A Vision to TRANSFORM Canada's Public Health System

The Chief Public Health Officer of Canada's Report on the State of Public Health in Canada 2021

Canada

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Table of Contents

Section 2

Section 3

Message from the Chief Public Health Officer of Canada

The COVID-19 pandemic represents the biggest public health crisis that our country has confronted in a century. There is no doubt that this has tested our public health systems. And while there have been challenges, there have also been remarkable achievements, such as Indigenous ownership of the pandemic response in their communities and the rollout of the largest mass vaccination program in Canadian history. I am incredibly proud of the over 28 million Canadians 12 years of age and older who have been fully vaccinated so far. With the recent approval of Canada's first COVID-19 pediatric vaccine formulation for children 5 to 11 years old, we will continue to see our vaccine coverage rates increase across the country.

There is no doubt that the COVID-19 pandemic will continue to be a key public health priority in Canada for the foreseeable future. At the time of publishing this report, Canada is in the midst of a fourth wave fuelled by the highly transmissible Delta variant and a new variant of concern, Omicron, has recently been identified by the World Health Organization. It is still too early to know how this new variant will impact our pandemic response in Canada but its emergence reminds us that we need to remain vigilant and adapt our response as needed moving forward. At the same time, there are other pressing public health issues that also require urgent action.

These include the worsening opioid overdose crisis, increasing mental health challenges, the health impacts of climate change, and the ongoing threat of antimicrobial resistance.

While our public health system has extended itself to meet the increased demands of COVID-19, it is stretched dangerously thin. The pandemic has highlighted the strengths of our system, but it has also exposed long-standing cracks in the foundation. The public health system lacks the necessary resources and tools to carry out its critical work, and is the subject of "boom and bust" funding cycles that leave us ill-prepared in the face of new threats.

Moving forward, we must ensure that public health is better equipped to protect all people living in Canada and help them to achieve optimal health.

Simply put, we must act now to ensure that our post-pandemic future is different than our pre-pandemic past.

In my 2020 annual report, I examined the broader consequences of the pandemic, and how persisting health and social inequities have resulted in disproportional impacts of COVID-19 on some populations. The report highlighted the need for a strengthened public health system that is centred on health equity and works towards good health and wellness for all.

My 2021 annual report builds on these findings. It draws on diverse input from public health leaders, researchers, community experts, intersectoral collaborators, and First Nations, Inuit, and Métis leaders. Working from the foundational building blocks of public health systems in Canada, my report outlines strategic opportunities and key actions for achieving a transformed public health system that best protects us all against current and emerging public health challenges.

While the pandemic is not yet over, we are at a pivotal moment where we can come together to reflect on what we have learned and, collectively, define a new way forward. Joining forces across communities and sectors, we can build the public health system that we all need and expect, in pursuit of the healthy and thriving society that we all want. It is in working together that we can make sure that we get it right.

Dr. Theresa Tam
Chief Public Health Officer of Canada

About this Report

This year's annual report of the Chief Public Health Officer of Canada (CPHO) examines the current state of public health in Canada. It describes the impacts of the COVID-19 pandemic and provides a forward-looking vision to transform Canada's public health system, in order for it to excel and be better prepared for the next public health crisis.

Like SARS and H1N1 in the past, COVID-19 was a stress-test of our health, social, and economic systems. It underscored the critical importance of the public health system in protecting us from the potentially crippling effects of emerging viruses. This includes the vital role that the system plays in helping to mitigate excessive pressure on healthcare resources.

As we continue to face evolving and worsening threats to human health, such as climate change, antimicrobial resistance, or the burden of non-communicable diseases, we need to ensure that our public health systems are better equipped to capably address these complex challenges.

This report builds on last year's CPHO annual report From Risk to Resilience: An Equity Approach to COVID-19 which documented the unequal impacts of COVID-19 on the health of Canadians. It highlighted the need for stronger public health systems to keep people well and healthy, while contributing to a flourishing society.

This year's report, *A Vision to Transform Public Health in Canada*, is divided into the following main sections:

Section one sets the context with an overview of the key epidemiological COVID-19 events in Canada between August 2020 and August 2021. By illustrating inequities, broader pandemic impacts, and lessons learned, this section provides compelling evidence on the need to strengthen the public health system in Canada.

Section two describes the unique role and impact of public health systems on the health of populations. It presents the foundational building blocks of Canada's systems, and outlines the opportunities for system-level improvements.

Section three builds on these opportunities, to offer a vision of a world-class public health system. It then outlines the elements needed to achieve this vision and ensure that the conditions are in place for Canada to be ready for current and future public health challenges.

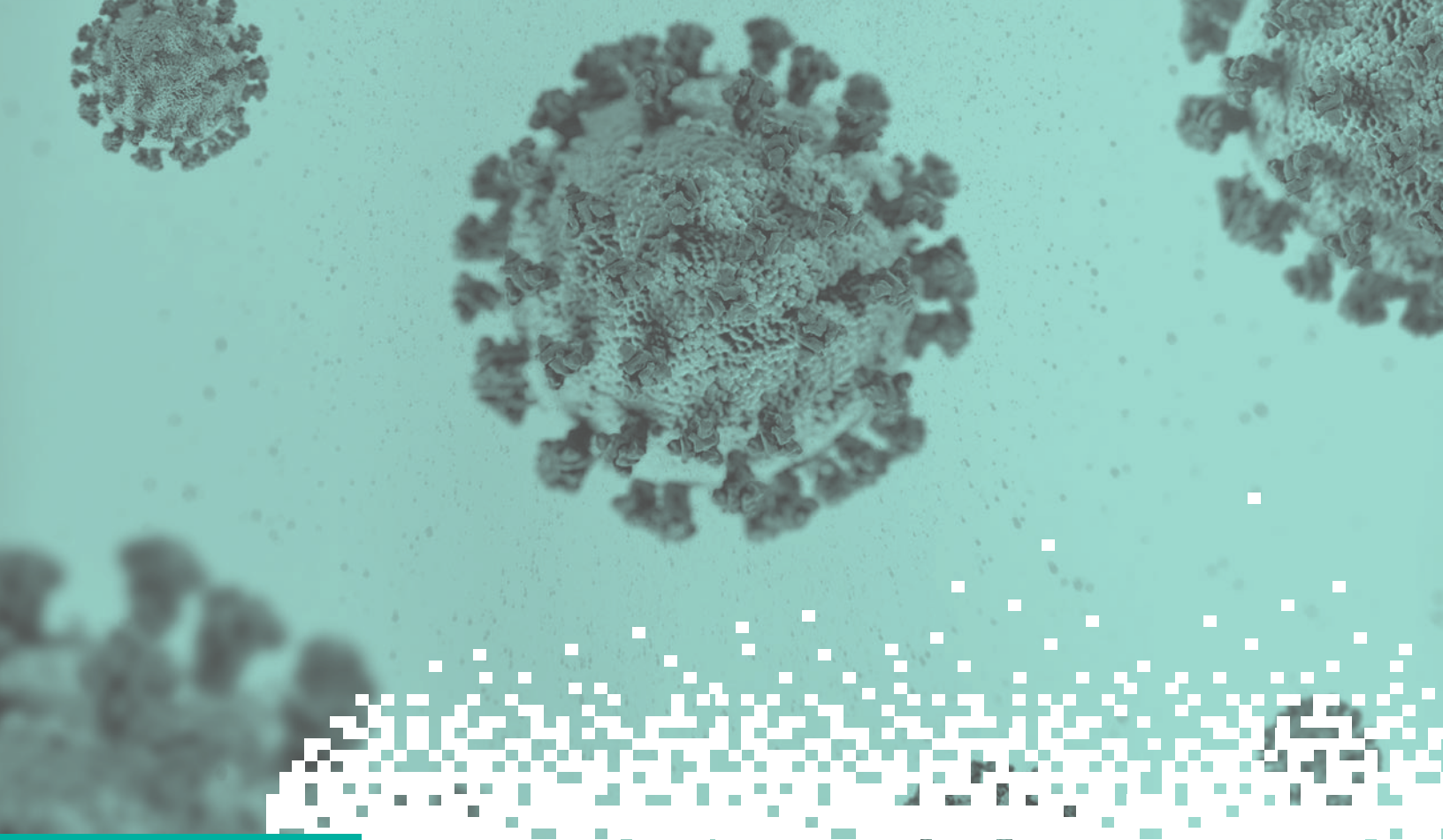
Note to the reader: This report was written with the knowledge that the COVID-19 pandemic and its impacts continue to evolve. Given the need to finalize the report well in advance of publication, it does not cover changes in epidemiology, emerging events, or implementation of additional public health measures beyond the end of August 2021. Further details on the methods and limitations are provided in Appendix A.

