ANNUAL REPORT OF THE

Chief Science Advisor

2021–2022

Office of the Chief Science Advisor of Canada
Bureau du conseiller scientifique en chef du Canada

Canada

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Message from the Chief Science Advisor

It is one of the indelible lessons of the COVID-19 pandemic: Science matters to public policy. Since March 2020, the Government of Canada has made a series of policy choices on everything from public health guidance to vaccine distribution to travel restrictions. In each case, decision-makers were able to consider the latest scientific developments as part of their deliberations. Science does not dictate policy, but it is an important input among many in the policy process. Policymakers and legislators need timely access to relevant scientific insight, communicated clearly and concisely.

This is the primary mandate of my office: to improve the flow of timely and helpful science advice to government decision makers. The pandemic's onset injected a measure of urgency into this task, and my office responded in kind. Throughout 2021-22, the Office of the Chief Science Advisor (OCSA) participated in multiple pandemic-focused advisory bodies established by other organizations within and outside of government. The OCSA also worked with its own advisory groups and cleared new pathways for delivering science advice to government committees and ministries.

These advisory bodies and pathways were all established on an ad hoc basis. They were not prescribed or recommended by prior government policies or guidelines, yet they quickly took root in practice. The OCSA endeavoured to demonstrate foresight and agility in its deliberations as the pandemic evolved. As a result, throughout 2021-22, decision-makers were provided with sound and timely science advice on the pandemic.

Contributions to pandemic response were just one facet of our work in 2021-22. Throughout the year, my office continued its ongoing efforts to support federal government scientists, make government research more open and available to Canadians, foster international scientific cooperation, maintain Canada's position as a global scientific leader, and promote the benefits of science to government, Parliament, and the Canadian public.

Canada is a global leader in science. Across government, academia and the private and non-profit sectors, Canada's scientific capabilities are the envy of most nations around the world. Science is an effective and reliable tool not only for understanding our universe, but for generating workable solutions to problems of any magnitude. Science has helped Canada weather the worst of the COVID-19 pandemic, and science will play a crucial role in the country's recovery and future prosperity.

Dr. Mona Nemer
CM, CQ, FRSC

Introduction

If Canadians were asked the simple question “What does the federal government do?” their responses would likely cover a broad range of topics. Their answers might include such things as income and sales taxes; Employment Insurance, the Canada Pension Plan and Old Age Security; immigration and border services; military defence and foreign relations.

Few Canadians would include among their answers, “The federal government does science.” Yet the reality is that the conduct of scientific research, and the application of scientific knowledge to policy problems and other responsibilities, is a cornerstone of federal operations.

The federal government spends upwards of $7 billion annually operating its science-based departments and agencies (see Appendix A). Science supports a significant part of government operations, from ensuring ocean resilience and sustainable agriculture to space exploration and most everything in between. Though Canadians may not realize it, their federal government is a scientific force for the advancement of human knowledge and for social and economic innovation.

This science workforce can be harnessed in many ways for enhancing science advice and for helping translate new knowledge into societal benefits for all.

The Role of the OCSA

The Office of the Chief Science Advisor (OCSA) was created in September of 2017 with a mandate to support the Government of Canada’s science functions and improve the flow of science advice to decision makers. Since its inception, the OCSA’s work has involved establishing new advisory bodies and pathways for delivering science advice; recommending ways for the government to support quality scientific research; promoting stronger linkages between scientists within and outside of government; recommending ways to make government science more accessible to researchers and Canadians, ensuring that federal scientists can speak freely about their work; and promoting the role of science with the public, both nationally and internationally.

Since early 2020, and particularly over the course of 2021-22, much of the OCSA’s work has concentrated upon assisting the federal government with pandemic response. All aspects of its mandate listed above came into sharp focus, and important progress was made in each of them.

The OCSA also made significant contributions to many other federal government activities. The OCSA’s work in the past year, as reflected in the pages of this annual report, will also guide its priorities in the years ahead, namely augmenting the role of science in Canada’s emergency preparedness; fostering stronger links between federal government scientists and their peers in academia and the private and not-for-profit sectors; guiding the implementation of open science principles; magnifying the benefits of science to Canadian society; and recommending priorities and actions that will help Canada maintain and improve its standing as a global scientific leader.

The work of the OCSA in 2021-22, and its priorities for the years ahead, will be to the benefit of Canadian economic and social prosperity, and further underscore the value of the OCSA itself.

Dr. Mona Nemer was a special guest of the Right Honourable Prime Minister Justin Trudeau and the Honourable François-Philippe Champagne, Minister of Innovation, Science and Industry during the Prime Minister’s Science Fair hosted by NSERC on April 6, 2021.

Science in Emergencies

CONTRIBUTIONS TO PANDEMIC RESPONSE AND BEYOND

The Need for Coordinated Scientific Contributions in Emergency Response

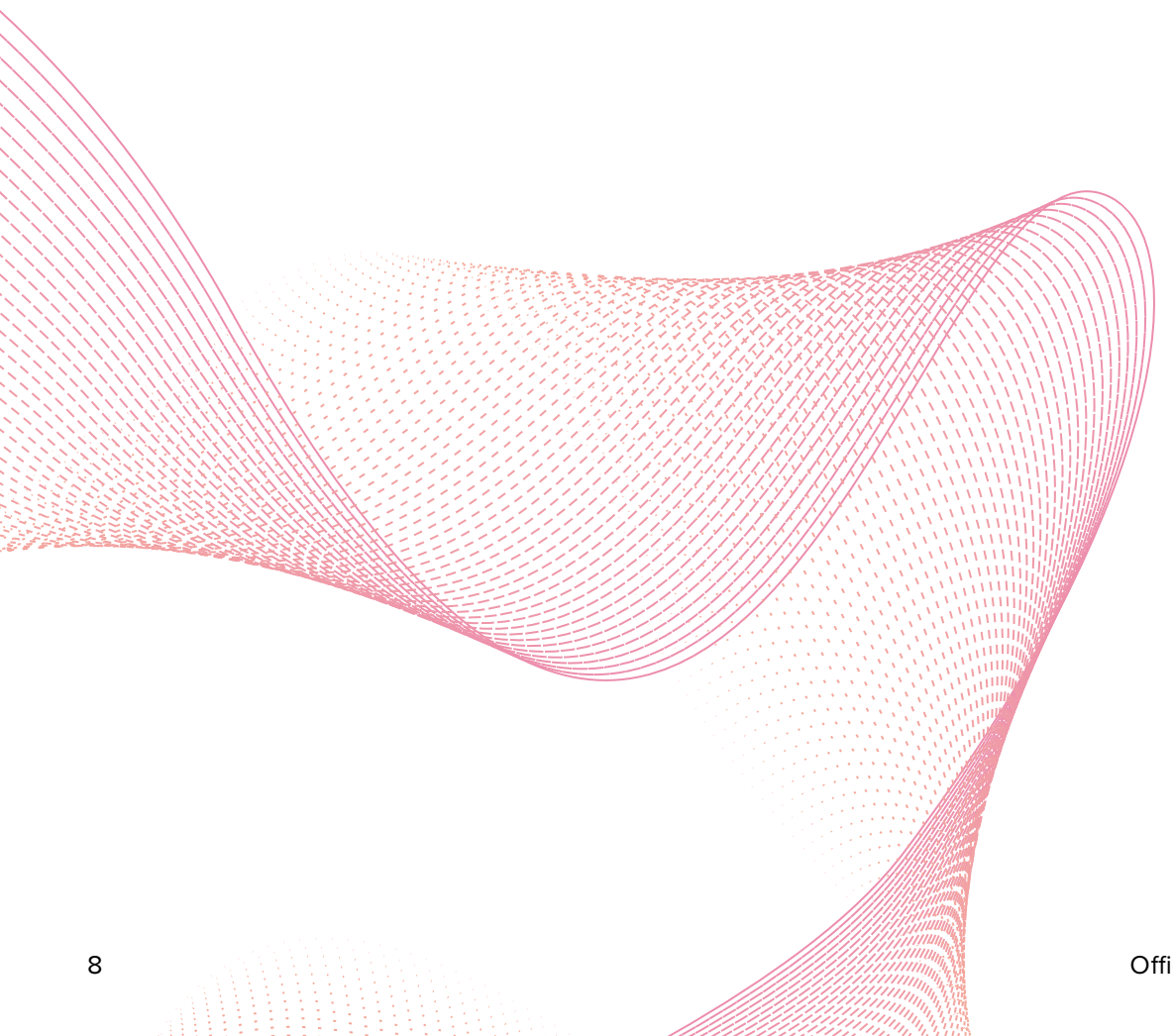
Since March of 2020, pandemic response has been an overriding concern for nearly all branches of the federal government. That response included fiscal and economic supports for people and businesses; procurement of personal protective equipment, vaccines and other therapies; cross-border travel restrictions; public health guidance for individual Canadians; and more.

That response also required the marshalling of Canada's vast scientific capabilities, both within government and beyond. The federal science workforce numbers more than 30,000 employees across the whole of government, largely concentrated in a number of science-based departments and agencies, including health-focused ones such as Health Canada and the Public Health Agency of Canada (*see Appendices A and B*).

Even so, the scale of the COVID-19 pandemic was unprecedented in modern times, which meant that there were no pre-established and well-tested protocols or procedures for coordinating the government's response, including the provision of science advice or the prioritization of research initiatives. Likewise, at the onset of the pandemic, the Office of the Chief Science Advisor had no formally structured or assigned role to play in those efforts.

