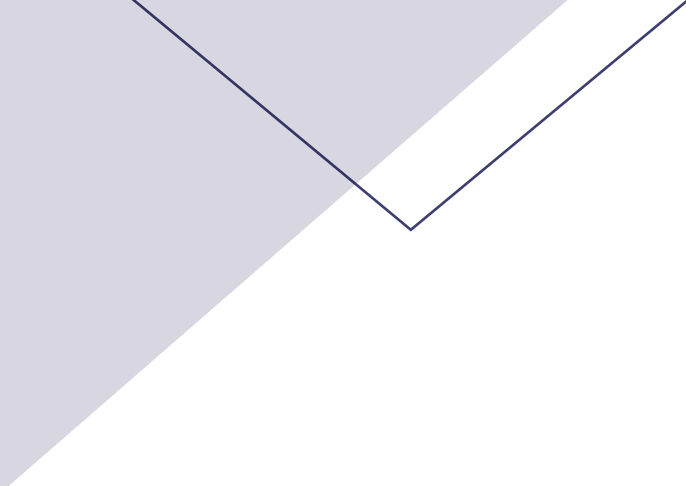


Post-COVID-19 Condition in Canada: What We Know, What We Don't Know and a Framework for Action.

A Preview of the Chief Science Advisor's
Upcoming Report on post-COVID-19 condition.

December 2022





Cette prépublication est aussi disponible en français sous le titre :
Le syndrome post-COVID-19 au Canada : état des connaissances et cadre d'action

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POST-COVID-19 CONDITION IN CANADA:

WHAT WE KNOW, WHAT WE DON'T KNOW, AND A FRAMEWORK FOR ACTION

Executive Summary

The COVID pandemic has had devastating effects on our society and on human health and mortality. Over the past two years, evidence has emerged to suggest that the impacts of COVID-19 extend beyond the acute phase of the disease which, in some infected individuals, can turn into a chronic illness. In Canada, as of August 2022, more than 1.4 million people – or about 14.8 per cent of adults who have contracted COVID-19 – say they experience symptoms three months or more after their initial infection. These include respiratory, cardiovascular, neurological and cognitive impairments and they can be debilitating.

These symptoms are collectively identified as post-COVID-19 condition (PCC), or long COVID. Currently, there is no consensus definition of the condition or its diagnosis and few if any clinical practice guidelines are available. Globally, data for different countries consistently show that 10-20 percent of infected individuals experience PCC. People suffering from the condition receive standard of care for medically defined symptoms (e.g., cardiovascular complications) but for the many who suffer from other broad or medically undefined symptoms (such as chronic fatigue or brain fog), little other than rehabilitation therapy is presently offered. Several international clinical trials are ongoing to test new treatments or the benefits of existing repurposed medications. With the pandemic and the virus still spreading, PCC is likely to affect many more Canadians. Interestingly, COVID-19 vaccines significantly reduce, but do not eliminate, the risks of developing PCC.

The biologic basis for the complex symptoms and conditions seen in PCC remains unknown and represents a major impediment to diagnosis and care of individuals suffering from the condition. Disease mechanisms may include effects on specific organs, systemic effects due to chronic inflammation and deregulation of the immune system or persistence of viral proteins or RNA in host cells. Known risk factors include female sex, hospitalization due to COVID, pre-existing chronic health conditions, and repeated SARS-CoV-2 infection.

In addition to health, PCC has a significant socioeconomic impact on individuals and communities. Among other things, PCC impacts the labour market, the workplace, and social support programs. The lack of defined diagnostic criteria and treatments together with the modest awareness of the condition is leading to stigma and disbelief, further affecting the mental and physical health of individuals living with PCC and their families.

In this context, Canada's Chief Science Advisor established a multidisciplinary task force in July 2022 to investigate and advise on ways to address post-COVID-19 condition in Canada. The product of their deliberations is a report that took into account existing scientific literature, published evidence, experience of service providers and the perspectives of people with lived experience. The report also proposes an integrated framework for the management of PCC in Canada.

The recommendations include ensuring that research be interconnected with PCC clinical service delivery as part of a continuous learning framework; that services be developed and tailored to people and their families living with PCC, recognizing that females disproportionately suffer from PCC; and that sustainable human and physical infrastructure be put in place to support PCC management, prevention and research. These are integral to the broader effort of pandemic preparedness.

