectiveness of air purification. Governments are working to reduce air pollution but it may take years to clean up the pollution to acceptable levels.

PROPOSED ACTION

I have a vision of how we can democratize access to clean air through better knowledge-based policies. My idea is an evidence based policy that engages citizens in collecting data and learning from their data. The policy would involve providing access to portable air monitoring add-ons for child cribs, strollers and car seats. Such devices are available commercially and can be provided to the parents at birth centres. The devices can detect pollution sources and suggest interventions, helping parents manage the health of their child. The devices would form a dense online air quality map, providing citizens, researchers and medical professionals with data on local and neighborhood levels of ambient air pollution. The data would be anonymized and specific location would not be disclosed for privacy reasons. However, the collected information would still be a powerful tool for parents, researchers and policy makers. The platform would allow medical professionals to identify the people at risk of developing respiratory conditions and improve treatment regimen for people at risk. At-risk groups could benefit from access to real-time air pollutant exposure information, helping them to control their medication, identify and control pollution sources and avoid locations associated with high pollution levels. This would in turn reduce healthcare costs.

The result would be citizens engaged in knowledge production, feeling empowered for not just taking an action to ensure health of their kids but also for contributing to revitalization of their communities. The solution would help public feel more accountable for the actions they take, encouraging reduction in carbon emissions. For example, by having access to their own air quality device, citizens minimize driving and the associated carbon emissions since it's both a source of air pollution and green house gases.

Lower-cost technologies for personalized air pollution monitoring could allow policy-makers to develop more targeted and effective air pollution policy interventions to prevent air pollution impact (i.e. urban planning) or control it (i.e. urban remediation, source control). At the societal level, such technology can be a disruptive force for positive change. It's about time for us to know more about the air we're breathing and become more engaged and healthy.

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HONOURED PARTICIPANT - DR. AMANDA PAPPIN

Towards Integrated and Targeted Air Quality and Climate Policies

Theme 4:
How can we more effectively bring new and existing scientific knowledge to bear on Canada's challenges?

BIOGRAPHY

Dr. Amanda Pappin is an NSERC postdoctoral fellow in the Water and Air Quality Bureau at Health Canada. She received her Ph.D. from Carleton University in 2016 after completing her Bachelor of Engineering in 2011. In her research, Dr. Pappin offers an engineering perspective on the interactions between atmospheric pollution, public health, economics, and policy. She devises methods to address environmental and public health policy challenges with far-reaching societal relevance. A former Fulbright scholar and visiting researcher at Yale University, Dr. Pappin is a recipient of numerous national and international awards. Examples of such awards are Fulbright Canada's Fulbright Student Award; NSERC's Alexander Graham Bell Canada Graduate Scholarship; Mitacs' Canadian Science Policy Fellowship (declined), the Air & Waste Management Association's Award for Policy Research and Study Related to Air Quality; and Environment and Climate Change Canada's Atmospheric and Meteorological Graduate Supplement.

INSPIRATION

"My interest in air pollution research was inspired early in my Bachelor's degree. Having learned about what happens to pollutants when they are released into the atmosphere, I was curious about the impacts of air pollution and how to best manage them. I began a research project to estimate the public health impacts of emissions, and loved that I was developing a unique approach and learning so much about different disciplines – from environmental economics, to epidemiology and policy. I continued building upon my undergraduate work into my Ph.D., where I have contributed to the development of an important research area that is still evolving and vital today. What I enjoy about my research is its tangible societal impacts and policy-oriented nature. At Health Canada, I am working to extend the reach of engineered models into epidemiological applications and to more directly inform evidence-based policy development in Canada."

OPPORTUNITY FOR ACTION

Ambient air pollution is a leading risk factor for premature death and illness worldwide, resulting in an estimated 3.2 million deaths per year[1,2]. A number of outdoor air pollutants have been linked to mortality and morbidity endpoints, including fine particulate matter or PM2.5 (airborne particles less than 2.5 m) and gaseous oxidants ozone (O3) and nitrogen dioxide (NO2).