Pandemic response requires a high degree of cooperation and mutual assistance among previously independent entities, with new interagency structures designed to share information and coordinate efforts. It also requires structured pathways for drawing upon scientific expertise outside of government, in universities, health care institutions, and the private sector.

From the onset of the pandemic, the OCSA's efforts — described in detail below — were guided by its mandate to improve the science advisory function within government and ensure that scientific analyses are considered when the government makes decisions.



External and Internal Advisory Bodies

OCSA-led Expert Panel and Task Forces

The novelty of the coronavirus that causes COVID-19 meant that scientific knowledge about it, though initially scarce, expanded rapidly in the pandemic's early months. Yet there was no established, formalized process to gather and assess the evolving multidisciplinary knowledge for whole-of-government advice in a rapidly evolving crisis situation.

Given these circumstances, the OCSA set out to create an advisory structure that could draw upon the knowledge and expertise of front-line scientists outside of government. Since March of 2020, the **OCSA's COVID-19 Expert Panel** [1] has brought together over 20 scientists and researchers from within and outside government, with its membership changing over time to include new areas of expertise as required.

As the pandemic evolved, the original Expert Panel met less frequently; its efforts were supplemented by a series of issue-specific special meetings that brought together different groups of scientists. Each meeting group was interdisciplinary with representation from across Canada. All told, 11 meetings were held in 2021-22.

Each meeting's agenda dealt with a specific topical issue that arose from the evolution and progression of the pandemic. Summaries of the meetings [2] were promptly shared with ministers and other decision-makers. Each meeting proved to be prescient, resulting in the provision of helpful scientific information and analysis for subsequent policy decisions. For example:

- **Infection, vaccination and immunity.** On June 4, 2021, the Panel reviewed the scientific updates on COVID-19 infection and the durability of vaccine-induced immunity. The Panel foresaw the need for additional vaccine doses for the upcoming fall–winter season and this advice was relayed to the government.
- **Responding to the Omicron variant.** On December 13, 2021, the Panel reviewed the evidence on the spread of the Omicron variant and how that knowledge could impact Canada's response. Experts identified three actionable items to inform Canada's response — public access to rapid tests, upgrading face coverings to N95 respirators, and accelerating administration of third vaccine doses.

In addition to getting vaccinated, masks and face coverings along with rapid antigen tests are part of the effective tools used to slow or stop the spread of COVID-19 and manage the risks and health decisions during the pandemic.

The OCSA: Connecting Government and Extramural Scientists

In November 2021, following a World Health Organization briefing on what was then an emerging variant of concern in South Africa (B.1.1.529), a Canadian evolutionary virologist contacted the OCSA to share their analysis and express their concern about the variant's potential for rapid transmission and potential immune evasion — before clinical or epidemiological data were available.

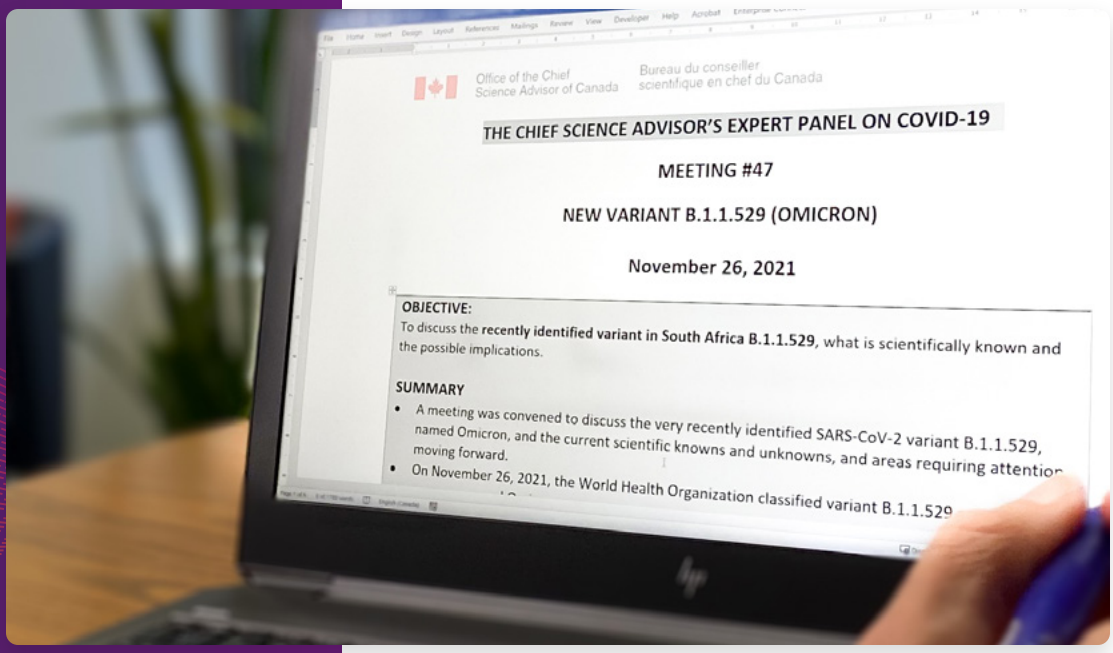
The Chief Science Advisor convened an Expert Panel meeting within hours of that initial contact on November 26, and a summary of the analysis was shared with decision-makers in time to help inform key policy choices on such issues as booster vaccinations, border measures, and access to rapid testing.

Through the Expert Panel and special meetings, the OCSA served as an effective bridge between government and the broader Canadian scientific community, providing scientists and researchers with a forum through which to share their knowledge with the government.

- **Vaccine and infection-induced immunity to Omicron.** On February 22, 2022, the Panel reviewed updates on vaccine-induced and infection-induced immunity, and suggested that a second booster shot (i.e., a fourth dose of mRNA vaccine) would likely be needed for high-risk populations, which turned out to be the case.

The value of these deliberations lies in the OCSA's ability to mobilize the country's top scientific minds to engage in a timely and insightful way, providing helpful contributions to key officials in advance of their decision making. The meetings often helped establish consensus around what the science was saying, and at times also played a challenge function when the science was unclear, providing foresight in terms of knowledge gaps and the need for further research.

The Chief Science Advisor met regularly with her COVID-19 Expert Panel and Task Forces to stay on top of the latest scientific developments relevant to COVID-19. Each meeting dealt with a specific topical issue that arose from the evolution and progression of the pandemic. Summaries of the meetings were promptly shared with ministers and other decision-makers.



The meetings held in 2021-22 built upon the Expert Panel's previous work since its inception in March 2020. The Panel has authored five public reports on emerging issues related to the pandemic, including one this past fiscal year. The reports provided timely advice in advance of government decisions on each topic.

- *COVID-19 vaccine-associated myocarditis/ pericarditis* [3]
- *Scientific Considerations for Using COVID-19 Vaccination Certificates* [4]
- *The Role of Bioaerosols and Indoor Ventilation in COVID-19 Transmission* [5]
- *Long-Term Care and COVID-19* [6]
- *COVID-19 and Children* [7]

Similarly, in the earliest stages of the pandemic, the Expert Panel itself established eight mission-driven ad hoc task forces [8] with a clear mandate to quickly study a specific issue, prepare a summary, and offer proposals for the Chief Science Advisor to consider as part of her advice to government. Each task force also included representatives from Health Canada and the Public Health Agency of Canada (PHAC) to facilitate direct and immediate access to task force findings.

As the pandemic evolved, and as knowledge gaps were filled in by scientific research, the OCSA's focus shifted towards the issues of primary and secondary prevention, including understanding SARS-CoV-2 immunity, procuring vaccines and deploying rapid tests. Many of these issues were subsequently taken up by other government agencies, with the benefit of the OCSA's prior deliberations.

Science Advice in Action: Wastewater Testing

The Departmental Science Advisors (DSA) Network brings together lead science advisors from science-based departments and agencies to promote excellence in research and expedite science advice to government (*see page 20*).

In the spring of 2020, the members of the DSA Network learned of the work being done by scientists at the University of Ottawa and the Children's Hospital of Eastern Ontario to develop a method for detecting SARS-CoV-2 in wastewater. The DSAs quickly recognized the value of wastewater surveillance as a useful complement to individual testing and tracing in tracking community spread of COVID-19. They relentlessly advocated for support and broader use of wastewater testing as an unbiased indicator of viral spread in certain settings such as schools and congregate living centres, as well as in whole neighbourhoods and communities.

The DSAs sought to raise awareness of the benefits of wastewater testing within their departments and contact networks, and to promote a coordinated approach. Over the past year, as governments have stepped up to provide funding for research and adoption of wastewater testing, the practice has been broadly adopted by communities across Canada.

In June 2021, the Public Health Agency of Canada embarked on an ambitious plan to create a pan-Canadian wastewater surveillance network in conjunction with federal departments; provincial, territorial and municipal governments; and academia. PHAC has also developed an online dashboard [9] to track and compare wastewater testing results from communities across Canada.

The virus that causes COVID-19 infection (SARS-CoV-2) can be detected in the stool of infected people over a significant portion of their illness. Testing and monitoring wastewater (sewage) can provide an early indication of COVID-19 in communities and help determine the best collective responses.

Photo credit: Delatolla Research Group, uOttawa.