Below are the Task Force's recommendations.

1. Establish PCC diagnostic criteria and develop clinical practice guidelines for health professionals, in collaboration with national and international partners.
2. Develop, make available and consistently apply specific PCC diagnostic codes at all points of care to accurately track PCC cases in Canada and support the effective delivery of clinical services.
3. Provide timely and equitable access to person-centered care pathways for individuals living with PCC across the health care continuum regardless of ability, age, gender, geographic location or socio-economic or cultural background.
4. Develop a federal, provincial, territorial (FPT) long-term integrated research strategy for infection-associated chronic conditions, including PCC, that articulates clear priorities, considers both adults and children, and supports pandemic preparedness.
5. Establish a Canada-wide research and clinical care network for PCC and other similar post-infection chronic conditions to harmonize and coordinate efforts nationally and internationally.
6. Quickly advance five targeted priority research areas: (i) patho-physiology/biologic mechanisms and risk factors; (ii) development of therapeutics; (iii) evidence-based prevention; (iv) clinical and translational research; and (v) socio-economic impacts of PCC.
7. Modernize relevant policies and eligibility criteria to maximize the participation of people living with PCC in society, along with necessary supports and services.
8. Develop resources and tools that respond to the needs of people living with PCC, their caregivers and their dependents, in partnership with persons with lived experience and community groups.
9. Acknowledge that PCC is real by raising awareness through outreach to citizens, schools and workplaces.
10. Develop and continuously update a web-based platform that lists available government services for individuals affected by PCC and their families.
11. Develop, regularly evaluate, and adapt the effectiveness of PCC educational approaches for health care providers, particularly primary care.
12. Empower Canadians to make informed decisions about prevention of SARS-CoV-2 infection and PCC, as the science evolves.

13. Establish a multidisciplinary scientific advisory council on infection-associated chronic conditions, in collaboration with the Office of the Chief Science Advisor, to support an integrated research strategy.
14. Set up a whole-of-government PCC coordination structure within the federal Health Portfolio to engage and coordinate with internal and external partners, including levels of government, the private sector, and patient groups.
15. Enhance the timely capture and sharing of data and the use of state-of-the-art data analysis strategies for improving the management of PCC and evidence-informed policy.
16. Strengthen the human, digital and physical infrastructure that interconnects and supports research, care and emergency preparedness.
17. Scale-up and monitor effective prevention interventions, such as improving ventilation in schools, workplaces and public places as part of a first line of prevention of SARS-CoV2 infection and other respiratory/airborne pathogens.
18. Encourage innovation in PCC care models and evaluate them to inform future resilience in the health care system including the recruitment and retention of a thriving health care workforce.

The current pandemic is not the first, nor will it be the last. A legacy of learning from PCC and the current pandemic should include strengthened infrastructure, systems, epidemiological surveillance, data collection and sharing, and effective governance for coordinating actions and communications. Such efforts that include physical and human infrastructure, the built environment and common platforms and pan-Canadian networks will serve to enhance our preparedness and response to future outbreaks and emergencies.

A THREE-POINT FRAMEWORK FOR THE MANAGEMENT OF POST-COVID-19 CONDITION IN CANADA

In developing this framework, the Chief Science Advisor’s Task Force on Post-COVID-19 Condition considered the evidence available up to October 2022 as well as the information gathered from seven roundtable discussions with experts and individuals living with post-COVID-19 condition (PCC). The three-point framework proposes 18 actions that, taken together, will help manage the health and socio-economic impacts of PCC in Canada and enhance pandemic preparedness and recovery.

VISION

The number of Canadians living with disabling, long-term effects of SARS-CoV-2 infection is reduced, and the negative health and societal impacts of post-COVID-19 condition (PCC) are limited through enhanced services and supports.