DR. AMANDA PAPPIN

Towards Integrated and Targeted Air Quality and Climate Policies

Despite the fact that Canadians experience better air quality than many polluted regions in the world[2], there is still a substantial public health burden associated with outdoor air pollution in Canada. Mortality estimates range from 7,700[3] to 21,000 deaths per year in Canada[4], with millions more exacerbated asthma symptoms and days of breathing difficulties.

Air quality in Canada is currently managed through the Canada-wide Air Quality Management System (AQMS). The AQMS is an agreement by the federal government, provinces and territories in Canada to collaboratively manage air pollution and emissions. The main driver for the AQMS is the setting of Canadian Ambient Air Quality Standards (CAAQS) for pollutants such as PM2.5, O3, and NO2. In order to achieve CAAQS, collaborative initiatives to regulate emissions from industrial and mobile (motor vehicle) sources have been undertaken across airsheds in Canada. The AQMS and former programs have resulted in declines in emissions of PM2.5 and nitrogen oxide by roughly 20%[5]. The result has been a gradual but sustained improvement in ground-level NO2, SO2, volatile organic compounds (VOCs) and peak O3 levels in Canada[6].

Managing air quality through reducing pollutant emissions entails significant societal benefits to Canadians. In a recent report, Stieb et al.[7] estimated a reduction of 2,500 premature deaths per year, 2,200 hospital visits, and 770,000 asthma cases due to the declining levels of PM2.5 across Canada from 2000 to 2011. Despite these averted health outcomes, estimates of the damages of air pollution have increased over time as the collective evidence points towards risks for health endpoints not previously considered, new and refined shapes of the exposure-risk relationship, and a changing atmospheric mixture, leading to higher risks at lower concentrations[8-13]. While traditional health benefit assessments (e.g., Stieb et al., 2016[7]) provide invaluable information on the distribution of averted air pollution impacts, they do not make the direct connection between changes in anthropogenic activities (i.e., emissions) and public health. The impacts of emissions depend on characteristics of the atmosphere that vary in time and geographically (such as weather), necessitating the use of sophisticated models for making this connection. In past work[14], I developed a novel method to integrate health benefit assessment with state-of-the-science atmospheric models.

Such models track how pollutants emitted are transported and transformed in the atmosphere. I extended these modelling abilities to trace health outcomes back to their sources, offering measures of how sensitive public health is to changes in emissions. The approach I developed is unique in its ability to differentiate between the societal impacts of each polluter, by source type, location, and time of emission. This linkage of emissions and health impacts creates a streamlined approach for assessing the damages incurred by anthropogenic emissions, on a source-by-source basis, and the benefits of their control. My work in this area continues to be at the forefront of the rapidly growing intersection between policy, atmospheric science, public health, and economics.

DR. AMANDA PAPPIN

Towards Integrated and Targeted Air Quality and Climate Policies

PROPOSED ACTION

In my research career, I have conducted work to inform air quality policy using advanced atmospheric models. Applying atmospheric models in health benefit assessment offers a new perspective and enhanced level of detail on the benefits of reducing emissions. These quantified benefits are often presented as benefit per tonne, or the monetary benefit of a metric tonne reduction in emissions in a given location ($/tonne). My past research indicates that the same tonne of emissions can have very different health impacts depending on the location of release into the atmosphere. For example, the long-term benefits of reducing NOx emissions (a key pollutant emitted from fossil fuel combustion) in large cities (e.g., Toronto or Montreal) would entail hundreds of thousands of $/tonne in benefits to the health of Canadians, while the same tonne of reduction in rural areas incurs significantly smaller benefits[13]. This finding has important policy implications, as not all emissions (and emission reductions) are equal. Further, my research provides economic incentive for more aggressive control policies, as the per-tonne benefits of control substantially outweigh per-tonne costs. This finding is consistent with the 2011 assessment of the U.S. EPA's air rules that reported an order-of magnitude difference between benefits and costs (an average benefit-to-cost ratio of 14:1[15]).