Participation on Multiple COVID-19 Advisory Bodies

In addition to the advisory groups convened and managed by the OCSA, the Chief Science Advisor was invited to participate in a variety of COVID-19 committees, task forces and roundtables established by various government departments, including:

- **COVID-19 Immunity Task Force**[10]**:** Established by the federal government, this task force brings together representatives of Health Canada, PHAC, the OCSA and the provinces, as well as experts from universities and healthcare facilities across Canada, in an effort to harmonize research and knowledge about COVID-19 immunity to assist policymakers in their plans.
- **COVID-19 Vaccine Task Force**[11]**:** A multidisciplinary group of 14 experts established by the National Research Council to help the government make sound evidence-based decisions to protect the health and safety of Canadians during the pandemic.
- **COVID-19 Therapeutics Task Force**[12]**:** A group of 19 industry and academic representatives created by Innovation, Science and Economic Development Canada (ISED) to assess and prioritize COVID-19 therapeutic projects seeking government support.
- **COVID-19 Industry Strategy Council**[13]**:** A group of private-sector representatives from nine economic sectors plus the Chief Science Advisor, established by ISED to coordinate input from the business community.
- **Industry Advisory Ad Hoc Roundtable on COVID-19 Testing**[14]**:** A group of 16 external representatives established by Health Canada in consultation with the Industry Strategy Council to advise on the role of testing and screening in the resumption of economic activities.
- **Variants of Concern Scientific Advisory Council:** A group of scientists established by Health Canada to take a long-term perspective on how to identify, assess and manage emerging COVID-19 variants.

These mission-focused bodies brought together experts from across the country. The Chief Science Advisor's membership in each one placed her in a unique position, providing her with insight into the broadest possible range of perspectives and priorities on pandemic response and allowing her to play an integrative role across multiple departments and agencies. She also brought this insight to regular meetings of federal deputy ministers and, upon invitation, to the Cabinet Committee on the federal response to COVID-19.

Coordinating Research

Through her participation in the Deputy Ministers COVID-19 Committee, the Chief Science Advisor regularly reviewed and assessed the federal pandemic response. As part of those discussions, the group was able to identify the research priorities that could best assist the government's pandemic response and coordinated efforts to undertake that research. The Committee's work was integral to the federal government's Biomanufacturing and Life Sciences Strategy that received a $2.2 billion investment in Budget 2021[15].

International Cooperation

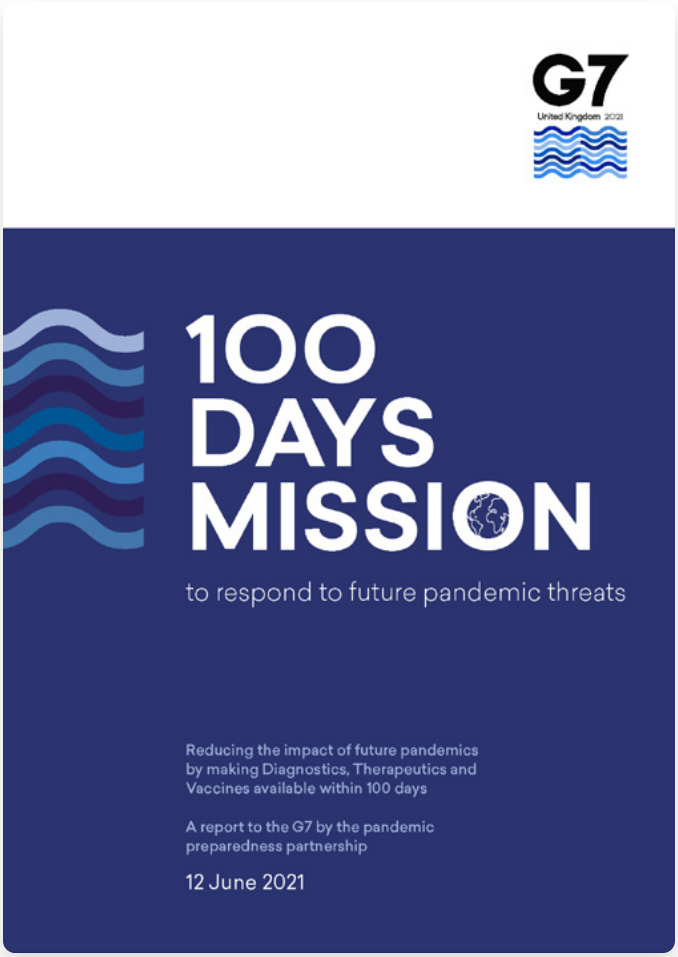
International cooperation has been an essential part of every nation's response to the COVID-19 pandemic. The OCSA has been at the forefront of Canada's efforts to promote international scientific cooperation to combat the virus and to prepare for future pandemics.

At the G7 Summit in June 2021, the leaders of the member nations, acting on the recommendation of their respective chief science advisors, adopted the 100 Days Mission to Respond to Future Pandemic Threats [16]. Drafted by a panel of independent experts led by Sir Patrick Vallance, Chief Science Advisor to the Government of the United Kingdom, the objective of the 100 Days Mission is to ensure the swift development and distribution of effective diagnostics, therapeutics and vaccines within 100 days of the identification of new pandemic threats.

In December, Canada's Chief Science Advisor joined with her G7 counterparts to produce the first implementation report of the 100 Days Mission to Strengthen Pandemic Preparedness [17]. Among Canada's contributions to the implementation are the COVID-19 Genomics Network (CanCOGeN [18]) for large-scale sequencing of SARS-CoV-2 isolates to better track viral origin, spread and evolution; an advisory panel [19] to lead the pivot to COVID-19 testing in non-clinical settings; and the Biomanufacturing and Life Sciences Strategy [20], to rebuild a strong and resilient domestic sector in vaccine manufacturing and life sciences.

In addition to the 100 Days Mission, the Chief Science Advisor also represented Canada at the Research Ministers' Meeting of the G20 group of nations, where countries discussed how research, higher education and the digital economy can promote an inclusive post-pandemic recovery [21]. The OCSA also co-organized, alongside the non-profit research organization Mitacs, a series of Canada–France and Canada–UK roundtables that included, among the main topics of discussion, research into pandemic preparedness and response.

Through these activities, the OCSA is strengthening Canada's diplomatic ties with its allies by expanding them into the realm of scientific cooperation and knowledge brokering, making science one of the foundations for the mutual advancement of national interests, while also raising Canada's international profile in the global scientific community.



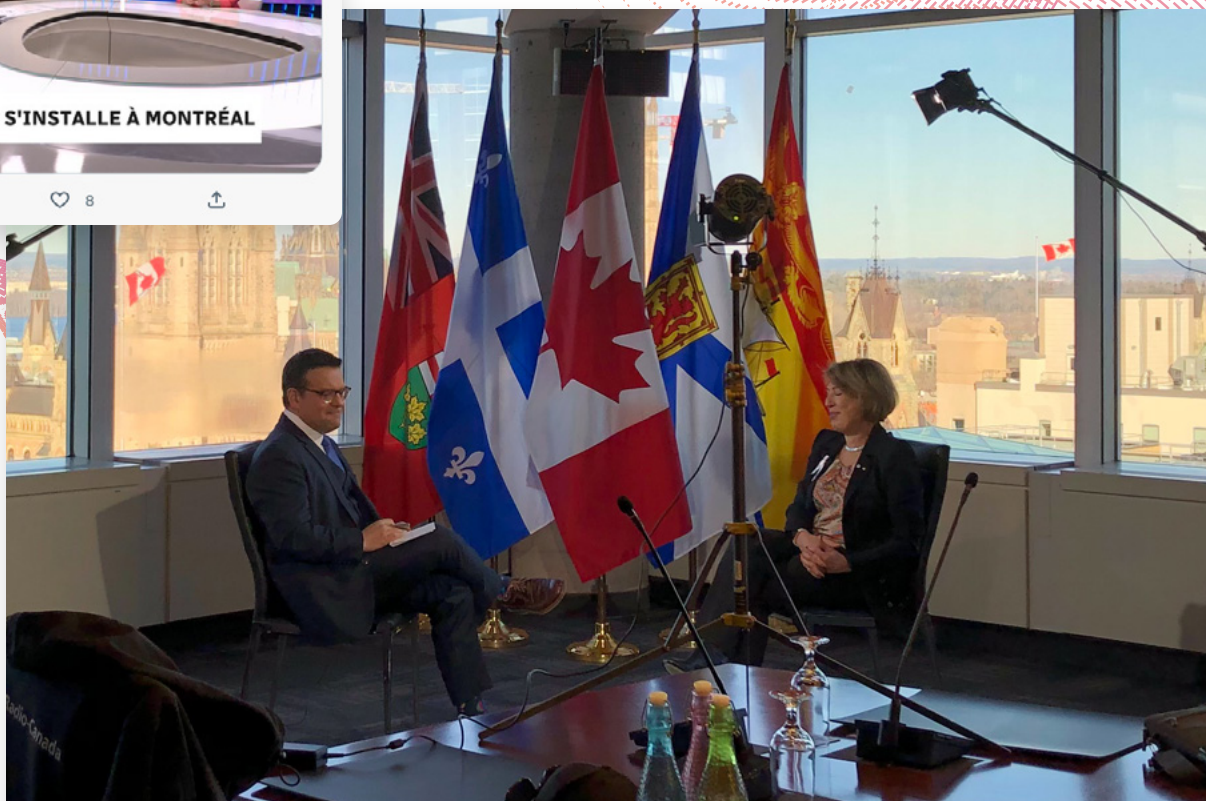
Canada's Chief Science Advisor joined with her G7 counterparts to produce the first implementation report of the 100 Days Mission to Strengthen Pandemic Preparedness — a roadmap that lays out the steps to developing and deploying safe, effective diagnostics, therapeutics, and vaccines within the first 100 days of a pandemic.

Public Information

The pandemic's evolution has given Canadians a candid, real-time glimpse into how science functions and the role that it plays in policymaking. To help Canadians understand the science shaping the government's pandemic response, the Chief Science Advisor conducted a total of 25 media interviews on the scientific aspects of Canada's pandemic response, leading to multiple stories in print, broadcast and online media.