GOALS AND OUTCOMES

- 1** Individuals with PCC, their families and dependents have timely access to the health services and support they need.
- 2** Research on PCC mechanistic pathways, risk factors and effective treatments is accelerated and translated into better care for PCC and other infection-associated chronic conditions.
- 3** Accurate data on PCC in Canada is collected and shared as part of a learning health system to inform clinical approaches, communication, and policy and program development.
- 4** Socio-economic policies and programs address the realities of living with PCC and provide necessary support and services.
- 5** Health care providers, individuals living with PCC and the general public have access to accurate information about PCC, thereby reducing stigma and promoting access to quality care.
- 6** Broader systemic and infrastructure changes that can benefit individuals living with PCC and other chronic post-infection conditions are identified and actioned. This will contribute to pandemic preparedness.

PRINCIPLES

Actions should be guided by the following seven principles:

- 1** **Equity**, recognizing all people have the right to be treated fairly and have equitable access to resources, opportunities, and benefits.
- 2** A **person-centred** research agenda to improve prevention, treatment and quality of life.
- 3** **Open and collaborative data and research** within an appropriate ethical-legal-social framework.
- 4** **System innovation** that encourages an implementation science approach in the context of learning health systems that address systemic barriers and evaluates novel approaches to overcome them.
- 5** **Partnership across disciplines**, sectors, and levels of government focussing on common goals.
- 6** **Inclusivity**, noting that individuals living with other infection-associated chronic conditions face similar challenges and would benefit from a similar approach.
- 7** **Pandemic preparedness and recovery**, such that actions taken to address PCC contribute to Canada's preparedness and response to future pandemics and infection-associated chronic conditions.

A THREE-POINT FRAMEWORK

Recommendations within this framework are aimed at public, not-for-profit and private organizations, as relevant, including levels of government, employers, institutions and insurers.

Preventing and managing PCC and its socio-economic impacts across Canada requires a **dynamic framework that is informed by the most current scientific evidence**. Actions to achieve the vision and goals, guided by the principles outlined above, are multipronged.

Recommended actions are organized from direct to broader and include A) *Direct Actions* Related to PCC Clinical Practice and Research; B) *Broad Actions* Related to PCC Socio-economic Policies and Communication; and C) *Foundational Actions* Related to Infrastructure, Systems and Coordination that would further support individuals living with PCC. The proposed actions within this three-point framework span: clinical practice and services; research to guide practice and policy; communication; socio-economic policies and programs; and infrastructure, systems and coordination that contribute to PCC management and the foundation for pandemic preparedness.

1. DIRECT ACTIONS RELATED TO PCC CLINICAL PRACTICE AND RESEARCH

Clinical Practice and Services

Clinical practice and services for PCC should be guided by person-centred and interdisciplinary approaches, including allied health services (e.g., rehabilitation, mental health and other services), drawing on lessons learned from the management of other chronic diseases. Interconnected continuous learning, research, standardized and accessible data, evaluation and quality improvement should be integral parts of timely clinical services.

1. **Establish PCC diagnostic criteria and develop clinical practice guidelines for health professionals, in collaboration with national and international partners.** Canadian federal guidance would address an urgent gap and help build consistent approaches across provinces and territories. Other countries are making progress in this area, such as the United States Centers for Disease Control and Prevention's "Evaluating and Caring for Patients with Post-COVID Conditions: Interim Guidance" and "Post-COVID Conditions: Information for Health care Providers".
2. **Develop, make available and consistently apply specific PCC diagnostic codes at all points of care to accurately track PCC cases in Canada and support the effective delivery of clinical services.** The World Health Organization has been developing emergency use international classification of disease (ICD) codes for COVID-19, including for PCC. The application of standardized PCC diagnostic code(s) at all levels is a shared responsibility at local, provincial, territorial and federal levels.

3. Provide timely and equitable access to person-centred care pathways for individuals living with PCC across the health care continuum regardless of ability, age, gender, geographic location or socio-economic or cultural background. PCC care pathways within provinces and territories should be developed in collaboration with community care services and established within different geographic regions and sub-population groups, considering who is at risk.

3.1. Accelerate the availability and use of PCC care models and access to treatments in the context of a continuous learning framework. Models should be informed by learnings from other complex, multi-system chronic diseases. They should also be accessible, culturally appropriate, and effectively address community needs.

3.1.1. Engage and partner with PCC communities and health care providers to develop PCC care models and health care delivery solutions.

3.1.2. Scale up and evaluate interdisciplinary PCC clinics, including allied health services (as above) and self-management components.