While the evidence base clearly indicates a need for action, design of the most effective (i.e., optimal) approach to managing air pollution often remains an elusive objective to policy makers. Benefit-cost analysis is not a routine component of the current health benefit assessment framework. A more streamlined approach to conduct benefit-cost assessment will offer opportunities to devise cost-effective solutions as new modelling information about the benefits of emissions control becomes available. Making these health benefit estimates more readily available will strengthen the evidence base on which decisions are made, more effectively bringing scientific knowledge to address a complex environmental challenge facing Canada.

Air quality is impacted by policies beyond those targeting ambient pollution, the most notable of which are climate policies. As Canada transitions to a more proactive federal and provincial climate change mitigation strategy, my research is well positioned to quantitatively evaluate the interactions between climate and air quality policies. Approaches to reduce GHG emissions (mainly combustion-based CO2) result in reductions of air pollutants from the same sources. Using the benefit per tonne metric described above, the co-benefits of this simultaneous reduction in air pollutant emissions are readily quantifiable on a sector and location-specific basis. GHGs persist for many years once emitted, leading to uniform global concentrations relative to air pollutants, which have relatively short lifetimes and vary from place-to-place. While the same CO2 reduction from two different sources would have similar impacts on global temperatures, co-reductions in air pollutant emissions could entail vastly different public health impacts. The climate-related impact of 1 tonne of CO2 reduction is valued at the social cost of carbon (roughly $41/tonne[16]), yet co-benefits can be in excess of $1000/tonne for specific sources and locations[17].

Further, these co-benefits are realized on more immediate timescales than direct warming-related impacts of temperature reductions. Co-benefits can thus offer economic justification fortaking action on climate fronts. Coordinating efforts to improve air quality and mitigate climate change offer an untapped opportunity to optimize policy and maximize societal benefits. This linkage can provide a positive force for the success of market-based economic instruments (e.g., cap-and-trade) used in mitigating climate change. Translating these findings into policy will pave the way towards sustained and more equitable environmental quality across Canada.

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@samanthaZY

HONOURED PARTICIPANT - SAMANTHA YAMMINE

Give and take: how sharing science knowledge gets everyone further

Theme 5:
How do we engage the public in Canada's science system?

BIOGRAPHY

Samantha Yammine is a PhD Candidate in the Department of Molecular Genetics at the University of Toronto studying how stem cells build the brain during development and can be used for its repair after injuries or disease. She is passionate about science communication and has been using social media in innovative ways for over a year to make science accessible to people from all over the world. Across Instagram, Twitter, and Facebook, she shares engaging stories about my research journey and promote equity, diversity, and inclusivity in STEM fields with over 13,000 people daily. Her passion for science policy was sparked by her participation in the inaugural Science Outside the Lab North science policy week where she learned about the multi-faceted nature of science policy decisions. She is committed to changing the way people see science and scientists for the betterment of science policies and overall innovation in Canada.

INSPIRATION

"A few months ago I received an email from a well-meaning parent about the (unregulated) clinical trial abroad their child has been a part of for over a year. It was clear to me this was not an actual clinical trial and that their child was undergoing very painful and dangerous procedures. But since it was not clear to those parents who did their best to research their options, scientists are not doing enough to engage the public in a way that quells hype and empowers patients to make informed health decisions. Since science research is publicly funded, it is our responsibility to show Canadians that they are getting a return on their investment in science through the new knowledge it creates. Cultivating this public support of science is required for policymakers to be able to give research the funding it needs to keep Canada at the forefront of innovation."

OPPORTUNITY FOR ACTION

Canadian scientists are at the cutting edge of research and innovation that can improve the lives of Canadians and those around the world. Unfortunately this research is not always sufficiently and accurately translated by scientists to the public whose tax dollars support their research.

SAMANTHA YAMMINE

Give and take: how sharing science knowledge gets everyone further

It is important to bring all Canadians into discussions about science so that we can have an informed electorate with the diverse viewpoints necessary to address interdisciplinary policy challenges. Public support of science helps ensure that Canada's research program can continue to find solutions for the complex problems the world faces. Further, scientific literacy is of cultural value for Canadians because, as stated in the Fundamental Science Review chaired by Dr. David Naylor, "a society that values and supports scientists and scholars [...] is much more likely to remain a global beacon of inclusion and social solidarity."