The Chief Science Advisor earned a reputation with the media and the public as a reliable independent source and became a widely quoted, trusted official for explaining the evolving science and the science-based tools used to manage the pandemic.

Dr. Mona Nemer was sought regularly by Canadian media to give her perspective on the scientific issues of the pandemic.



The Chief Science Advisor was a guest on the December 5 episode of Les coulisses du pouvoir *to talk about the Omicron variant and the implications of the arrival of a new variant.*

Observations and Lessons on Science Advice in Emergencies

Though the pandemic is still ongoing, decision-makers at every level now have an opportunity to assess the effectiveness of their preparedness efforts and address any persistent gaps. As Canadians learned during the COVID-19 pandemic, what started off as a health crisis had cascading effects and quickly transformed into crises in many sectors of society and the economy. The same is true for many emergencies, including emergencies caused by climate change.

In his 2021 mandate letter to the Minister of Emergency Preparedness, the Prime Minister directed the Minister to work "with the support of the Chief Science Advisor... to further incorporate the use of science across all elements of emergency preparedness."

The government's framework for emergency planning includes four policy dimensions: prevention, preparedness, response and recovery. Having robust cross-disciplinary science advisory systems for preparedness and response, established during peacetime, ensures that we are prepared for future disasters and can quickly mobilize in case of an emergency. We also need a fast-responding, coordinated way to identify data and research needed for policy decisions.

Science Advice for Preparedness

Anticipation and preparation are critical elements of effective emergency response in general, and for science advice in particular. Science advice relies on having a robust and established science ecosystem and enabling its connection with government officials. Canada is fortunate to have science expertise and state-of-the-art infrastructure that can be mobilized as part of any response.

On February 16, 2022, the Chief Science Advisor met with the Honourable Bill Blair, Minister of Emergency Preparedness, and Yasir Naqvi, MP for Ottawa Centre, to discuss the scientific considerations around climate change mitigation and adaptation.

Given the interdisciplinary nature of emergencies, decision-makers need to have access to advice of top experts across disciplines and sectors (academia, industry, government and not-for-profit). Providing real-time science advice in evolving, large-scale emergencies requires both intramural and extramural expertise, as well as networks that can be activated to access their expertise quickly. This in turn requires the thoughtful and rigorous advance identification and vetting of top talent, which provides the opportunity to proactively engage with experts ahead of an emergency.

Preparedness can also be tested with simulated emergencies, just like the exercise the OCSA performed, alongside Public Safety and the Department of National Defence, in 2019 with our US and UK counterparts. The focus of the exercise was on science advice flow in emergencies; it provided the opportunity to test the Canadian system and observe how the UK Government Office for Science and the US Department of Homeland Security respond to the same scenario (*see 2019-2020 Annual Report of the CSA* [22]*, "Science Advice in Emergencies" section*). As a result of this experience, the Chief Science Advisor quickly established the COVID-19 Expert Panel in March 2020, an interdisciplinary venue for voices from outside government, to proactively support decision-makers with cutting-edge science advice. Conducting similar exercises in the months ahead can inform plans for preparedness and action for future national challenges.

Science Advice for Response

Science advice for emergency response works well when there is a pre-existing system that is designed ahead of time, is well understood by its stakeholders, and can be quickly activated in an emergency. Among international models for science advice, the UK Scientific Advisory Group for Emergencies (SAGE) stands out as an example to consider.

Under the UK system, a cabinet committee can ask the Government Chief Science Advisor to stand up SAGE to answer a specific science-related question. The membership of the group is tailored to the nature of the emergency and includes experts from academia, industry and government. Once the crisis is over, the SAGE is deactivated.

This system has served the UK for decades and was activated to provide advice on events such as COVID-19 pandemic (2020), Salisbury poisoning (2018), the UK winter flooding event (2013), the Japan nuclear incident (2011), the Iceland volcanic ash emergency (2010) and the swine flu pandemic (2009). Using this example, Canada could create a similar science advisory mechanism that can be activated on as-needed basis.

Prioritization of Data and Research Gaps

In emergencies of all persuasions, there is invariably a significant degree of uncertainty. To generate much-needed data and evidence for policy decisions during an emergency, there needs to be a deliberate effort to prioritize and fund research on data gaps. While the government has provided funds to support COVID-19 research during this pandemic, the funding was not always deliberately targeted to the areas needed for policy decisions.

The process of identifying, prioritizing and funding research where there are data gaps requires tight coordination and collaborations between the Chief Science Advisor and senior government officials so that funds are allocated in an agile manner and data are shared as they are produced to support policy decisions. In addition to supporting fundamental research, efforts to accelerate discovery research in the context of mission-focused objectives must be examined as both pipelines are important to prepare for and respond to emergencies.

Science for Canadians

THE OCSA AT WORK

Science in Society

In addition to its pandemic response efforts, the OCSA was engaged throughout 2022 across a broad portfolio of activities, many of them ongoing initiatives that began shortly after the Chief Science Advisor's position was created in 2017. The Chief Science Advisor's mandate focuses the OCSA's efforts on three key roles of science in society: informing policy, advancing knowledge and informing citizens.

There is no other office within the federal government which serves these important functions as a matter of mandate and mission. While the importance of these functions was highlighted by the pandemic, they remain essential no matter the circumstances.

On September 9, 2021, the Chief Science Advisor hosted members of the Departmental Science Advisors (DSA) Network for a planning session and a presentation by former Clerk of the Privy Council Michael Wernick.

From left to right:

Danial Wayner, DSA and Chief Science Officer at the National Research Council Canada; Cara Tannenbaum, DSA at Health Canada; Scott Findlay, Researcher in Residence at OCSA; Dr. Mona Nemer; Michael Wernick, former Clerk of the Privy Council; Gary Slater, Researcher in Residence at OCSA; Sarah Gallagher, DSA at Canadian Space Agency; Gordon Lovegrove, DSA at Transport Canada; Shawn Marshall, DSA at Environment and Climate Change Canada.

Science Informing Policy

When it was created in 2017, the OCSA was asked to recommend ways to improve the quality and flow of science advice to government decision-makers. For many of Canada's allies in the world, the presence of a chief science advisor has been a policy constant for decades. As a result, their governments have well-established pathways for delivering science advice to policymakers.

The OCSA has made important strides this past year in its continuing work to help establish a similar infrastructure network for science advice within Canada's federal government. Its efforts have also included the fostering of international networks to promote research and science–policy collaboration.

Convening and Coordination

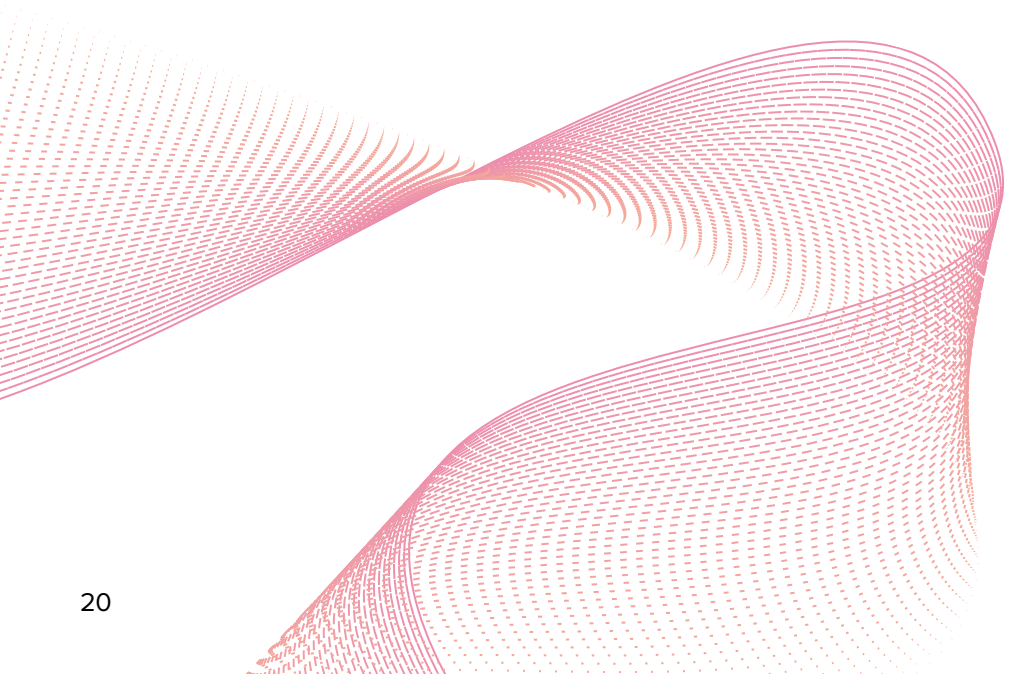
The Chief Science Advisor sits on a number of committees that serve to connect government science to the broader scientific community and emerging research issues. These include the Canada Research Coordinating Committee, the Deputy Ministers Science and Technology Committee, and the Government of Canada Advisory Council on Artificial Intelligence.

Through her membership on these committees, the Chief Science Advisor provides advice to key government bodies and leaders. At the same time, her memberships help her stay abreast of government needs and key research and scientific developments both within and beyond government, all of which is integrated into the science advice she provides.

Strengthening Science Advice within Government

Part of the OCSA's mandate is to promote collaboration and to facilitate the flow of science advice to decision-makers. This element was underscored in the mandate letters issued to cabinet ministers in December 2021, all of which included a commitment to "continued collaboration, engagement, and the use of science and evidence-based decision making."