3.1.3. Establish learning health systems and networks to develop a cohesive infrastructure enabling knowledge building and exchange.

3.1.4. Provide faster and equitable access to clinical trials and studies, including approaches to rehabilitation, while ensuring patient safety.

3.2. Support primary care providers as a key point of entry into the health care system through education, training, and human resource capacity to address PCC.

3.3. Consider the development and use of services and tools to assist people, as appropriate. These include virtual/web-based tools, telehealth, self-management tools, group-based care and peer support, including for triage prior to clinical assessment.

3.4. Provide health care workers who develop PCC with timely care and flexible return-to-work arrangements, considering the significant impact of their absenteeism on the health care system.

3.5. Implement and evaluate the effectiveness of PCC virtual clinical assessment and care approaches, especially in remote areas.

3.6. Using existing cohorts, monitor changes in the frequency or presentation of other chronic illnesses such as diabetes, and cardiovascular and neurological diseases.

Research

Understanding the biological triggers and pathways underlying PCC is essential for developing diagnostics as well as preventative and therapeutic avenues. Knowledge of the molecular effects of SARS-CoV-2 in various cells and organs is essential. Persistent knowledge gaps are an impediment to improved health outcomes. Research that is interdisciplinary and collaborative spanning basic biomedical, clinical and translational (discovery to treatment) pillars should be accelerated. As noted above, research should be interconnected with PCC clinical service delivery as part of a continuous learning framework. Attention should be given to data stewardship, as advancing research and care depends on accessible and standardized approaches to data collection and management, the availability of appropriately trained human resources and access to secure data repositories. Additionally, there is an urgent need to better document the socio-economic impacts of PCC in order to adequately address them.

4. **Develop a federal, provincial, territorial (FPT) long-term integrated research strategy for infection-associated chronic conditions (including PCC) that articulates clear priorities, considers both adults and children, and supports pandemic preparedness.** Such a resourced research strategy could enable cross-jurisdictional collaboration, data sharing, and the rapid mobilization of knowledge. It must be co-developed with patients and community groups.
5. **Establish a Canada-wide research and clinical care network for PCC and other similar post-infection chronic conditions** to harmonize and coordinate efforts nationally and internationally. This national network would accelerate the translation of research into care and policy.
6. **Quickly advance targeted priority research areas, given the number of people potentially affected by PCC.** Standardization of PCC definitions, use of consistent study methodologies, sample collection procedures and stratification of participant groups (across jurisdictions in Canada and internationally) would enable comparative analyses and accelerate the development of evidence-based care and therapies for PCC. Five priority research areas are proposed below to address needs and knowledge gaps, including understanding **pathophysiology and risk factors** and developing **effective therapies for treatment and prevention**.

6.1. Pathophysiology/biologic mechanisms and risk factors

6.1.1. Encourage basic research into the molecular consequences of SARS-CoV-2 entry into different cell types by reaching out to researchers with expertise in different systems and organs and including them in the Canada-wide research network that will provide national platforms to share research tools and facilitate preclinical, clinical and translational research. More specifically:

6.1.1.1. Apply modern approaches of genetics, genomics, proteomics and metabolomics and harmonize bioinformatic analysis and data sharing to understand PCC pathogenesis and risk factors including host-virus interactions.

6.1.1.2. Provide sustainable funding for technological platforms such as data and biobanks that enable collecting and sharing of biological materials and serve skills and capacity development.

6.1.1.3. Develop and validate animal models that reproduce the systemic and organ specific effects of COVID-19 and the PCC phenotypes as accessible and shared resources.

6.1.2. Apply learnings from other infectious and zoonotic diseases to define direct and indirect effects of SARS-CoV-2 infection and help inform pandemic preparedness plans. More specifically:

6.1.2.1. Differentiate between the long-term health effects of viral infection and health effects associated with hospitalization, intensive care unit admission, or extended social isolation.

6.1.2.2. Analyze the impact of PCC on the immune response to subsequent infections and the impact of repeated SARS-CoV-2 infections on the development of PCC.

6.1.2.3. Study historical outbreaks of infectious diseases for insight into virus evolution, human behavior and their long-term health outcomes.