This report benefits from the leadership and expertise of many contributors. In particular four independent commissioned reports were prepared to inform its content, which will be on the National Collaborating Centres for Public Health website:

- The experiences, visions, and voices of First Nations, Inuit, and Métis Peoples on the future of public health in Canada are reflected in a companion report entitled *Visioning the Future: First Nations, Inuit, & Métis Population and Public Health*, which was developed and led by Indigenous public health leaders, in collaboration with Indigenous scholars and national Indigenous organizations.
- The components, approaches, and overarching factors to support a Pan-Canadian public health data system are summarized in a companion report entitled *An Evidence-Informed Vision for a Public Health Data System in Canada*, which was developed by Dr. David Buckeridge.
- Opportunities to strengthen, improve, or transform existing public health governance are discussed in a companion report entitled *Governing for the Public's Health: Governance Options for a Strengthened and Renewed Public Health System in Canada*, which was led by Dr. Erica Di Ruggiero.
- Proposed key actions to better incorporate and support the capacity of communities beyond COVID-19 are presented in a companion report entitled *Strengthening Community Connections: The Future of Public Health is at the Neighbourhood Scale*, which was developed by Dr. Kate Mulligan.

Finally, also available is a "What We Heard" report, entitled A Renewed and Strengthened Public Health System in Canada that provides a summary of discussion groups and key informant interviews conducted to inform the development and drafting of this report.

We respectfully acknowledge that the land on which we developed this report is in traditional First Nation, Inuit, and Métis territory, and we acknowledge their diverse histories and cultures. We strive for respectful partnerships with Indigenous Peoples as we search for collective healing and true reconciliation. Specifically, this report was developed in Ottawa, on the traditional and unceded territory of the Algonquin Anishnaabe people; in Halifax, on the ancestral and unceded territory of the Mi'kmaq people; in Montreal, on the traditional and unceded territory of the Mohawk (Kanien'kehá:ka) Nation; and in Toronto, on the traditional territory of the Wendat, the Anishnaabeg, Haudenosaunee, Métis, and the Mississaugas of the New Credit First Nation.