According to a 2014 report by the Council of Canadian Academies, Canada's science culture is in good international standing but still has major gaps that need to be addressed. Their expert panel found that more than half of Canadians lack the basic understanding of scientific concepts required to make sense of public debates on issues related to science. They also found that 49% of Canadians do not understand the concept of DNA, thus limiting their ability to make informed decisions about new technologies and research; further, 59% cannot describe what it means to study something scientifically.

Scientists are responsible and privileged to be able to address these gaps in knowledge so that the negative impact they have on personal health and policy opinions can be mitigated. A study conducted by Campaign Research found that 83% of Canadian respondents have some trust in scientists, which is greater than the 63% of respondents who had trust in media[1]. Given that trust is an important aspect of effective social communication[2], scientists can therefore be a valuable medium for science communication. At present, however, there is neither coordination nor formal training for scientist-led science communication in Canada. Scientists and trainees can go through their entire career without receiving any proper training in how to speak to the media, explain their research in an accessible manner, or respond professionally and respectfully to sensitive questions from stakeholders in their research like patients.

Canada does currently have several separate training programs for science communication, and while these offer valuable training for those trying to transition into careers in science communication, the majority of scientists who remain in industry or academic research do not participate.

Researchers who do attempt to do science outreach and communication anyway often do so without institutional support or encouragement, and at the risk of negative perception by their colleagues[3-6]. In fact, several scientists report fear of negative impact to their professional reputation as a major barrier to participating in science outreach they otherwise deem valuable[7]. This has been given a name: the "Sagan effect", whereby the more you well known you are the less serious of a scientist you are considered to be[8,9]. This is a symptom of an academic culture that is isolated from the social system that supports it and entrenched with intellectual elitism that can give scientists a negative perception in the public eye.

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There also tend to be disparities in the representation of scientists who do science outreach and communication. For example, in a survey of 3455 scientists from the trainee to faculty level, 72% of women and 43% of men participated in science outreach across several disciplines in the natural sciences[10]. While in one way this is a positive because it means more visible role models in STEM for young females, this is largely negative given the compounding barriers these female faculty members are having to overcome as minorities in many STEM departments across the country[11].

PROPOSED ACTION

Science research does not occur in a vacuum and Canadian policies should reflect this so we can remain a world leader in academic excellence and science literacy. Science communication should therefore become a mandatory part of academic training, and research grants supported by tax dollars should require some efforts in science outreach to relevant communities and patient populations.

But before we can get more scientists sharing their science, we have to make sure they are armed to do this effectively, as many scientists report that they lack the confidence in their abilities to do so[3,8]. Training and mandatory participation in science communication are necessary so scientists can acquire sufficient training, motivation, and support to conduct their outreach effectively[8]. If science communication training were a mandatory part of all scientific training, this could change the stigma and normalize the practise of responsible sharing of new knowledge.

This would not mandate that researchers become the sole communicators of science in Canada; on the contrary, their efforts should be complementary to the valuable work done by science journalists and reporters. Science outreach and communication done by researchers would involve mentorship or career talks to younger students, hands-on activities, public lectures, and open access lay summaries online. Documentation and metrics of these efforts should be requirements on federally funded grant applications, similar to the Broader Impacts review criterion on National Science Fund grants in the US.

To empower researchers to do this, science communication training should begin early in their academic careers. There are currently only a few training programs for science communication in Canada and they are not accessible to all scientists due to cost, location, scope and time given that they are extra-curricular. If it became part of regular academic training, it would be viewed as less of a burden[10]. General science communication training should take the form of workshops and short courses throughout science training and particularly in graduate school.

Topics covered should include the fundamentals of science communication: science writing for a public audience, navigating controversies and crises, digital media strategies, and psychosocial training on how to be an effective communicator, including training on inclusive language.