6.2. *Development of therapeutics*

6.2.1. Invest in the development of effective broad-acting antivirals to minimize long-term sequelae from SARS-CoV-2 infection and reinfection. This requires adequate funding of medicinal chemistry research and making platforms for preclinical testing of bioactivity accessible to chemists as done by the National Institutes of Health in the USA.

6.2.2. Accelerate research into therapeutics that target the burdensome symptoms of PCC, including those related to inflammation, neuropsychiatric, respiratory and cardiovascular symptoms where there are unmet clinical needs.

6.2.3. Establish a clinical trial framework with strong central coordination to test the effectiveness of existing therapies that may be successfully repurposed for treating PCC, as part of the Canada-wide research network. Central coordination would add value through building on common protocols, enabling domestic and international linkages, and combining efforts thereby avoiding several small-scale underpowered trials.

6.3. *Evidence-based prevention*

Study the effectiveness of potential prevention measures using socio-behavioural, clinical and biochemical approaches. In particular:

6.3.1. Evaluate primary prevention of SARS-CoV-2 infection through the built environment and adaptive behaviour over the long-term to reduce COVID-19 transmission.

6.3.2. Improve secondary prevention once infected with SARS-CoV-2, through the use of effective antivirals or other therapies that are known to prevent organ damage, to minimize severe infection and evaluate the effect on reducing the likelihood of developing PCC.

6.3.3. Support tertiary prevention of organ damage and disability in the context of living with PCC, using pharmacological and non-pharmacological interventions (such as rehabilitation and clinical care models).

6.3.4. Document the impacts of prior vaccination and use of antivirals such as monoclonal antibodies and Paxlovid™ on the risk of PCC development in various demographics and define the biologic basis.

6.3.5. Identify the reason why female sex is an independent risk factor for PCC.

6.3.6. Engage in behavioural and sociological research on effective public health communication strategies and messages to raise population-level awareness about PCC and prevention.

6.4. *Clinical and translational research*

With the objective of promoting synergies and accelerating the transfer of new knowledge into health outcomes, promote collaboration between preclinical and clinical investigators and between researchers and practitioners within the framework of the research network noted above. Among others:

6.4.1. Advance diagnostic and biomarker development.

6.4.2. Support cohort studies with appropriate comparator groups to evaluate long-term health effects, including on aging and human development, as well as prognostic factors.

6.4.3. Determine effectiveness of treatments, including rehabilitation and physical therapy approaches, and clinical care models across the continuum of care and across different subpopulations.

6.4.4. Evaluate the effectiveness of teams led by people with lived experience and the impact of citizen science approaches in improving PCC care.

6.4.5. Ensure adequate physical and human infrastructure through sustainable capacity for interoperable data collection systems and biobanking (see also 6.1.1.2) This includes having data sharing and material transfer agreements in place as part of emergency preparedness in the spirit of transparency and open, secure science.

6.5. *Socio-economic impacts of PCC*

6.5.1. Collect data and support research related to accessibility of benefits and services, including for disability; impacts on family life; and effects on the labour market for individuals suffering from PCC. Data required for modelling the ongoing and future socio-economic impacts of PCC should also be dynamically collected and analyzed, including by Statistics Canada and the Bank of Canada.

6.5.2. Study the socio-economic impact across the life course (children, youth, middle years, the elderly), on women and their dependents who may bear the brunt of PCC impacts, and in marginalized population groups (e.g., Indigenous, racialized, homeless, etc.)

6.5.3. Collect data and analyze the current and projected impact of PCC on the health care workforce. More specifically, understand and mitigate the impact of PCC on health care workforce burnout within the broader study of causes and solutions of burnout in health care workers.

2. BROAD ACTIONS RELATED TO PCC SOCIO-ECONOMIC POLICIES AND COMMUNICATION

Socio-Economic Policies and Programs

Individuals living with PCC can experience a variety of symptoms that occur in irregular or episodic patterns over time. Tailored supports and services through effective policies and programs are required to meet their needs, including those related to physical and/or cognitive impairment, recognizing the impacts on families and the fact that females disproportionately suffer from PCC. Determining and addressing needs should consider equity, inclusivity and accessibility, and be done in partnership with persons with lived experience.