Section 1

COVID-19 in Canada and the World

The COVID-19 Pandemic in Canada

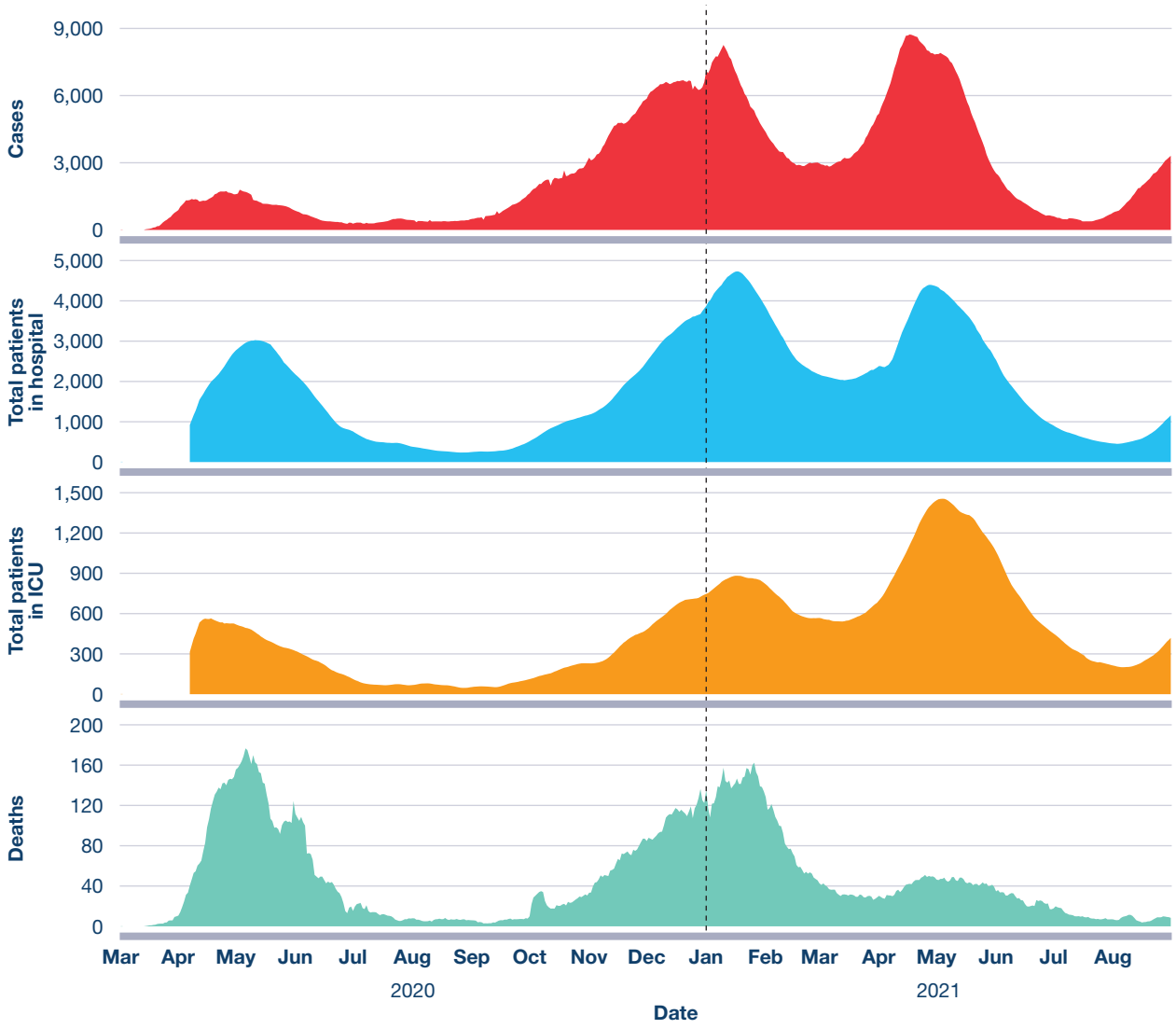
Overview of COVID-19 Epidemiology

The COVID-19 pandemic remains one of the most significant public health crises in recent memory. As of August 31, 2021, there were about 1,500,000 reported COVID-19 cases and close to 27,000 COVID-19-related deaths in Canada.[1] COVID-19 was estimated to be the third leading cause of death in 2020, following only cancer and heart disease.[a,2] This marks the first time since the mid-20th century that an infectious disease has ranked among the top three causes of death in Canada.[3, 4] The 2020 CPHO Annual Report detailed the early epidemiology of the COVID-19 crisis until the end of the first wave in August 2020.[5] Since that time, Canada has experienced additional waves, including one in the winter of 2020-21 and another in the spring of 2021.[b] As of August 2021, at the time of writing this report, rising incidence signalled the beginning of a fourth wave.[6] Figure 1 shows an overview of nationally reported COVID-19 cases and related outcomes, such as daily number of patients in hospital, daily number of intensive care unit (ICU) patients, and deaths in Canada for the period of March 2020 to August 2021.[1]

[a] Based on 93% complete provisional information available, COVID-19 was the third most common cause of death (5%), following cancer (26%) and heart disease (17%).

[b] This report will use the term "wave" to refer to significant resurgences of the virus.

FIGURE 1: Overview of Canada's COVID-19 Pandemic (March 2020 – August 2021)



Note that the vertical axes for each variable are differently scaled. All variables are seven-day moving averages of daily data by reported date. Complete hospitalization and ICU data are unavailable before April 2020.[1]

The patterns of principal disease severity indicators changed over time. Compared to the first wave and despite significantly higher case counts, a smaller proportion of the total number of people with COVID-19 died, were hospitalized, or were admitted to ICU in the second and third waves (Table 1).[1] It is important to note that, once better testing and surveillance infrastructure became available after the first wave, the detection of mild and asymptomatic cases was more likely.[7] In addition to changes in testing, another factor that influenced this trend is better protection of those at higher risk of the most severe outcomes, such as residents of long-term care facilities, by enhanced public health interventions and targeted vaccination programs (further described below).

However, as a result of the prolonged high incidence and, therefore, the high number of ICU admissions (Figure 1), the third wave greatly challenged ICU capacity, especially in the most populous provinces.[8] In some provinces, patients had to be transferred to other regions in response to overcrowded treatment settings, and many areas reduced or postponed elective medical procedures and surgeries.[8]

TABLE 1: Summary of Key National COVID-19 Statistics per Indicated Time Period (January 2020 – August 2021)

COVID-19 indicators	Total number 1st wave (Jan 2020 – Aug 2020)	Total number 2nd wave (Aug 2020 – Feb 2021)	Total number 3rd wave (Feb 2021 – Aug 2021)
Cases	126,707	751,158	640,293
Males	57,107 (45%)	369,989 (49%)	327,180 (51%)
Females	69,383 (55%)	380,177 (51%)	311,806 (49%)
Other	14 (<1%)	56 (<1%)	82 (<1%)
Case median age (range)	47 years (0 to 119)	37 years (0 to 115)	33 years (0 to 113)
Deaths	9,363 (7%)	13,573 (2%)	4,463 (1%)
Males	4,294 (46%)	6,931 (51%)	2,627 (59%)
Females	5,054 (54%)	6,625 (49%)	1,822 (41%)
Other	0 (0%)	0 (0%)	0 (0%)
Death median age (range)	86 years (0 to 112)	85 years (0 to 109)	75 years (1 to 105)
Hospitalizations	13,428 (11%)	36,251 (5%)	29,920 (5%)
Males	6,865 (51%)	19,296 (53%)	16,401 (55%)
Females	6,554 (49%)	16,924 (47%)	13,477 (45%)
Other	0 (0%)	2 (<1%)	3 (<1%)
Hospitalizations median age (range)	73 (0 to 106)	71 (0 to 108)	59 (0 to 107)
ICU admissions	2,733 (2%)	5,996 (1%)	6,557 (1%)
Males	1,740 (64%)	3,798 (63%)	4,024 (61%)
Females	993 (36%)	2,191 (37%)	2,524 (38%)
Other	0 (0%)	0 (0%)	0 (0%)
ICU admissions median age (range)	65 (0 to 99)	66 (0 to 104)	59 (0 to 99)

This data may be influenced by variation in testing approaches over time as well as between regions. In addition, some evidence suggested that COVID-19-related deaths were undercounted in the spring and fall of 2020.[9] The denominator for the deaths, hospitalizations, and ICU admissions percentages is the total number of reported cases. For each disaggregation by gender/sex the denominator is the total number for each respective indicator.[1]

Each wave of the pandemic in Canada has been marked by key characteristics (summarized in Table 2). This section describes some of the main epidemiological features of the pandemic, with a primary focus on the period between August 2020 and August 2021.

TABLE 2: Summary of Key Characteristics of Each Wave of the COVID-19 Pandemic in Canada (January 2020 – August 2021)

Time period	Brief description of key characteristics
1st wave (Jan 2020 – Aug 2020)	▸ The COVID-19 situation unfolded differently across the country. Quebec and Ontario reported the highest incidence rates, while Nunavut did not report any confirmed cases. Residents and staff of long-term care facilities were the most affected groups. ▸ In the absence of vaccines, the implementation of broad and stringent public health measures brought disease activity to low levels in the summer of 2020. ▸ COVID-19 testing and surveillance was limited, and there were challenges with access to personal protective equipment.
2nd wave (Aug 2020 – Feb 2021)	▸ Community transmission increased and became widespread across the country as restrictions eased during the summer of 2020. Spread of the virus also impacted areas and populations that were not as significantly affected in the first wave (e.g., the Territories, the Prairie provinces, some Indigenous communities, younger Canadians). ▸ The relative proportion of individuals experiencing severe outcomes due to COVID-19 was significantly reduced compared to the first wave. Some individuals at the highest risk were better protected than during the first wave, partly due to vaccination efforts that began in December 2020.
3rd wave (Feb 2021 – Aug 2021)	▸ Highly transmissible variants of concern combined with easing of public health measures fuelled a large wave affecting many regions across the country. ▸ The sustained number of high cases heavily impacted acute care capacity. Overall mortality rates decreased as higher vaccination coverage among older Canadians led to virus transmission being focused in younger age groups at lower risk of hospitalization and intensive care unit admission.

Time period	Brief description of key characteristics
4th wave (began Aug 2021)	▸ In July 2021, longer-range dynamic modelling predicted that a large fourth wave was possible if contact rates at the time were maintained or increased. This was expected to be driven by the highly transmissible Delta variant of concern and insufficient vaccine coverage, simultaneous with many jurisdictions entering their final phases of reopening. As of the end of August 2021, COVID-19 cases had increased nationally for five consecutive weeks. ▸ Cases were expected to be concentrated in regions with lower vaccine coverage and among younger age groups not yet eligible for vaccination as schools reopened. High vaccine coverage is expected to result in a smaller proportion of cases with severe outcomes. However, inadequate vaccine coverage, especially among younger adults, could threaten to overwhelm hospital capacity in the fall of 2021.