As communication skills are a necessary part of nearly every career, this training will be of benefit beyond outreach efforts. Further, this training also has the added benefit of offering trainees a more diverse skillset, which is very valuable given that less than 19% of Canadian PhDs remain in academia[12].

SAMANTHA YAMMINE

Give and take: how sharing science knowledge gets everyone further

There are several organizations committed to outreach and engagement across the country that have been incredibly successful, though they are not always valued sufficiently to receive the resources they require to reach more people. For example, SciXchange program at Ryerson University sets a good example for the vision of this policy. This program has organized several outreach events for the public that offer great opportunities for scientists to practise their science communication, such as science street festivals and informal public lectures. The SciCommTO community is a grassroots organization doing an excellent job at coordinate inter-disciplinary science outreach events delivered to the public by scientists.

These efforts ought to be mandatory across the country and nationally coordinated to optimize efficiency and ensure equitable access. Some of the only coordinated, nation-wide programs at present are Let's Talk Science and Science Literacy Week. While both fantastic models for outreach, they are not evenly distributed across time, geography, and ages. By having policies that support science communication, Canada can improve its health, economy, culture, and environment[13,14]. If science communication training and practise became mandatory through science policies for education and funding, this could change academic culture to be more inclusive and engaged with society. Since science outreach promotes more public inclusion and support of science, an investment in science communication is an investment in all science policies.

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HONOURED PARTICIPANT - CHARLES YIN

A National Oversight Body for Physician-Scientist Training: Challenges and Opportunities

Theme 2:
How does Canada get the new scientific knowledge it needs?

Theme 3:
How do we strengthen the environment for the production and integration of new scientific knowledge?

BIOGRAPHY

Charles Yin is a MD/PhD Candidate and Vanier Scholar in the Department of Microbiology and Immunology in the Schulich School of Medicine and Dentistry at Western University. Under the supervision of Dr. Bryan Heit, he studies the role of macrophages in the progression of atherosclerosis and heart disease. Charles previously completed his undergraduate degree in Integrated Science and Biochemistry at McMaster University, where he volunteered extensively as a public science educator and co-founded a student club that promotes student science research. Since beginning his studies at Western, Charles has brought his passion for science advocacy to promoting physician-scientist training both locally within Western's MD/PhD program and at the national level through the Canadian Federation of Medical Students (CFMS) and Clinician-Scientist Trainee Association of Canada (CITAC).

INSPIRATION

"The decision by CIHR to cut funding for MD/PhD programs in 2015 prompted a series of conversations amongst program directors and trainees on the future of physician-scientist training. I was part of a group of MD/PhD students that felt that this was a step in the wrong direction and that the trainee voice on this issue had to be heard. This group evolved into a national committee, which I chaired, that examined how to reform and improve physician-scientist training in Canada. After a comprehensive review of available data from the U.S. and Canada, we concluded that beyond funding, issues such as a lack of mentorship and limited integration between clinical and research training will require a coordinated response from a national body that will oversee physician-scientist training. Our findings have been published as an opinion article, a blog post on CMAJ and adopted by the Canadian Federation of Medical Students."

OPPORTUNITY FOR ACTION

Physician-scientists are physicians who dedicate a significant portion of their time advancing medical knowledge through scientific research.[1] As the practice of medicine has become increasingly more dependent on scientific evidence generated through research, there is a rapidly growing need to bridge a growing gap between research and clinical practice. Physician-scientists, having expertise as both clinicians and researchers, are perhaps uniquely poised to bring scientific innovations from the bench to the bedside.[2]

CHARLES YIN

A National Oversight Body for Physician-Scientist Training: Challenges and Opportunities

There are two dedicated training pathways for physician-scientists in Canada: the Clinician-Investigator Program, which integrates graduate school into residency training, and the MD/PhD (or MD/MSc) program, which instead sees trainees engage in graduate studies during undergraduate medical training. These programs can considerably extend the length of training, with MD/PhD programs taking on average 8 years to complete.