- 7. Modernize relevant policies and eligibility criteria to maximize the participation of people living with PCC in society, along with necessary supports and services.**
 - 7.1.** Develop best practices around flexible return to school and work policies that accommodate the episodic, medium-term, and long-term nature of PCC, in partnership with persons with lived experience as well as private and public sector partners.
 - 7.2.** Consider updating the requirements of short- and long-term disability, insurance claims, workers' compensation, social assistance and employment insurance as appropriate, to provide flexibility given the episodic and medium- to long-term nature of PCC.
- 8. Develop resources and tools that respond to the needs of people living with PCC and other similar post-infection conditions, their caregivers and their dependents, in partnership with persons with lived experience and community groups.**
 - 8.1.** Introduce community-level support resources and programs that help people living with PCC with everyday tasks.
 - 8.2.** Encourage employers to provide suitable accommodations (such as for resting and pacing) for workers with physical and cognitive limitations due to PCC or other chronic, post-infection conditions.
 - 8.3.** Enhance access to wellness programs and mental health support for individuals with PCC or other chronic post-infection conditions.

Communication and Outreach

Effective and culturally sensitive PCC communication and outreach efforts are needed to maintain public trust, provide consistent messaging, help reduce stigma and protect vulnerable individuals from disinformation, profiteering and unauthorized treatments.

9. **Acknowledge that PCC is real by raising awareness through outreach to citizens, schools and workplaces.**
 - 9.1. Develop PCC public awareness and outreach efforts through consistent and culturally sensitive messages, in partnership with patient and community groups.
 - 9.2. Provide public education on the risks of PCC and the importance of tools for preventing SARS-CoV-2 infection and PCC development.
 - 9.3. Provide proactive outreach and education to help people living with PCC make informed decisions about treatment options.
 - 9.4. Follow communication campaigns on PCC prevention with public health campaigns to increase the rates of vaccination across the country.
10. **Develop and continuously update a web-based platform that lists available government services for individuals affected by PCC and their families.** Local municipal and provincial sites along with patient associations may provide such information. A federal Health Portfolio PCC coordinating body (see section 3.1.3) could collate links to local and provincial/territorial PCC supports through a federal website, thereby improving awareness and access.
11. **Develop, regularly evaluate and adapt the effectiveness of PCC educational approaches for health care providers, particularly primary care.** Effective PCC educational activities should be promoted through Continuing Professional Development (CPD), the College of Family Physicians of Canada and the Royal College of Physicians and Surgeons of Canada.
12. **Empower Canadians to make informed decisions about prevention of SARS-CoV-2 infection and PCC, as the science evolves.** Among others, make data available that facilitates individual risk assessment and use messages that emphasize the personal and collective benefits of individual actions.

3. FOUNDATIONAL ACTIONS RELATED TO INFRASTRUCTURE, SYSTEMS AND COORDINATION

Infrastructure, Systems and Coordination

Sustainable human and physical infrastructure and systems are foundational to support health and socio-economic management of PCC, including research and care to individuals and communities. All elements required for effective data monitoring systems and related infrastructure should be strengthened within and across jurisdictions. In addition, the physical environment of schools, institutions, workplaces and public spaces can support primary prevention and can help reduce ongoing transmission of infectious respiratory diseases and the development of PCC and other post-infection conditions. Coordination of PCC efforts is required domestically and internationally, given the various sectors and actors implicated. Shared commitment, collaborative and interoperable approaches to sample/data collection and sharing, and supporting open and secure science within a learning environment are all required to effectively manage PCC and future pandemic threats.

13. **Establish a multidisciplinary scientific advisory council on infection-associated chronic conditions, in collaboration with the Office of the Chief Science Advisor, to support an integrated strategy (see also recommendation 4).** In addition to providing updates on scientific developments and recommendations on synergies between various efforts, the council could provide advice to ensure that the infrastructure needed to address post-infection challenges is part of future pandemic preparedness.
14. **Set up a whole-of-government PCC coordination structure within the federal Health Portfolio to engage and coordinate with internal and external partners, including levels of government, the private sector and patient groups.**
15. **Enhance the timely capture and sharing of data and the use of state-of-the-art data analysis strategies for improving the management of PCC and evidence-informed policy.**
 - 15.1. Immediately implement the Pan-Canadian Health Data Strategy, in particular the recommendation to establish a harmonized pan-Canadian health data policy framework, which supports person-centred data that can be shared within an appropriate ethical-legal-social framework.
 - 15.2. Contribute to ongoing readiness for pandemics by strengthening and streamlining monitoring systems across the health system and beyond, so there is a continuum from infectious disease outbreaks through to monitoring chronic (long-term) health effects.
16. **Strengthen the human, digital and physical infrastructure that interconnects and supports research, care and emergency preparedness.**
 - 16.1. Work towards standards for research ethics board (REB) review that accelerate clinical studies, and the integration of findings for improved health policy and effective care.
 - 16.1.2. Streamline REB review and establish a REB of record for multi-jurisdictional research.