For references and more detail on these topics, refer to the following content. The details of this section were finalized in August 2021; therefore, the included data do not represent a complete review of the fourth wave.

The Second Wave: August 2020 to February 2021

Easing of Public Health Measures Fuelled Epidemic Growth

By the summer of 2020 at the end of the first wave, nationally reported COVID-19 cases had declined to low levels (Figure 1).[1] Although there was variation among jurisdictions, many of the most restrictive public health measures implemented as part of Canada's initial pandemic response, such as closures of businesses, workplaces and schools, stay-at-home orders, cancellation of public events, and restrictions on social gatherings, were relaxed. International border protocols, case detection and isolation, and contact tracing, as well as advice around individual personal preventive practices and population-based measures to reduce contacts, remained in place.[10]

Canadians' increasing contact rates amplified the spread of the virus by the fall of 2020.[11] At the time, mathematical modelling predicted that, if these rates of contact were maintained, the epidemic could quickly resurge with higher case counts.[11] This was an early warning indicator for the large second wave that began at the end of August 2020, and peaked nationally in January 2021 (Figure 1).[1] While long-term care facilities continued to be the most frequent outbreak setting, social gatherings and workplace outbreaks greatly contributed to community spread in the second wave, especially as infection rates increased among younger, more socially active and mobile age groups with higher contact rates.[12]

In the winter of 2020-21, in response to surging numbers of cases and hospitalizations (Figure 1), many areas of the country reintroduced more restrictive public health measures.[10] With the resulting decline in cases to less than half of the daily number peak observed in January 2021, many regions eased restrictions by March 2021 before tightening them once again in April 2021.[8] This was in line with modelling forecasts that accurately predicted another surge in cases that would become the third wave.[13]

Public Health Measures were the Primary Tools Available to Limit Spread

During most of the second wave, public health measures continued to be the primary means to manage the epidemic in Canada, since effective pharmaceutical interventions (e.g., vaccines) were not yet widely available. Implemented measures included a range of interventions to reduce community transmission of SARS-CoV-2 with the goal of "minimizing serious illness and overall deaths while minimizing societal disruption".[14] These encompassed both individual practices (e.g., masks, physical distancing, hand hygiene) and population-based measures (e.g., case management and contact tracing, school and business closures, stay-at-home orders).[15] It was difficult to mitigate the social, psychological, and economic consequences of public health measures, while also reducing transmission by limiting community-wide contact rates. In addition, some individuals had limited ability to follow recommendations as a result of their health, age, economic, or social circumstances.[15]

Public health authorities at federal, provincial/territorial, and local levels adapted public health measures as new scientific evidence and expert opinion from Canadian and international researchers became available. For instance, outbreak investigations and scientific studies revealed that SARS-CoV-2 can spread via respiratory droplets that vary in size, from large droplets that fall to the ground rapidly near the infected person, to smaller droplets, called aerosols, that linger in the air in some circumstances.[16] Short-range aerosol transmission was suggested to be particularly relevant for poorly ventilated indoor crowded spaces.[16] As a result, the Public Health Agency of Canada (PHAC) updated guidance on the construction, fit, and proper wearing of face masks and on improving indoor ventilation during the second wave.[17-19] National guidance on public health measures was based on pan-Canadian pandemic planning that jurisdictions adapted to their local epidemiological context, such as using curfews or designating more granular regional zones, to tailor approaches specific to the local area.[10, 14]

The pandemic response required rapid adoption and broad acceptance of public health measures, with consistent and sustained adherence for extended periods of time. Many Canadians reported high adherence to, and support of the use of, measures to limit the spread of the virus.[20-23] For example, a survey conducted by Impact Canada in March 2021 indicated that the vast majority of respondents were "always" or "almost always" complying with measures, such as mask wearing, hand washing, and physical distancing.[24] Statistical modelling indicated that the strongest factors driving adherence to public health measures include anxiety related to family's health, trust in government sources, and trust in medical experts.[25]

A variety of non-traditional data sources provided insight into overall adherence to public health measures that aimed to reduce movement and contact with others. For example, mobility data gathered from cellular networks showed that there was a significant decrease in the proportion of time Canadians spent at home after the first wave, which appears to align with the relaxation of public health measures.[10] While there were a variety of factors that influenced adherence to public health measures, it is important to note that some people had higher mobility and more contact with others regardless of the measures, due to factors such as essential work or high-density housing arrangements, respectively.[26]

The Third Wave: February 2021 to August 2021

Highly Transmissible Variants of Concern Contributed to Rapid Epidemic Growth

Following a decline in average daily cases nationally from January through February 2021, infection rates rose sharply in March 2021 in most provinces and territories (Figure 1).[1] This

was driven by increased contact rates following the easing of restrictions and the emergence and spread of more contagious virus variants of concern.[13] As with all viruses, SARS-CoV-2 accumulates genetic mutations over time. Some of them may lead to virus variants that are considered to be variants of concern because they spread more easily, cause more severe illness, or decrease the effectiveness of available diagnostics, vaccines, therapeutics, or public health measures.[27] In early 2021, more contagious virus variants began to be detected in Canada, and as of August 2021, included the Alpha, Beta, Gamma, and Delta variants. These variants of concern had spread to most provinces and territories and were responsible for about 80% of all cases in August 2021.[28] While Alpha initially accounted for the majority of national COVID-19 cases at the beginning of the third wave, in early July 2021, Delta replaced Alpha as the most frequently reported variant.[28]

Early evidence from Ontario suggested that, compared to the original strain of SARS-CoV-2, the Alpha variant was associated with a 62% increase in hospitalizations, a 114% increase in ICU admissions, and a 40% increase in deaths, among those infected.[29] Preliminary findings indicated that the Delta variant was more transmissible and also more virulent than the Alpha variant.[30]

International border measures were deployed and adjusted over time as knowledge of SARS-CoV-2 and variants of concern evolved. Throughout the pandemic, air and land traveller volumes remained at less than 90% of pre-pandemic levels.[31] To further reduce the risk of virus importation, especially variants of concern, Canada implemented enhanced testing and quarantine measures at international borders, in addition to those already in place, beginning in the winter of 2020-21. These included mandatory testing before departure and in-Canada for all non-exempt travellers, as well as a three-day mandatory hotel stopover in a government-approved accommodation for non-exempt travellers arriving by air at the four main airports permitting international arrivals.[32]

In early 2021, Canada quickly increased surveillance and genomic sequencing efforts to detect known and emerging variants of concern.[33] PHAC worked with partners at all levels of government as well as academic researchers to establish a pan-Canadian surveillance network that used new genetic assays to detect SARS-CoV-2 variants from wastewater samples.[34] This acted as part of a system of early warning indicators, in combination with predictions from mathematical models, which facilitated the adaptation of the COVID-19 response to evolving information. For example, in the Northwest Territories, a positive COVID-19 signal in wastewater led to the identification of an infected individual, prompting wider community testing. This rapid response allowed for the early detection of additional COVID-19 cases, which interrupted further spread and potentially prevented a larger outbreak.[34]

COVID-19 Vaccines as Vital Tools to Control the Virus

Towards the end of 2020, less than a year after the emergence of the SARS-CoV-2 virus, researchers developed the first safe and effective COVID-19 vaccines – a feat unprecedented in scientific history. This marked a turning point in the response to the pandemic. These vaccines were the result of collaboration of academic and private sector researchers around the world and increased funding that, together, enabled them to build on scientific and technological advancements made over the past decade.[35] For information on how vaccines protect populations, see text box "Vaccines Provide Protection for Everyone through Enhanced Community Protection".