Despite the growing need, support for physician-scientist training and career development in Canada has declined. Even prior to being halted altogether, Canadian Institutes of Health Research (CIHR) funding for MD/PhD training did not keep pace with increasing student enrollment.[3] Since the inception of the first Canadian MD/PhD programs at the University of Toronto in 1984 and McGill University in 1987, enrollment has steadily increased from just over 50 trainees in 1997 to well over 200 as of 2015.[3,4] CIHR began to fund MD/PhD programs in 1999 and annual funding rose rapidly to $1.5 million by 2005. However, from 2005 to 2010, funding increased by just $0.5 million. By 2015, funding from CIHR was sufficient for about half of all MD/PhD trainees in the country.[3]

In June of 2015, CIHR announced it would be cutting all funding for MD/PhD programs—citing budgetary issues—despite the money involved being a small portion of the CIHR annual operating budget and recommendations from an independent advisory panel urging increased support for physician-scientist training.[5,6] Although programs were not dependent on CIHR funding to continuing existence, the removal of this funding had the effect of exacerbating already sizable disparities between the level of financial support available to MD/PhD trainees at different institutions, and in decreasing the attractiveness of Canadian MD/PhD programs compared to their American counterparts, which often have very generous funding packages attached.[7]

This development prompted an outcry from the physician-scientist community in Canada and abroad.[8-10] Amongst calls for the decision to be reversed, a wider discussion emerged on the challenges of physician-scientist training and the idea of the training pathway being a “leaky pipeline” that results in a portion of trainees to be lost and never enter into a career as physician-scientists.[10] Amongst the challenges identified, recurring themes were a lack of appropriate mentorship as trainees transition between clinical and research training, increasing length of training, and a dearth of support for early-career physician-scientists for whom dedicated funding to establish and stabilize a research programme is crucial for success.[11] Compounding the difficulty in supporting physician-scientist training is the lack of available data on program structure, best practices and training outcomes.

Now is a particularly opportunity time to dramatically reform and renew how physician-scientist training is conducted in Canada. The recently released Naylor Report has called for wide-spread re-structuring of basic science funding and oversight, presenting an opportunity to establish an oversight body specifically for physician-scientist training that could work to ensure sufficient funding and necessary support for trainees at each stage of training and between transitions in training.[12]

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PROPOSED ACTION

The challenges identified in physician-scientist training in Canada presents an opportunity to reform our approach to re-think how training should be structured. In particular, there is surprisingly little in the published academic literature on best practices in training and outcome data from training programs. What available data there is on the outcomes of MD/PhD programs and other physician-scientist training pathways has largely been from the American experience and outcomes data on physician-scientist training in Canada has only become available within the past few years.[3,11] As a result, it has been difficult to address in any cohesive and evidence-based manner the challenges inherent in the physician-scientist training pathway.

The challenges of insufficient mentorship, integration between different stages of training and early-career support are not institution-specific issues and will need to be addressed at every training program in the country. To achieve the necessary changes, it will be necessary to form a national oversight body whose function will be to oversee physician-scientist training. This body would be composed of funding bodies such as the CIHR, regulatory bodies such as the Royal College of Physicians and Surgeons of Canada (RCPSC) and educational bodies such as the Association of Faculties of Medicine of Canada (AFMC). Its mandate will be to track enrollment and outcome data from Canadian physician-scientist training programs, be an forum to share institutional best practices, and to ensure that trainees are supported within individual institutions and as they move between institutions as they progress in the training pathway. (See figure below for overview of how oversight body will function; adapted from: Yin et al. Clin Invest Med. 2017;40(2):E95-101.).