16.1.3. Promote data sharing and data sharing agreements based on open and secure science between public health laboratories and researchers on priority research questions.

16.1.4. Align actions with legal and public health research ethics frameworks and work towards developing pan-Canadian consensus on data sharing guidelines.

16.2. Enhance biobanking capacities through sustainable funding and the development of sample sharing/material transfer agreements that can enable rapid collaborations for the management of acute infections and their post-acute illnesses, including PCC.

16.3. Provide an effective governance framework to enable readiness to address new and ongoing research needs for infectious diseases and their sequelae. Among others, enhance linkages between discovery research strengths in Canada and life sciences/biomanufacturing sectors to accelerate the development of new therapies and support multi-site clinical trials within and between provinces.

17. Scale-up and monitor effective prevention interventions, such as improving ventilation in schools, workplaces and public places as part of a first line of prevention of SARS-CoV2 infection and other known and emerging respiratory/airborne pathogens. This can be achieved by improving and enforcing indoor air quality standards, such as through heating, ventilation, and air conditioning (HVAC) improvements, upper room ultraviolet germicidal irradiation or other approaches.

18. Encourage innovation in PCC care models and evaluate them to inform future resilience in the health care system including the recruitment and retention of a thriving health care workforce. A learning health care system, must be organized in a way that makes health data available for research, evaluation, and quality improvement.

18.1. Establish learning collaboratives and scalable pilot studies, with provincial, territorial and academic health centers, to help address some of the major health challenges that may be worsened by PCC, such as human resources shortages and medical imaging backlogs. This will lead to scientific data that supports best practices in care and helps guide health system innovation.

18.2. Foster resilient learning health care systems through proactive evaluation of the effectiveness and quality of PCC interventions, taking an implementation science approach.

18.3. Consider multi-pronged approaches to PCC care that include case management and triage, treatment (medical and rehabilitative), self-management, education, and social support, including community and peer support.

18.4. At all levels of government, consider the needs of individuals who have or may develop PCC in the future as part of continuing to manage the current COVID-19 pandemic, as well as domestic efforts related to pandemic preparedness and health care reform.

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Task Force consultative roundtables were held on August 11, August 18, August 25, September 8, September 15, September 22, and October 7, 2022.

The Task Force invited additional subject matter experts to the following roundtables:

Roundtables on Clinical Research and Practice held on August 11 and 18, 2022

Invited Subject Matter Experts*

- Husam Abdel-Qadir MD, FRCPC, DABIM, University of Toronto (August 11)
- Susanne Basiuk RN, Alberta Health Services (August 11)
- Laura Benard Alberta Health Services (August 18)
- Anne Bhéreur MD, University of Montreal
- Simon Decary PT, PhD, University of Sherbrooke
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- Emilia Falcone MD, PhD, Institut de recherches cliniques de Montréal
- Alan J. Forster MD, FRCPC, MSc, University of Ottawa (August 18)
- Gary Groot MD, PhD, FRCSC, FACS, University of Saskatchewan
- Salim S. Hayek MD, University of Michigan (August 11)
- Chester Ho MD, University of Alberta (August 11)
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- Sze Man Tse MD, FRCP, University of Montreal
- Anu Wadhwa MD, University of Toronto

** participated in both meetings unless otherwise indicated*

Roundtable on Pathogenic and Mechanistic Pathways held on August 25, 2022

Invited Subject Matter Experts

- Slava Epelman MD, PhD, FRCPC, University of Toronto
- Eleanor Fish PhD, University of Toronto
- Samira Moubaraka MD, FRCPC, Sunnybrook Health Sciences Centre
- Gavin Oudit MD, PhD, University of Alberta
- Anne Claude Gingras PhD, University of Toronto
- Josef Penninger MD, PhD, University of British Columbia