On December 9, 2020, Canada authorized the first COVID-19 vaccine, which uses novel messenger RNA (mRNA) technology, for use in adults in Canada.[36] Subsequent vaccine authorizations included another mRNA-based vaccine as well as viral vector-based vaccines. At the time, most required two doses for the best possible protection.[37] Rapid authorization was supported by the ability of Health Canada to review new evidence as it became available, and the dedication of more scientific resources to the vaccine safety and efficacy review process.[38, 39] Vaccine safety assessment and monitoring is an ongoing process throughout a vaccine's life cycle (see text box "Creation of the Vaccine Injury Support Program"). As of August 31, 2021, over 53 million doses of safe and highly effective vaccine products had been administered in Canada.[40]

The distribution and administration of COVID-19 vaccines was the largest and most complex vaccination program Canada has ever implemented. The federal government took on the responsibility of procuring vaccines, overseeing logistics, coordinating surveillance, and working very closely with provincial/territorial governments, as well as public health partners, to ensure a timely, fair, and well-coordinated rollout.[43]

Canada's National Advisory Committee on Immunization (NACI) provided independent expert advice to support the provinces and territories in prioritizing an initially limited supply of COVID-19 vaccines. NACI takes into consideration the broader, real-world context and the best evidence available at the time when making recommendations.[44] NACI identified the key populations for prioritization in Stage 1 of their *Guidance on the Prioritization of Initial Doses of COVID-19 Vaccine(s)* to be residents and staff of congregate living settings that provide care for seniors, adults aged 70 years or older, healthcare workers, and adults living in Indigenous communities.[45] These populations were generally considered at greatest risk of severe illness and in most urgent need of protection. Before offering vaccines to the general population as vaccine supply increased, NACI recommended that Stage 2 of the vaccine rollout include healthcare workers not part of Stage 1, residents and staff of all other congregate settings, and essential workers.[45] In March 2021, based on emerging evidence of the degree of protection provided by one dose, NACI recommended that jurisdictions extend the interval for those vaccines requiring a second dose to maximize the number of people with some protection and reduce transmission in the context of limited initial vaccine supply.[46] Provincial and territorial governments, who were responsible for delivering and administering vaccines, largely adopted NACI's recommendations.

Vaccines Provide Protection for Everyone through Enhanced Community Protection

Vaccines are one of the most important preventive health interventions for many serious infectious diseases. They can provide both direct protection for vaccinated individuals as well as indirect protection for a community. The higher the proportion of people vaccinated, the less opportunity a pathogen has to circulate, thereby minimizing the risk of larger outbreaks. High community vaccination rates further protect those who cannot be vaccinated, or who are not as well protected by vaccination, and reduce the opportunities for the pathogen to mutate.[41] This enhanced community-level protection is especially important for those at highest risk of severe health outcomes, including hospitalization and death. Mass vaccination is one of the most effective ways to protect the population against COVID-19.[42]

Creation of the Vaccine Injury Support Program

All vaccines authorized for use in Canada meet the highest standards for safety and efficacy.[47] As with any medication, vaccines may cause reactions and side effects. Severe adverse events are very rare, but they do occur.[47] PHAC created the federal Vaccine Injury Support Program to offer fair and timely compensation to Canadians who have experienced a serious and permanent injury as a result of receiving any Health Canada-authorized vaccine administered in Canada on or after December 8, 2020.[47, 48] This no-fault program builds on a program that Quebec has had in place for over 30 years and brings Canada in line with other Group of Seven (G7) countries.[47] Vaccine injury compensation can also support vaccine innovation and procurement by reducing legal risks for manufacturers.[49]

Once initial vaccine supply limitations were overcome, vaccine delivery rapidly accelerated beginning in the spring of 2021. Beneficial vaccine impacts became readily apparent in prioritized populations, such as among long-term care facility residents and people who work in healthcare settings, who saw significant decreases in COVID-19 cases as vaccine coverage increased.[50] Early evidence showed that COVID-19 vaccines are highly protective, especially at preventing severe outcomes. Between July 18, 2021 and August 14, 2021, data from 11 provinces and territories revealed that the average rate of new COVID-19 cases was 12 times higher among unvaccinated people, and the rate of COVID-19 hospitalizations was 36 times higher among unvaccinated people than in fully vaccinated individuals.[51] Strengthened public health measures in combination with increasing vaccination coverage brought COVID-19 activity to low levels in most areas of Canada by July 2021 (Figure 1).[52] This also allowed for Canada to begin a phased approach to easing border measures for fully vaccinated travellers.[53]

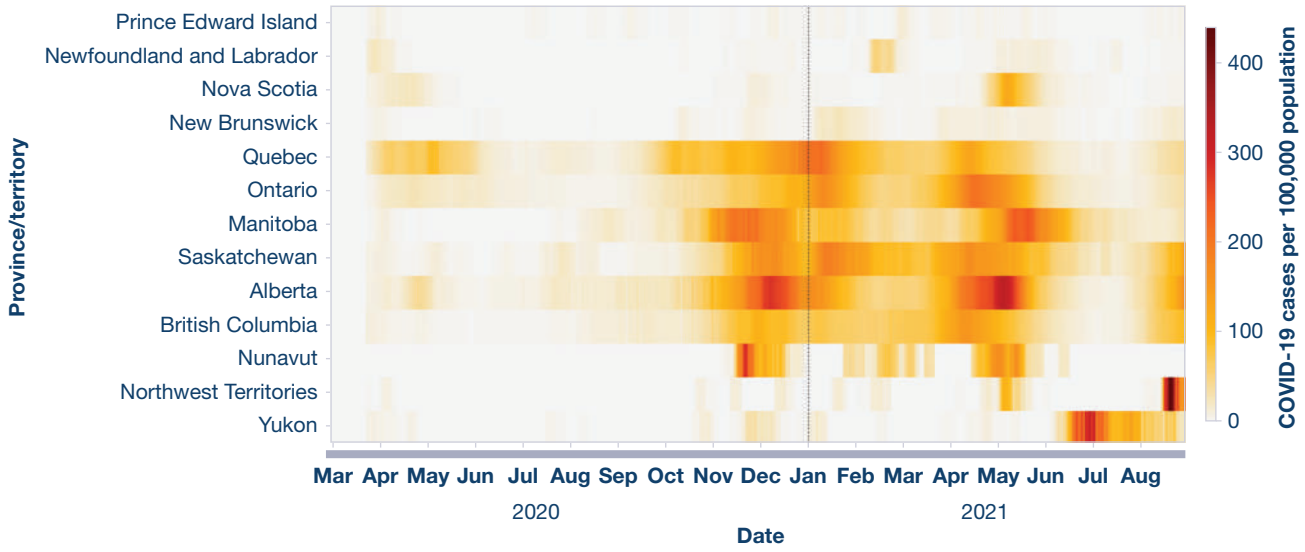
Disproportionate Impacts of the Second and Third Waves of the Pandemic