To fulfill this part of its mandate, starting in 2018, the CSA recommended the creation of departmental science advisors (DSAs) and brought them together as a network to share best practices, promote quality research, and serve as a conduit for science advice. In addition to strengthening scientific expertise and providing a fresh perspective on key programs and files, the departmental science advisors facilitate collaboration across government departments and with the academic scientific community.



DSA Network: A Sampling of Key Initiatives for 2022

National Research Council of Canada

Departmental Science Advisor:
Dr. Danial Wayner (now retired)

Dr. Wayner championed the Horizon Initiative to identify key economic and societal challenges of significance for Canada over the next 10 to 15 years, and the relevant technological innovations likely to be implemented within that timeframe. Its Phase I report, published in Spring 2021, explored six broad subjects: Climate Change, Resource Futures, Big Data and Artificial Intelligence, Cybersecurity and Privacy, Healthcare Futures and New Models of Innovation. In Phase II of the initiative, which began in summer 2021, the Horizon team is holding workshops with experts to identify the technologies required to respond and assess of Canada's readiness in these areas.

Environment and Climate Change Canada

Departmental Science Advisor:
Dr. Shawn Marshall

Dr. Marshall is co-leading the development of the National Climate Science and Knowledge Plan. The Plan will play a key role in identifying the science and knowledge priorities and the national collaborations that are needed to inform and advance climate change mitigation and adaptation efforts in Canada. The DSA Network has served as the backbone for the Science Advisory Group steering this project.

Public Health Agency of Canada

Departmental Science Advisor:
Dr. Sarah Viehbeck

Dr. Viehbeck and her predecessor Dr. Michel oversaw the development of core science policies and continued scientific support of the COVID-19 response at the Public Health Agency of Canada (PHAC). This included implementing PHAC's Open Science Action Plan, establishing PHAC's Open Science Community of Practice, adopting a new Policy on the Dissemination of Research and Scientific Findings under the Scientific Integrity Policy, training on research ethics, and partnering with Health Canada to develop training modules on scientific integrity. Dr. Viehbeck also championed the Best Brains Exchange on Artificial Intelligence in Public Health to foster digital innovation in public health.

Fisheries and Oceans Canada

Departmental Science Advisor:
Dr. Paul Snelgrove

Dr. Snelgrove chaired the External Advisory Committee on Aquaculture, an international body that provides science advice on DFO's multiyear aquaculture plan. He also championed DFO's Canadian Scientific Advisory Secretariat update of their process for providing scientific advice. Dr. Snelgrove also led efforts to develop a program on oceans and climate change, representing DFO in Climate Science 2050 deliberations and coordinating Canada's efforts in the United Nations' Decade of Ocean Sciences for Sustainable Development.

Health Canada

Departmental Science Advisor:
Dr. Cara Tannenbaum

Dr. Tannenbaum led the development and launch of the "Science Snapshot Survey" which measured awareness of Health Canada's science priorities and provided advice to departmental leaders on how to build and measure progress. Partially as a result, Health Canada appointed both an ADM Science Champion and an Executive Lead in Human Resources for science at Health Canada. Dr. Tannenbaum also jointly led the Health Canada–Public Health Agency Town Hall and Panel of Experts on the "Science of Climate Change and Your Health."

The value of the DSAs and the DSA Network is increasingly appreciated within the public service. The DSA Network added three more departments to its number this past year, bringing its total to nine (*see Appendix C*). It is anticipated that more departments will appoint a departmental science advisor to join the Network, and that the DSA position will become an integral element in the leadership teams of federal departments and agencies.

The DSA Network met on a monthly basis throughout 2021-22. Its discussion topics have included such important horizontal files as research security, science for the climate agenda, emergency preparedness, science workforce and Indigenous Knowledge.

The DSA Network meetings often included special guests to exchange on common issues, challenges, and priorities as well as share best practices. This year's guests included the former Clerk of the Privy Council, the New Zealand Network of Chief Science Advisors, and the Chair of the Deputy Minister Science and Technology Committee.

In addition to their role in their respective departments and the promotion of wastewater surveillance for COVID-19 (*see sidebar on page 12*), DSAs actively participated in the Science Advisory Group established by Environment and Climate Change Canada (*see sidebar on page 21*), helping to identify actionable items that can advance Canada's contributions to the fight against climate change.

A Youth Perspective on Science and Science Advice

First established in 2020, the Chief Science Advisor's Youth Council [23] (CSA-YC) is an important component of the science advice function within government. Made up of 20 scientists and engineers from across Canada, currently either studying or in the early stages of their careers, the CSA-YC's role is to raise issues of importance to young scientists and provide a sounding board for the perspective of youth on key scientific issues (*see Appendix D*).

The past year saw the CSA-YC engage more deeply across the whole of government. Its members participated in multiple initiatives, including the annual Canadian Science Policy Conference, the biannual convention of the International Network for Government Science Advice, the Open Science Dialogues organized by the OCSA (*see page 27*), the strategic planning workshops on the future direction of the Natural Sciences and Engineering Research Council, and the Climate Science 2050 Advisory Group established by Environment and Climate Change Canada.

Through these efforts and their regular meetings with the Chief Science Advisor, the members of the CSA-YC are both promoting and entrenching the presence of youth perspectives in current discussions and debates about science and research. They have served as able ambassadors for Canada's young scientists and are now seeing their work embraced: when Environment and Climate Change Canada unveiled the creation of its own youth council, they called upon a member of the CSA-YC to serve as the emcee for the public announcement in Vancouver, alongside Minister Jonathan Wilkinson.

Member of the Chief Science Advisor's Youth Council, Sara Guzman, was invited by the Honourable Jonathan Wilkinson to serve as announcer for the launch of Environment and Climate Change Canada's own youth council.

In August 2021, the Chief Science Advisor and the Chief Scientist of Quebec co-hosted the biennial conference of the International Network for Government Science Advice (INGSA) in Montreal, Quebec. The conference, under the theme of "Build Back Wiser" brought together more than 2,600 delegates from 50 countries, both in person and online.

Stronger Together

Canada's Chief Science Advisor has developed strong relationships with her international counterparts, sharing information on best practices and solutions on a regular basis — all of which have served the country well during the COVID pandemic and beyond. Many of Canada's international allies and partners have had a chief science advisor (or similar role) in place for decades. They also have established pathways, sometimes enshrined by legislation or convention, for the provision of science advice to decision-makers in which their chief science advisors, in collaboration with national academies of science, play well-coordinated roles.

In late summer 2021, Canada served as the host country for the biennial convention of the International Network for Government Science Advice (INGSA). Held in Montreal from August 30 to September 2, the conference was co-chaired by the CSA and Rémi Quirion, the Chief Scientist of Québec and new President of INGSA. The conference, entitled *Build Back Wiser*, was attended by a total of 2,600 delegates from 50 countries, both in person and online. The four-day event featured 150 speakers and included one full day dedicated to science advice in *La Francophonie* group of nations.

In November 2021, the CSA, at the invitation of her UK counterpart Sir Patrick Vallance, participated in the 2021 United Nations Climate Change Conference, known as COP26. Dr. Vallance served as the Chief Science Advisor to COP26, and this year marked the first time that this long-running conference provided a showcase for science and innovation. Beyond identifying climate change problems, science will be a key part of efforts to monitor progress towards global commitments and solutions. In advance of the Conference, the OCSA staff worked with the UK to assist in drafting a joint statement calling for evidence-based long-term strategies and greater international cooperation in the fight against climate change. That joint statement has now been signed by science advice representatives from 43 countries worldwide.

In addition, the OCSA's Researchers in Residence have worked with their international peers to advance the OCSA's work on priority initiatives such as Indigenous-led biodiversity conservation; evaluation frameworks for net-zero technologies; and evaluation frameworks for institutional and organizational adaptation to climate change.

Looking Ahead: Stronger Connections Between Science and Policy

The OCSA's key 2022-23 priorities for science policy include:

- **Science advisory mechanisms in government:** The CSA, in collaboration with DSAs, will initiate a survey of science advisory instruments available to federal science departments and recommend best practices.
- **Science–policy dialogue:** A partnership between the OCSA and the Canadian Science Policy Centre (CSPC), Science Meets Parliament brings Canada's emerging scientific leaders to Parliament Hill to meet with MPs and raise awareness of Canada's scientific capabilities and the role science can play in policy development. The inaugural event was held in 2018. The second Science Meets Parliament event, originally scheduled for 2021, was postponed until May 2022 due to the pandemic.
- **The Youth Council vision for science:** The CSA's Youth Council will deliver a report, written at the request of the Chief Science Advisor, outlining a next generation view of what Canada's science and research landscape could look like.
- **Expanding the Departmental Science Advisors Network:** As the value of the Network is increasingly appreciated, the Chief Science Advisor will continue to support departments and agencies in their efforts to bolster independent science advice and advisors in their decision-making structures. This includes non-science-based departments where science and technology are increasingly integral to programs and policy making (e.g., Justice, Global Affairs and Public Safety).

In November 2021, Canada's Chief Science Advisor was invited by her UK counterpart to speak at a press conference during COP26 in Glasgow, Scotland. The event included the release of a joint statement signed by science advice representatives from 43 countries, including Canada, calling for evidence-based long-term strategies and greater international cooperation in the fight against climate change.

Science Advancing Knowledge

The Chief Science Advisor's mandate includes making recommendations to better promote high-quality research both within and beyond government, in order to maintain Canada's position as a scientific leader among nations. To fulfill this aspect of its mandate, the OCSA continues to lead on several files, most notably Scientific Integrity Policy, Open Science and priority areas for scientific and technological advancement in Canada.