Roundtable on Socio-Economic Impacts held on September 8, 2022

Invited Subject Matter Experts

- Lynn Barr-Telford MA, Statistics Canada
- Noel Baldwin, Future Skills Centre
- Colleen M. Flood PhD, University of Ottawa
- Dana Hirsh JD, Schmidt Mediation Group
- Hal Koblin BA, C.D. Howe Institute
- Kim Lavoie PhD, FCPA, FABMR, University of Quebec in Montreal
- Cori Lawson-Roberts, Manulife Financial
- Louise Lemyre PhD, University of Ottawa
- Parisa Mahboubi PhD, C.D. Howe Institute
- Ellen Rafferty PhD, Institute of Health Economics, Alberta Canada
- William B.P. Robson ICD.D, C.D. Howe Institute
- Tingting Zhang, C.D. Howe Institute

Roundtable on Health System Impacts held on September 15, 2022

Invited Subject Matter Experts

- Simon Decary PT, PhD, University of Sherbrooke
- Carl-Ardy Dubois, PhD, University of Montreal
- Alan Forster, MD, University of Ottawa
- Donna Goodridge, RN, PhD, University of Saskatchewan
- Benita Hosseini, University Health Network
- Emily Jenkins, PhD, MPH, RN, University of British Columbia
- Kim Lavoie, PhD, FCPA, FABMR, Université du Québec à Montréal
- Cory (Cordell) Neudorf, MD, MHSc, FRCPC, University of Saskatchewan
- Beate Sander, PhD, University of Toronto
- Louis-Martin Rousseau, PhD, Université Polytechnique de Montréal
- Tom Wong, MDCM MPH FRCPC, University of Ottawa, Indigenous Services Canada
- Rosalie Wyonch, MA, C.D. Howe Institute

Public Panel on Understanding the Lived Experience of Post-COVID-19 Condition held on September 22, 2022

Invited Subject Matter Experts

- Anne Bhéreur, MD, CCMF(SP), FCMF, Université de Montréal,
- Carrie Anna McGinn, MSc., CIUSSS de la Capitale-Nationale
- Susie Goulding, COVID Long-Haulers Canada, Long COVID Kids
- Cara Kaup, BScPT, Executive Board, Long-COVID Physio
- Hannah Wei, Long COVID Patient-Researcher
- Jonah McGarva, Long COVID Canada
- Adriana Patino, Long COVID Canada
- Manali Mukherjee, MSc., PhD, McMaster University
- Sarah Butson, MSc., Canadian Lung Association

Roundtable on International Approaches held on October 7, 2022

Invited Subject Matter Experts

- Olalekan Lee Aiyegbusi MBChB, PhD, University of Birmingham, UK
- Ziyad Al-Aly MD, Washington University, USA
- Katie Bach MBA, MSc, Brookings Institution, USA
- Matthew Burke MD, University of Toronto, Canada
- Janet V Diaz MD, World Health Organization, Switzerland
- Temeika Fairley PhD, White House Office of Science and Technology Policy, USA
- Trish Greenhalgh MD, University of Oxford, UK
- Charu Kaushic PhD, McMaster University, Canada
- Avindra Nath MD, National Institutes of Health, USA
- Pragna Patel MD, MPH, Centers for Disease Control and Prevention, USA
- Jeremy Rossman PhD, University of Kent, UK
- Dafna Yahav MD, Sheba Medical Center, Israel
- Dana Yelin MD, Tel Aviv University, Israel

Observers:

- Taylor Morisseau, PhD Candidate, Chief Science Advisor's Youth Council Member, University of Manitoba, Canada
- Farah Qaiser MSc, Chief Science Advisor's Youth Council Member, Evidence for Democracy, Canada

Office of the Chief Science Advisor Support

- Lori Engler-Todd, MSc
- Masha Cemna, PhD
- Vanessa Sung, PhD
- Andreea-Diana Moisa, BSc
- Mary Helmer-Smith, BSc, MSc Candidate, University of British Columbia
- Melinaz Barati, BSc, MSc Candidate, Queens University