The second and third waves of the pandemic looked different from the first wave. Some areas and populations faced continued difficulties and/or new challenges. Evolving science and lessons learned led to jurisdictions adapting their public health response, which changed the dynamics of subsequent waves. This section will discuss some of the key observations made during later waves, including the continued disproportionate impact on Canadians who experienced poorer health, social, and economic circumstances prior to the pandemic due to pre-existing inequities.[14]

COVID-19 Spread Differently across the Country

In contrast to the first wave, subsequent waves of the pandemic were felt all across the country. However, not all regions experienced distinct second and third waves at the same time or with the same intensity (Figure 2).

FIGURE 2: Rate of COVID-19 Cases per 100,000 Population and Province/Territory (March 2020 – August 2021)



Daily data are shown by province and territory and by reported date.[54]

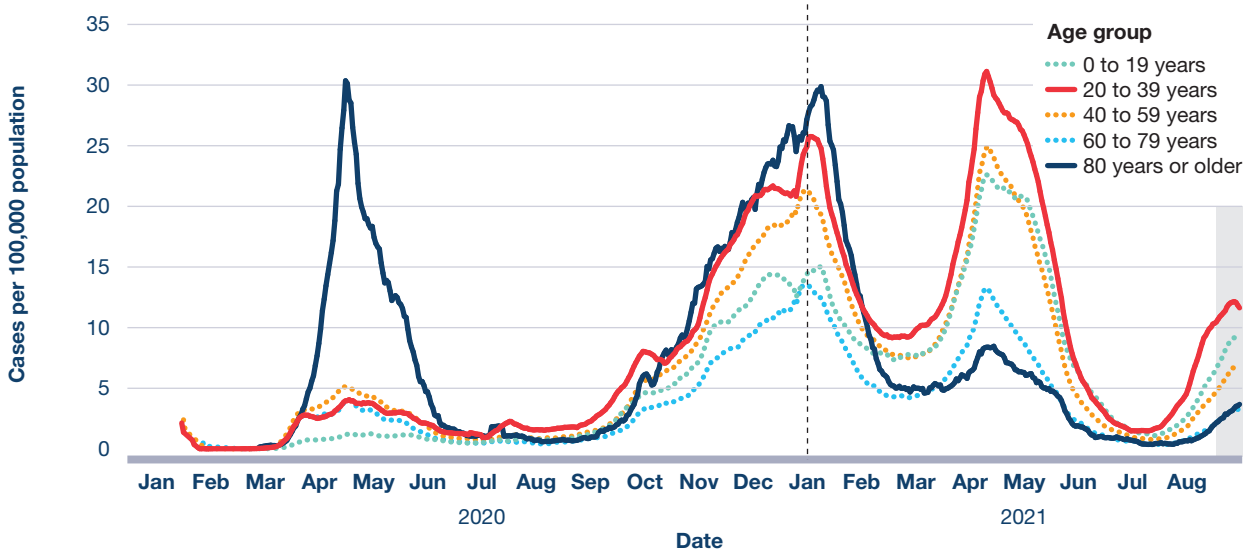
National incidence rates were driven by the provinces west of the Atlantic region, partly due to population size and density.[54] Since the first wave, the Atlantic provinces were largely able to sustain sufficient measures (e.g., interprovincial travel restrictions) to manage and limit case importations, interrupt spread, and maintain strong control of COVID-19 (Figure 2).[55-57] However, there were surges that provincial governments quickly interrupted with rapid implementation of stringent public health measures to prevent further spread. These measures were particularly important given limited health system capacity in some of these jurisdictions.

Other regions that had relatively low COVID-19 rates in the first wave saw an increase in disease activity after the summer of 2020. For example, while the territories had no to very few cases initially, by late 2020, some communities experienced a rapid rise in cases, with community transmission following importation of the virus (Figure 2).[54] This necessitated fast implementation of stringent public health measures locally and territorially to prevent further spread. The territories, whose communities were prioritized in the initial vaccination rollout, achieved high vaccine uptake and, as of July 20, 2021, 84% of adults aged 18 years or older had received at least one dose of a COVID-19 vaccine and 76% were fully vaccinated.[40] The territories' early success in expanding vaccine coverage was supported by prioritized allocation of vaccines that were somewhat easier to transport and store as well as robust community-level outreach and leadership.[58-60]

Shift towards Spread in Younger Canadians

As older Canadians became better protected through public health measures, adaptation of the COVID-19 response in long-term care facilities, and ultimately, high vaccination rates, the median age of COVID-19 cases dropped (Table 1).[1] Until the end of the second wave, Canadians aged 80 years or older had the highest national incidence rate. However, starting in early 2021, incidence rates in this age group decreased sharply. At the time of report writing in August 2021, Canadians aged 80 years or older had maintained the lowest incidence rates out of all age groups since March 2021 (Figure 3), largely as a result of high vaccine coverage.[1] As of August 28, 2021, 93% of adults aged 80 years or older were fully vaccinated against COVID-19.[40]

FIGURE 3: COVID-19 Incidence Rates by Age Group (January 2020 – August 2021)



All variables are seven-day moving averages of daily data by date of illness onset. Shaded area indicates data uncertainty due to reporting lag.[1]

Age is one of the most significant risk factors for developing severe COVID-19.[61, 62] Despite the decrease in overall case burden, as of the end of August 2021, Canadians aged 80 years or older continued to have the highest rate of COVID-19 deaths per 100,000 population. However, this rate fell significantly after the second wave.[1] Of the 15,300 people who died of COVID-19 in 2020, 89% had at least one other health condition listed on their death certificate. Dementia and Alzheimer's disease were the most common conditions, followed by hypertensive disease, diabetes, and ischemic heart disease.[63]

Emerging evidence also showed an increased rate of pre-term births and stillbirths among pregnant people with COVID-19.[64] Compared to their non-pregnant counterparts, pregnant people testing positive for COVID-19 were four times more likely to be hospitalized and 11 times more likely to be admitted to the ICU.[64]

One of the key differences between the first wave of the pandemic and subsequent waves was a shift to more widespread detection of community transmission in younger adults. Individuals aged 20 to 39 years, who generally have higher contact rates and thereby an increased risk of virus exposure, have had the highest incidence rate since February 2021 (Figure 3).[1] Although severe illness is less common in younger individuals, in the spring of 2021, the number of COVID-19 hospitalizations in individuals aged 40 to 59 years increased.[57] This was likely due to a combination of the shift in the age distribution of cases as a result of better protection of older age groups, the increased severity of some variants of concern, and the easing of public health measures.