Scientific Integrity Policy

In 2018, the OCSA drafted a Model Policy on Scientific Integrity that to date has been adopted by 22 of 25 science-based departments and agencies. Departments that were early adopters have provided the OCSA with helpful feedback that is guiding the development of tools, resources and training to support policy objectives.

Plain Talk About Science

The COVID-19 pandemic resulted in greater demand for scientific information, requiring scientists to improve their ability to communicate effectively with policymakers and other audiences outside the scientific community. A collaborative effort between OCSA and the Health Canada Departmental Science Advisor saw the development of a training module on "Effective Science-Policy Conversations [24]."

The module incorporates a number of critical scientific integrity principles, helping researchers understand how best to disclose competing interests, communicate scientific uncertainty, and provide transparent representation of the strength of scientific evidence. The module will be available through the Canada School of Public Service in 2022-23.

The Roadmap for Open Science

In February 2020, the OCSA published the Roadmap for Open Science, which provides a step-by-step pathway for applying the principles of open science to federal science and research, namely: that federal government research, data and results should be open, accessible to all, and available for reuse, with minimal restrictions. The Roadmap leads to two key destinations:

- **Open Access:** The articles in peer-reviewed academic journals authored by federal scientists will be openly accessible online. In addition, open access will be extended to other publications by federal government researchers, including reports, conference papers, monographs, book chapters and more.
- **Open Data:** The data collected and used by federal scientists in the course of their publishable research should adhere to FAIR data principles (findable, accessible, interoperable and reusable).

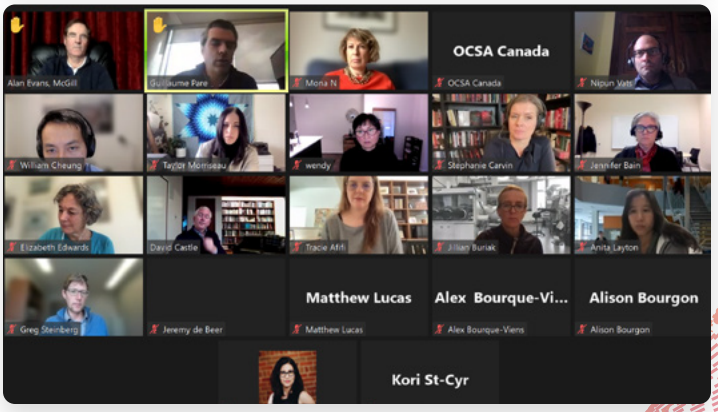
In 2021-22, the OCSA successfully completed an important phase in the Roadmap's plan. Over the course of the year, federal science-based departments and agencies each appointed a Chief Scientific Data Officer to oversee the open science initiatives. They also published departmental open science plans [25] that map out their individual routes to the Roadmap's destinations, a key step in ensuring the transition to open science principles and practices.

In November 2021, the OCSA also hosted a series of open science dialogues [26] with university researchers, Canadian funders, and international leaders. Five dialogue sessions were held to solicit practical approaches and suggestions for the implementation of open science for all publications of federally funded research across Canada. More than 80 participants contributed to the discussion, including international experts, federal and provincial officials, research funding agencies, and the Chief Science Advisor's Youth Council.

The OCSA, in conjunction with Shared Services Canada and a number of departments and agencies, also completed a successful pilot of an online open science publication repository. While the National Research Council of Canada and Natural Resources Canada already have their own online publication site, most federal science-based departments and agencies currently do not. The pilot demonstrated many logistical and cost-based advantages to establishing an open-science repository within the federal government. The project has garnered the support of the major science-based federal departments and agencies.

Ultimately, as per the Roadmap, open science policies should apply similarly to all federally supported research irrespective of where it is conducted, be it from within government or in academic laboratories and field sites.

Throughout the month of November, the Office of the Chief Science Advisor hosted five sessions of open science dialogues with university researchers, Canadian funders and international leaders. These sessions were held to solicit practical approaches and suggestions for the implementation of open science for all publications of federally funded research across Canada.



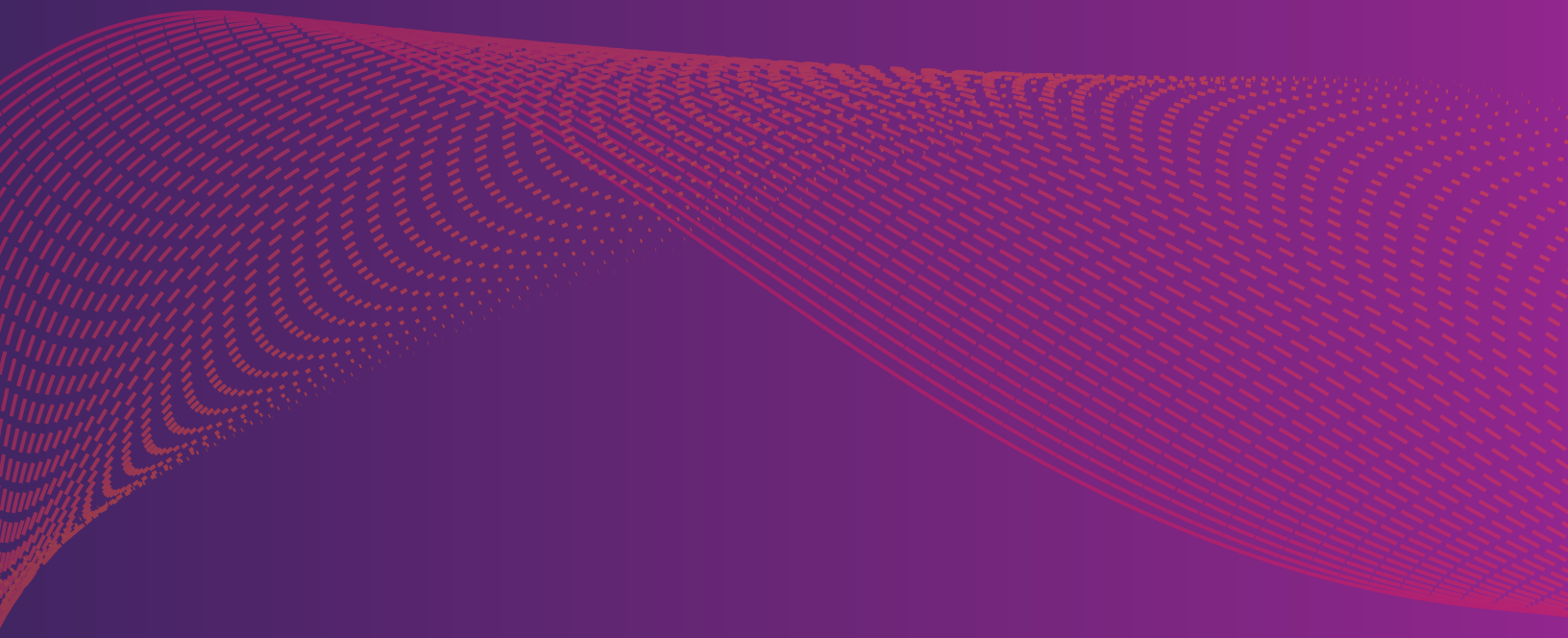
Open Science, Secure Science: The Impact of Global Competition

Scientists have long subscribed to the idea that scientific knowledge is universal. Science is collaborative by nature: a discovery by one team of researchers becomes the foundation upon which others can build. But in a time of rising global competition, questions linger about how best to safeguard research against theft or manipulation, particularly with the rapid growth of transformative health, communication and information technologies such as biotechnology and quantum computing.

The Chief Science Advisor addressed the issue of research security this past year in forums such as the INGSA Conference in Montreal and the Canadian Science Policy Conference in Ottawa, underlining two important messages:

1. **Security should not serve as an excuse for turning inward.** Science is an effective diplomatic vehicle for keeping communication channels open between countries. Over the years, scientific collaboration — such as the human genome project or the International Space Station — has supported peace and often paved the way to economic and political dialogue and partnerships.
2. **Research should be as open and secure as possible.** Some areas of research call for more scrutiny than others. The scientific community needs to understand that some research can deeply impact national interests, and the intelligence community must recognize the importance of research transparency and the positive impacts of collaboration.

More proactive engagement between researchers, funding agencies and the intelligence community will increase mutual understanding across the sectors and empower researchers to protect their research, for both the national interest and the sake of science itself.



Promoting Canadian Leadership in Transformative Technologies

Canada has a long history of scientific discovery, from the invention of the telephone and the discovery of insulin to the creation of the cardiac pacemaker. Canada is home to some of the world's top research institutes, including Waterloo's Perimeter Institute for Theoretical Physics.

Whether to ensure health and food security, to reach net-zero carbon emissions, or to remain a preferred science, technology and innovation (STI) collaborator, Canada will need to stay competitive in research and establish itself as an attractive destination for STI talent and investment. The Chief Science Advisor is a vigorous proponent of Canada's continued global research leadership, including in new transformative technologies and has provided advice to government on ways to best support Canadian excellence in advanced technologies.

Quantum Technology

Our recently acquired ability to measure and manipulate individual atoms and other particles is leading to a new generation of quantum technologies for timekeeping, imaging, sensing, communications and computing. These technologies have a strong potential to fuel disruptive innovation. For instance, though still in its infancy, quantum computing has the potential to revolutionize not only computing but all other fields that rely on computing power, including communications, security, transportation, medical imaging, mining, finance, pharmaceuticals and environmental stewardship.