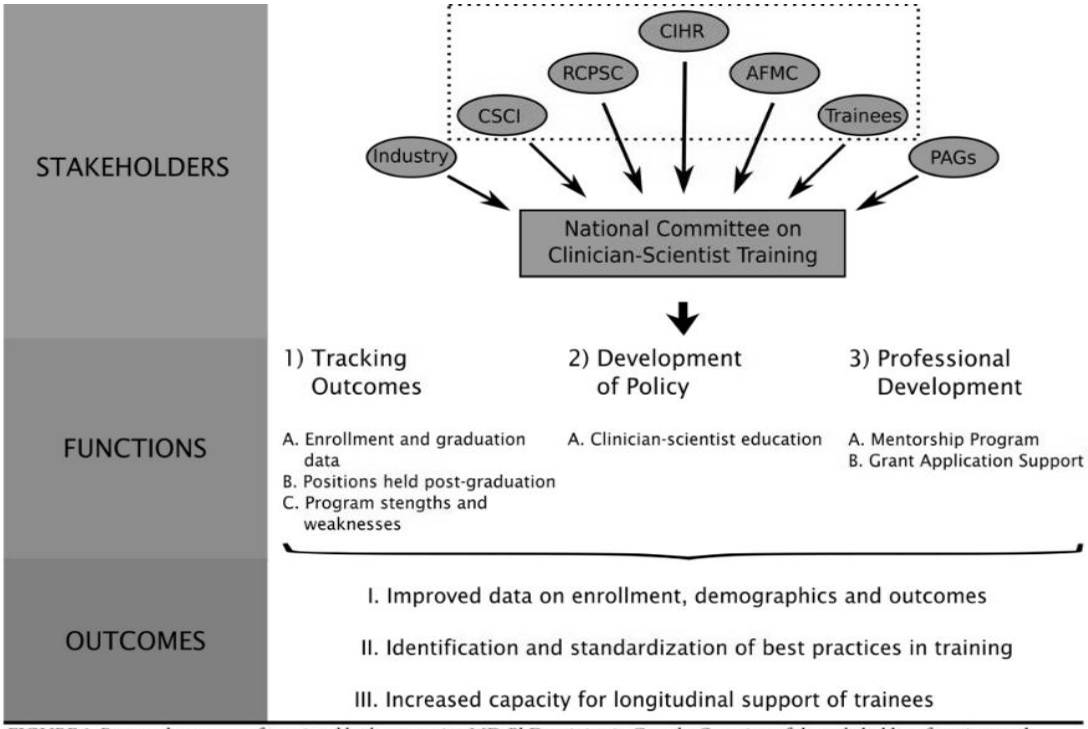

FIGURE 1. Proposed structure of a national body overseeing MD-PhD training in Canada. Overview of the stakeholders, functions and expected outcomes of a national body tasked with overseeing clinician-scientist training in Canada. Proposed core stakeholders, denoted by the dotted line are: CIHR (Canadian Institutes of Health Research), RCPSC (Royal College of Physicians and Surgeons of Canada), the Association of Faculties of Medicine of Canada (AFMC), CSCI (Canadian Society for Clinical Investigation), and Trainee organizations (CFMS (Canadian Federation of Medical Students) and CITAC (Clinician Investigator Trainee Association of Canada). Additional stakeholders essential for focused aspects of the committee's mandate are Patient Advocacy Groups (PAGs) and Industry Groups.

Evidence of the success of this approach can be seen by similar experiences in the U.S. and U.K., where there is significantly more oversight on the national level over physician-scientist training and career development. For example, the National Institutes of Health in the U.S. track MD/PhD enrollment and outcome data on the national level. The U.S. also provides a significantly greater proportion of financial support for MD/PhD trainees through its Medical Scientist Training Program (MSTP).[13] In the U.K., recognition of a lack of support for early-career physician-scientists led the National Institute for Health Research (NIHR) to develop new funding programs for clinical fellows and academic lecturers to support physician-scientist development at the early-career stage.[14] As the need grows for physicians-scientists who are able to bridge the gap between research and clinical practice, it is imperative that Canada positions itself as a leader in training and developing the next generation of successful physician-scientists. The CIHR's decision to cut MD/PhD funding, while a set-back, presents an opportunity for the country to re-evaluate its approach to physician-scientist training. A national oversight body would be an avenue to enable the tracking of outcomes and sharing of knowledge necessary to address the challenges of physician-scientist training.

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