Differential Impact of COVID-19 across the Sexes and Genders

Since the summer of 2020, women and men accounted for an equal proportion of COVID-19 cases (Table 1).[1] This is in contrast to the first wave when women made up 55% of all cases, possibly due to their overrepresentation among healthcare workers and residents of long-term care facilities, and therefore an increased probability of being exposed to, and tested for, the virus.[5] This could also explain the larger percentage of deaths in women during the first wave. During the second and third waves, these groups may have been better protected by improved access to personal protective equipment and vaccines.[65]

However, men comprised a larger percentage of hospitalized cases and ICU admissions throughout the pandemic as well as a larger percentage of deaths after the first wave (Table 1).[1] Researchers propose that fundamental biological differences mainly tied to immunology are a likely driver of the increased risk of severe outcomes from COVID-19 in males. Behavioural differences, such as men being more likely to smoke and less likely to seek health care, could also be possible influencing factors.[66-69]

Variation in Impacts across Different Outbreak Settings

Long-Term Care Facilities

Long-term care facilities remained a high-risk setting in many provinces and territories.[8] However, the proportion of total COVID-19-related deaths associated with these facilities dropped from 79% during the first wave to 50% during the second and third waves.[1] Beginning in January 2021, the number and size of outbreaks in these settings steadily declined, largely due to the impact of vaccinations.[8]

Healthcare Settings

In April 2020, 25% of all COVID-19 cases were in people who work in healthcare settings.[1] Due to improved infection control measures, vaccine prioritization, as well as wider community case detection outside healthcare settings, this proportion dropped to 3% by March 2021.[1] People who work in healthcare settings represent a wide range of individuals, including healthcare professionals and support workers, who experience varying risks of exposure to SARS-CoV-2 in the workplace. For example, based on data from Ontario, Manitoba, and British Columbia, personal support workers had a 1.8 times greater risk compared to nurses and a 3.3 times greater risk compared to physicians of contracting COVID-19.[70]

Congregate Living and Working Conditions

Federal prisons reported a substantial increase in COVID-19 cases during the winter of 2020-21. While 13 out of 43 institutions experienced outbreaks during the second wave, 70% of the total 880 cases occurred at the country's two largest penitentiaries, one in Manitoba and one in Saskatchewan.[71] Indigenous Peoples were disproportionately impacted as a result of over-representation in the prison system in Canada.[71] Vaccinations were accelerated for people incarcerated in federal institutions and, as of August 8, 2021, 78% of this population had received at least one dose of a COVID-19 vaccine.[72]

Regional medical officers of health reported that workplace outbreaks became one of the most common drivers of transmission in some provinces and territories during the second and third waves.[73-75] Many jurisdictions experienced outbreaks at large employment sites where workers faced challenges in maintaining physical distancing. Many of these outbreaks required additional efforts to contain. For example, the Canadian Red Cross provided contact tracing in response to a COVID-19 variant of concern outbreak at a fly-in mine in Nunavut for employees who had left the work location and returned to homes across the country.[76] As in the first wave, several public health authorities reported large outbreaks at meat-processing plants during subsequent waves, some of which required temporary facility closures.[77, 78] This led several jurisdictions to prioritize vaccinations for food-manufacturing workers.[79, 80]

Tracking workplace outbreaks at a provincial/territorial and national level was limited, but is necessary for the adoption of policy measures targeting specific industries and settings to limit future spread.[81] Some local authorities launched initiatives during the pandemic to collect this type of data. For example, Toronto Public Health began publicly posting the names of workplaces

in active outbreaks that employ 20 people or more, and Ottawa Public Health required employers to report if two or more people in their workplace tested positive for COVID-19.[82, 83]

COVID-19 Burden Disproportionately Impacted Certain Communities

During the first wave, neighbourhoods in Canada in the highest ethno-cultural composition quintile had an age-standardized COVID-19 mortality rate two times higher than those in the lowest quintile.[69, 84, 85] Similarly, Canadians living in areas in the lowest income quintile had twice the age-standardized COVID-19 mortality rate compared to Canadians living in areas in the highest quintile.[69, 84] In both analyses, men had much higher mortality rates compared to women.[69, 84]

While these populations had differential exposure to SARS-CoV-2 due to factors such as essential work and living conditions, the reasons for the differences in mortality rates include long-standing socioeconomic differences in the distribution of underlying risk factors and access to health care.[5, 86] While similar national data for the second and third waves were not available at the time of report writing, racialized communities and low-income groups in general were likely to continue experiencing higher rates of COVID-19 and severe outcomes in subsequent waves. This is a result of the fundamental inequities that predate the pandemic and continued disproportionate risk of SARS-CoV-2 exposure.

Seroprevalence data collected from blood donors in May 2021 indicated that racialized donors were more than twice as likely to have antibodies acquired through past COVID-19 infection.[87] Additionally, Toronto Public Health reported that, between May 20, 2020 and May 31, 2021, 73% of all individuals testing positive for SARS-CoV-2 identified with a racialized group, which usually make up 52% of the Toronto population. Similarly, 45% of reported cases were in individuals living in lower-income households, which represent 30% of the population of Toronto.[88]

Recognizing that a possible inequitable allocation of vaccines threatened to exacerbate social and health inequities already intensified by the pandemic, in February 2021, NACI updated their initial guidance on the prioritization for COVID-19 vaccinations in Canada to include adults in racialized communities disproportionately affected by COVID-19.[89] As with other national guidance, jurisdictions adapted these recommendations based on their own local context.

For instance, after analysis revealed unequal vaccine coverage across Ontario, likely as a result of complex institutional and social factors, the province diverted 50% of its vaccine supply to hotspots with the highest incidence of infection for two weeks in May 2021.[90] These neighbourhoods often had higher concentrations of racialized and low-income populations as well as the highest proportion of essential workers.

Place-based targeting of vaccines (e.g., geographic hotspots) also needed to be accompanied by initiatives directly aimed at confronting social inequities.[91] For example, the Health Association of African Canadians, the Association of Black Social Workers, and African Nova Scotian Affairs, along with community leaders, hosted vaccine clinics for members of African Nova Scotian communities.[92] Additionally, many urban centres, including Montreal and Vancouver, prioritized vaccines for people experiencing homelessness in January 2021 and used targeted strategies to increase vaccine uptakein this population.[93, 94]

COVID-19 and Indigenous Communities

During the first months of the pandemic, First Nations, Inuit, and Métis communities swiftly took control of the response and worked collaboratively to successfully limit the spread of COVID-19.[5] As in many areas of Canada, case numbers rose rapidly in many Indigenous communities during the second wave.[95] Given the intersection of social and economic challenges, and the lasting and ongoing impacts of intergenerational trauma and systemic oppression, Indigenous communities in general were at high risk for rapid spread of COVID-19 and potentially more severe outcomes compared to the general Canadian population. Difficulties included inadequate and crowded housing, geographic isolation, and reduced access to health and critical care services.[5]