In February 2022, the Chief Science Advisor delivered the opening remarks to the Quantum Days Conference, which brought together over 1,000 participants from Canada's quantum science community. In her remarks, the Chief Science Advisor promoted a number of initiatives to ensure Canada's continued leadership in quantum research, including roundtable consultations; the development of a quantum roadmap; long-term investment in quantum infrastructure and talent development; greater international cooperation to advance quantum research; and ensuring quantum readiness for the many sectors of the economy that will reap the technology's benefits.

Artificial Intelligence

The Chief Science Advisor is a member of Canada's Advisory Council on Artificial Intelligence [27], which advises government on the development and application of AI to numerous sectors.

To further encourage open and secure international cooperation on AI and other transformative technologies, the OCSA also co-organized, alongside the non-profit research organization Mitacs, a series of Canada–France and Canada–UK roundtables that included both Quantum Science and Artificial Intelligence among the main topics of discussion. These roundtables led to new joint funding among Canadian agencies and their counterparts in Britain and France.

Establishing STI Priorities for Major Research Investments

During the summer 2021, the Chief Science Advisor, alongside ISED Deputy Minister Simon Kennedy, co-chaired a series of three virtual roundtables seeking the perspectives of key stakeholders to refresh the science, technology and innovation (STI) priority areas for two flagship research funding programs: the Canada First Research Excellence Fund (CFREF) and the Canada Excellence Research Chairs (CERC) program.

Participants identified several areas of strategic relevance and future opportunity for Canada. The updated Government of Canada STI priorities for these programs were made public in April 2022 [28], and are Healthy Canadians, Innovative and Resilient Communities, Sustainable Food System, Clean and Resource-Rich Canada, and Advanced Technology Canada.

The Office of the Chief Science Advisor co-organized along with Mitacs a series of roundtables between Canada, France and the United Kingdom that aimed at discussing the challenges and opportunities in quantum science and artificial intelligence.

Looking Ahead: Maintaining Canada's Global Leadership

Science, technology and innovation (STI) are key drivers of economic prosperity and will be essential in addressing present and future global challenges, including national security. The Government of Canada has recognized the importance of STI for the future of the country, but efforts to gain technological advantage are ramping up around the world.

The Chief Science Advisor will continue advising the government on ways to support discovery science and its translation into socioeconomic benefits and developing the science workforce needed for the 21st century. Through her international engagements, the Chief Science Advisor will also continue promoting science diplomacy for Canada's advantage. The OCSA's priorities for promoting STI in Canada include:

- **Report on the Science Workforce.** As the need for science increases and evolves, the skills and tools required from the science community change and diversify. Better data on the federal science workforce is required to support government ambitions and mandates. The OCSA will review existing reports, identify gaps and propose methodology to systematically collect and analyse data to help the workforce keep pace with current and future trends.
- **Accelerating the adoption of open science.** Following the successful pilot of an online federal repository for open publication of federal research, the OCSA will continue to meet the milestones of the Roadmap for Open Science by helping to expand the pilot site to more departments and making it a permanent feature of federal research infrastructure. As part of this project, the OCSA will explore the possibility of publishing the work of Canadian academic scientists in the federal repository. The OCSA will also work with the newly created Chief Scientific Data Officers Network to implement the FAIR principles (Findable, Accessible, Interoperable and Reusable) for federal science data. The OCSA will continue working with academic scientists and Canada's major federal research councils and agencies to support the deployment of open science practices across the country.
- **Science and innovation in Canada's international relations.** Canada is globally recognized as a science and technology powerhouse, and our high standing can be leveraged in our international diplomacy. As evidenced by the COVID pandemic and the challenges of mitigating and adapting to climate change, international collaborations in STI will play an increasingly important role in regional and global relations. Developing countries must also be supported as they increase their own scientific and technological capacities to achieve the sustainable development goals that require STI talent and infrastructure. The OCSA has established productive relationships with colleagues at Global Affairs Canada and will continue supporting the development of an international STI strategy for Canada.
- **Environmental Impact Assessment Science.** As part of its ongoing review of the methods and integrity of the science used in decision-making under the Impact Assessment Act, the OCSA has developed a set of tools for assessing the scientific evidence submitted by proponents, third parties, stakeholders and rightsholders as well as science advice received from federal officials. In 2021-2022, graduate students from three Canadian universities were recruited to assist the OCSA in evaluating tool reliability and feasibility. The OCSA is now working with federal departments providing scientific advice as part of the impact assessment process to further refine the toolbox.

Science Benefiting Everyone

The Chief Science Advisor's mandate includes the promotion of positive and productive dialogue about science both in Canada and abroad, as well as raising awareness of scientific issues relevant to the Canadian public. In this regard, the Chief Science Advisor also serves as a champion of science and of the principles of equity, diversity and inclusion within the scientific community.

Promoting science literacy helps members of the public contextualize societal issues and make informed decisions about their lives. In recent years, and particularly during the COVID-19 pandemic, science has been discussed more frequently, and with more sophistication, in the public sphere. This has helped generate greater trust in scientists: according to a report by the UK-based Wellcome Foundation, survey respondents who say they trust scientists "a lot" rose by 9 percentage points globally between 2018 and 2020, from 34 per cent to 43 per cent.

According to the 2021 3M State of Science Index survey [29], skepticism of science among Canadians dropped from 29 to 21 per cent in a span of two years. Among young Canadians in particular, appreciation of science is high: in a survey [30] conducted by Ipsos for the Canada Foundation for Innovation and ACFAS (Association canadienne-française pour l'avancement des sciences), 70 per cent of respondents aged 18-24 said science is reliable because it is based upon facts rather than opinion.

Significantly, in that same Ipsos-ACFAS survey, 77 per cent of young Canadians think science is a good field in which to pursue a career.

Communicating with the Canadian Public

Science is more than a perspective on the world or a method for conducting experiments; science is also an effective tool Canadians have for generating solutions to problems of all kinds. It is in Canadians' best interest to have access to reliable sources of information on how science can impact their own decisions and those of their governments. Doing so requires concerted efforts by scientists, policymakers and communicators to overcome misinformation and build public trust by openly communicating scientific information with understanding and humility.

The Chief Science Advisor is a leading voice in this effort, doing media interviews and speaking at conferences and other public events throughout the year. While much of this work in the past year, particularly with respect to the media, has been focused on explaining science issues related to the pandemic, the Chief Science Advisor made multiple appearances to speak on a variety of additional topics, both in Canada and abroad, often focused on the future of research, science and innovation in Canada. Those appearances included making an appearance [31] before the parliamentary Standing Committee on Science and Research; speaking [32] at the Prime Minister's Science Fair and at the *Journées scientifiques de la recherche* at Université Laval; serving as a featured guest [33] at the CFI national conversation for youth and science; delivering opening remarks [34] at the 2022 Quantum Days Conference; and serving as a panelist at COP26 [35].

In early January 2022, Dr. Nemer was part of an expert panel on a special episode of Découverte *on ICI Radio-Canada, to talk about the Omicron variant and what the science says about the spread of the virus.*

The Chief Science Advisor also penned an op-ed [36] in the November 2021 edition of *Canadian Science Policy Magazine* on the issue of how to ensure research security while still advancing the principles and goals of open science. Later in the year, she also wrote and recorded an information video, titled Securing Your Research [37], to help researchers safeguard and share their research.

The Chief Science Advisor was the keynote speaker during the Journées scientifiques de la recherche at Université Laval, October 2021. Dr. Nemer was invited to visit the campus research facilities, including l'Institut Universitaire de Cardiologie et de Pneumologie de Québec.

Dr. Nemer was a guest panelist for a discussion about mentoring women in research and international collaborations. The event was hosted by the National Research Council of Canada and the German Ministry of Education and Research to mark the International Day of Women and Girls in Science.

Indigenous Knowledge and Science Systems

The OCSA is a co-founder of the Interdepartmental Indigenous Science, Technology, Engineering and Math (I-STEM) Cluster. Alongside representatives from 11 federal departments and agencies, the I-STEM Cluster works to inform and enhance policies to advance Indigenous priorities, aspirations and innovation in environmental stewardship and research.

This past year the I-STEM Cluster completed the development of an Indigenous Competency Training workshop. Entitled "Reframing Research through Reconciliation," the workshop consisted of eight sessions designed to improve the federal government's ability to work respectfully with Indigenous peoples and incorporate their knowledge into federal science. The I-STEM Cluster also embarked on an effort to identify best practices for supporting Indigenous governance in research by cataloguing common elements, guiding principles, and effective approaches to support science with Indigenous partners.

The OCSA also contributed to the advancement of Indigenous perspectives through the Chief Science Advisor's membership in the Canada Research Coordinating Committee [38] (CRCC), the eight-member body tasked with coordinating research priorities and programs among Canada's research funding agencies. The CRCC released its first progress report [39] on the Strengthening Indigenous Research Capacity initiative. Since the initiative was first launched in 2019, the CRCC has established working groups to address three key issues of concern: Indigenous funding opportunities, barriers to Indigenous-led community research, and appropriate reviews of Indigenous research.

Equity, Diversity and Inclusion in Government Science and Beyond

This past year the Chief Science Advisor upheld her ongoing commitment to the advancement of women and other underrepresented groups in the federal science workforce and beyond. The Chief Science Advisor addressed the issues of equity, diversity and inclusion with students, public servants, educators and others through a variety of speaking events, including appearing as a featured speaker [40] on women in STEM at a Canada School of Public Service virtual café discussion; delivering a keynote address [41] at the Leaders Overcoming Great Inequalities in Chemistry (LOGIC) conference; speaking at a virtual discussion of *Causerie Acfas' "Les chercheuses au pouvoir!"* on women scientists in leadership positions; and serving as a panelist on mentoring women in research and international collaborations, at a joint event [42] hosted by the National Research Council of Canada and the German Ministry of Education and Research to mark the International Day of Women and Girls in Science.

Dr. Nemer delivered a virtual keynote address on May 9, 2021, about promoting a diverse and inclusive science environment during the Leaders Overcoming Great Inequalities in Chemistry (LOGIC) Retreat.

On May 4, 2021, Dr. Nemer and Sarah Paquet, Director and CEO of FINTRAC, talked about their careers in STEM and shared their perspectives on the importance of women role models and diversity in STEM as part of a virtual event hosted by the Canada School of Public Service.

On October 5, 2021, the Chief Science Advisor joined Roseann O'Reilly Runte, President and CEO of the Canada Foundation for Innovation, Janice Bailey, Scientific Director of the Fonds de recherche du Québec, Claire Giry, Director General of Research and Innovation at the French Ministry of Higher Education, Research and Innovation and Christelle Roy, Director Europe of Research and International Cooperation at the Centre national de la recherche scientifique to discuss the place and representation of women scientists in leadership positions during an event hosted by Acfas.

In addition, the Chief Science Advisor advanced the causes of equity, diversity and inclusion in science through her role with the Canada Research Coordinating Committee. The CRCC's initiatives this past year included promoting the Dimensions Charter, which addresses systemic barriers in research faced by women, Indigenous peoples, persons with disabilities, members of visible minority and racialized groups, and members of the LGBTQ2+ communities. An additional 15 institutions signed the Charter this year, bringing the total number to 125. The committee also implemented equity, diversity and inclusion (EDI) guidelines and requirements for the New Frontiers in Research Fund and the Canada Research Chairs program, and awarded a second round of EDI Institutional Capacity-Building Grants, which will disburse a total of $4.8 million to 12 post-secondary institutions in Canada.

Looking Ahead: Promoting Science in Canada

The Chief Science Advisor will continue her efforts to promote equity, diversity and inclusion within the science community in Canada and internationally in the year ahead. It is important to recruit scientists from all backgrounds and communities, so that the science community can better reflect the diversity in our society, facilitating meaningful dialogue and mutual understanding and trust.

To this end, the OCSA will engage with post-secondary institutions, and work with partner organizations such as ScienceUpFirst and Let's Talk Science, to promote scientific literacy, encourage the STEM disciplines as a career choice, and dispel misinformation online. The fight against misinformation is one that scientists of all ages need to engage in.

The Way Forward

Over the course of the last two years, the conduct of scientific research and the provision of science advice have proven indispensable to all governments and decision-makers. That is unlikely to change in the months and years ahead. Science will continue to play a central role in all the major policy issues of our time: preparing and responding to public health challenges; addressing climate change through mitigation and adaptation strategies; managing energy transition; strengthening international scientific cooperation in the face of social and political uncertainty; and promoting peace and equality in a rapidly changing world.

Canada will need to remain committed to providing a welcoming environment to diverse STI talent, and to enhancing its competitiveness in attracting and retaining researchers and innovators in all fields and sectors. Canada has many enviable assets to build on in the face of fierce global science and technology competition not seen since the Cold War years. Strengthening cross-sector collaborations, including between government, academia and the private sector, must be a collective priority.

The Office of the Chief Science Advisor has proven to be, and will continue to be, a committed partner in these efforts. The OCSA plays a unique convening role at the nexus of science and policy in Canada promoting science excellence and robust science advice. In the future, the OCSA can help the development of a comprehensive STI strategy to ensure that Canadians continue to reap the full benefits of science. Such a strategy would address training through research, strengthening intellectual property protection at Canada's post-secondary institutions, and supporting the early stages of translating discovery into innovation. These are essential ingredients to our post-pandemic recovery and to building tomorrow's sustainable society.

Appendices

Appendix A: Departments' and Agencies' Scientific Activity

The list below shows the top federal departments and agencies in Canada in terms of expenditures in scientific research and development.

$ millions

Department/Agency	2019-20	2020-21	2021-22
Canadian Institutes of Health Research	1202	1503	1393
National Research Council Canada	1215	1714	1391
Natural Sciences and Engineering Research Council of Canada	1355	1372	1380
Innovation, Science and Economic Development Canada	602	797	1034
Environment and Climate Change Canada	808	853	1023
Social Sciences and Humanities Research Council of Canada	941	1419	1014
Statistics Canada	667	745	958
Health Canada	391	836	890
Natural Resources Canada	635	672	792
Global Affairs Canada	626	739	591
National Defence	483	533	558
Agriculture and Agri-Food Canada	533	526	553
Fisheries and Oceans Canada	357	417	473
Canada Foundation for Innovation	374	389	460
Canadian Space Agency	291	..	362
Sub-Total	**10480**	**12515**	**12872**
Other departments and agencies	2335	2513	2392
Total	**12815**	**15028**	**15264**

*All data is from Statistics Canada: Table 27-10-0026-01 [43],
Federal expenditures on science and technology by major departments and agencies.

Appendix B: Departments' and Agencies' Scientific Employment

The list below shows the top federal departments and agencies in Canada in terms of the number of scientific employees, March 2021.

Department/Agency	Scientific employees
Canadian Food Inspection Agency	4,240
Department of National Defence	3,703
Environment and Climate Change Canada	3,691
Health Canada	3,613
Fisheries and Oceans Canada	3,124
National Research Council	2,246
Natural Resources Canada	1,833
Agriculture and Agri-Food Canada	1,699
Public Services and Procurement Canada	1,133
Transport Canada	659
Innovation, Science and Economic Development Canada	649
Public Health Agency of Canada	577
Indigenous Services Canada	473
Statistics Canada	341
Canadian Space Agency	320
Others	2,247
Total	**30,548**

Appendix C:
Departmental Science Advisors Network Members

Name	Title	Organization
Sarah Gallagher	Science Advisor to the President	Canadian Space Agency (CSA)
David Hik	Chief Scientist and Executive Director	Polar Knowledge Canada (POLAR)
Shawn Marshall	Departmental Science Advisor	Environment and Climate Change Canada (ECCC)
Sarah Viehbeck	Chief Science Officer	Public Health Agency of Canada (PHAC)
Marc Saner	Departmental Science Advisor	Natural Resources Canada (NRCan)
Paul Snelgrove	Departmental Science Advisor	Department of Fisheries and Oceans (DFO)
Cara Tannenbaum	Departmental Science Advisor	Health Canada (HC)
Joel Martin	Chief Science Officer and Chief Digital Research Officer	The National Research Council (NRC)
Gordon Lovegrove	Departmental Science Advisor and Chief Science Officer	Transport/Infrastructure Canada

Appendix D:
The CSA's Youth Council Members

Keeley Aird	Max King
Justine Ammendolia	Audrey Laventure
Marie-Eve Boulanger	Chedi Mbaga
Andréa Cartile	Taylor Morriseau
Erin Crockett	Sophie Poirier
Landon Getz	Farah Qaiser
Sara Guzman	Madison Rilling
Amelia Hunter	Ali Sbayte
Natasha Jakac-Sinclair	Molly Meng Hua Sung
Chelsie Johnson	Arthur Van Havre

Links

1 https://www.ic.gc.ca/eic/site/063.nsf/eng/h_98027.html

2 https://science.ised-isde.canada.ca/site/science/en/office-chief-science-advisor/initiatives-covid-19

3 https://www.ic.gc.ca/eic/site/063.nsf/eng/h_98291.html

4 https://www.ic.gc.ca/eic/site/063.nsf/eng/h_98229.html

5 https://www.ic.gc.ca/eic/site/063.nsf/eng/h_98176.html

6 https://www.ic.gc.ca/eic/site/063.nsf/eng/h_98049.html

7 https://www.ic.gc.ca/eic/site/063.nsf/eng/h_98101.html

8 https://science.ised-isde.canada.ca/site/science/en/office-chief-science-advisor/initiatives-covid-19

9 https://resources-covid19canada.hub.arcgis.com/apps/public-health-agency-of-canada-dashboard/about

10 https://www.covid19immunitytaskforce.ca/

11 https://nrc.canada.ca/en/corporate/covid-19-vaccine-task-force

12 https://ised-isde.canada.ca/site/canadian-life-science-industries/en/covid-19-therapeutics-task-force

13 https://ised-isde.canada.ca/site/innovation-better-canada/en/industry-strategy-council

14 https://www.canada.ca/en/health-canada/services/drugs-health-products/covid19-industry/medical-devices/testing-outreach-collaboration/industry-advisory-roundtable.html

15 https://www.budget.gc.ca/2021/report-rapport/p1-en.html

16 https://www.gov.uk/government/publications/100-days-mission-to-respond-to-future-pandemic-threats

17 https://www.g7uk.org/g7-scientific-advisers-publish-report-on-100-days-mission/

18 https://genomecanada.ca/challenge-areas/cancogen/

19 https://www.canada.ca/en/health-canada/services/drugs-health-products/covid19-industry/medical-devices/testing-screening-advisory-panel.html

20 https://ised-isde.canada.ca/site/biomanufacturing/en/canadas-biomanufacturing-and-life-sciences-strategy

21 http://www.g20.utoronto.ca/2021/210806-research.html

22 https://science.ised-isde.canada.ca/site/science/en/office-chief-science-advisor/annual-reports/chief-science-advisor-annual-report-2019-20

23 https://science.ised-isde.canada.ca/site/science/en/office-chief-science-advisor/ocsas-youth-council-csa-yc

24 https://science.ised-isde.canada.ca/site/science/en/office-chief-science-advisor/scientific-integrity/resources-and-tools-effective-science-advice

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