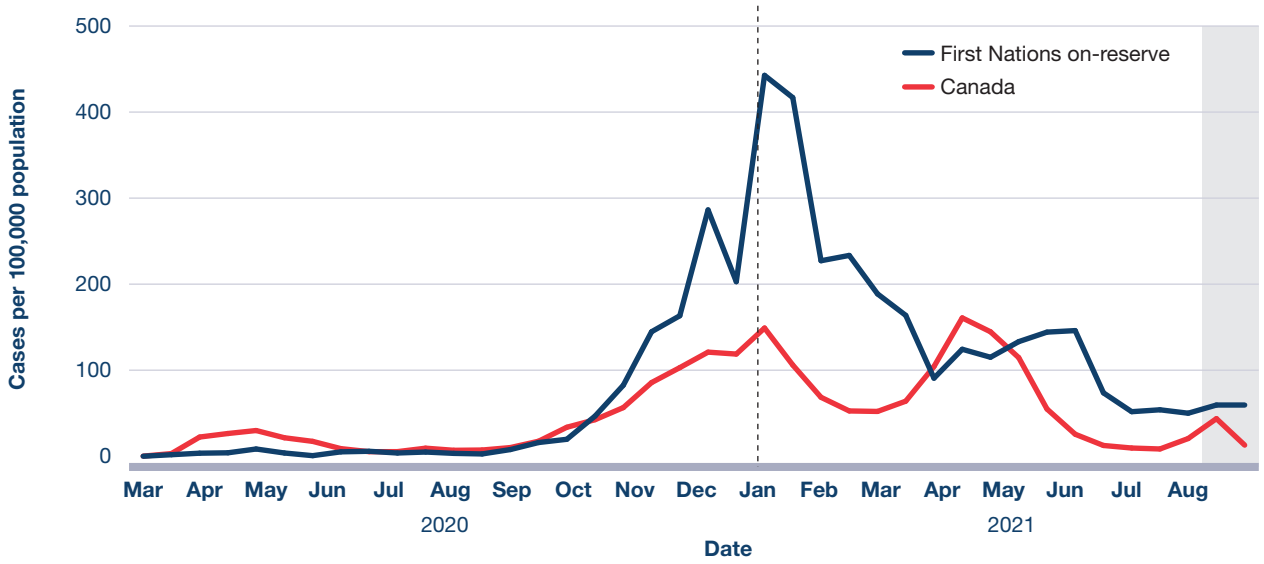
At the peak of the second wave in January 2021, the rate of new COVID-19 cases in First Nations living on-reserve was triple the rate in the general Canadian population (Figure 4).[95] Statistics on First Nations individuals who do not live on-reserve were unavailable nationally. However, regional evidence suggested that the COVID-19 burden may have been higher for those individuals residing off-reserve compared to those living on-reserve. For example, as of August 14, 2021, individuals that live off-reserve represented 56% of First Nations COVID-19 cases in British Columbia.[96]

After successfully preventing any case importations during the first wave, Nunavut, whose population is 85% Inuit, reported its first COVID-19 case in November 2020 (Figure 2).[54, 97] The territory swiftly interrupted further outbreaks and prevented resurgences through targeted public health measures, including proactive wastewater surveillance testing and territorial travel restrictions.[98-100] As of August 31, 2021, Nunavut's last reported case of COVID-19 occurred in June 2021, and the territory had administered at least one vaccine dose to 80% of the eligible population.[54, 60]

First Nations, Inuit, and Métis communities were prioritized for vaccines and demonstrated strong leadership in administering vaccination programs. Community groups, Indigenous governments, and leaders reacted quickly to set up clinics and provide culturally adapted educational materials.[101-103] Initiatives to safely and effectively deliver vaccines were implemented, such as Operation Remote Immunity, led by Ontario's Ornge air ambulance service in partnership with Nishnawbe Aski Nation that provided vaccinations to 31 remote First Nations communities in the province.[104]

Given prior experiences of stigmatization and racism, First Nations, Inuit, and Métis Peoples in Canada expressed a desire for knowledge and understanding of vaccine risks and benefits to come from trusted sources and for interventions to be specifically tailored to community needs and cultural practices.[105, 106] One such example was the partnership between the Indigenous Primary Health Care Council and the National Reconciliation Program at Save the Children for leading an Indigenous youth vaccine advocacy program. Young people developed social media strategies to share their reasons for getting vaccinated under the hashtags #IndigenousYouth4Vaccine and #SmudgeCOVID.[107] As of August 10, 2021, over 86% of individuals aged 12 years or older in First Nations, Inuit, and territorial communities had received at least one vaccine dose.[95, 108]

FIGURE 4: Rate of Reported COVID-19 Cases in First Nations Peoples Living On-Reserve Compared to the General Canadian Population (March 2020 – August 2021)



All variables are weekly data by date of illness onset. Shaded area indicates data uncertainty due to reporting lag.[95]

Expected Impact of Vaccination on the Fourth Wave

At the time of report writing in August 2021, rising incidence signalled the beginning of a fourth wave (Figure 1). Driven primarily by the more contagious Delta variant, long-range modelling in July 2021 predicted that daily cases in the fall of 2021 could exceed previous wave peaks as many jurisdictions planned to move into the final phases of their reopening plans.[30, 109]

As of August 28, 2021, 83% of the eligible population in Canada had received at least one dose of a COVID-19 vaccine and 76% were fully vaccinated.[40] Given ramp-up in vaccination coverage at the population level, the epidemiology and associated public health response for this wave was expected to be significantly different than in the past. Public health experts anticipated that transmission would be concentrated in areas with lower vaccine coverage and among children not yet eligible for vaccination as schools reopened for in-person learning.[109]

Achieving high vaccination coverage across eligible populations was predicted to significantly reduce the severity profile of disease going forward. However, updated modelling in August 2021 showed that there was still the potential for healthcare capacity to be overwhelmed if less than 80% of the eligible population remained not fully vaccinated, especially among Canadians aged 18 to 39 years, and if additional easing of public health measures further increased contact rates. This was partly due to the elevated risk of hospitalization and ICU admission associated with the Delta variant, particularly in unvaccinated individuals.[51]

In the summer of 2021, many jurisdictions focused on increasing vaccine uptake using more targeted campaigns (see text box "Supporting Vaccine Confidence in Canada"). Several regions also required proof of vaccination for certain groups or for participation in certain activities.[109] For example, in August 2021, Quebec became the first province to announce that individuals would need to be adequately vaccinated (or granted an exemption for medical reasons)

to access some non-essential services.[110] Alberta Health Services also announced plans to require all employees and contracted health-care providers to be fully vaccinated.[111]

Given high vaccine coverage, jurisdictions planned to focus the public health response more on localized surges in cases and monitoring severity indicators rather than applying broad restrictive public health measures. Ensuring sufficient public health system capacity was especially important as other pressing health priorities and a return to a more typical influenza/respiratory virus season would put added pressure on an already exhausted public health workforce.[118] Personal protective measures such as staying home when sick, hand hygiene, and respiratory etiquette continued to be important even after jurisdictions lifted restrictive public health measures. However, it was imperative to remain responsive to signals of increased SARS-CoV-2 activity, maintain vigilance and preparedness for existing and emerging variants of concern, and monitor vaccine effectiveness, both across the country and internationally.

Supporting Vaccine Confidence in Canada

National survey results from September to December 2020 found that 77% of Canadians aged 12 years or older reported being "somewhat" or "very willing" to receive the COVID-19 vaccine.[112] By February 2021, after the administration of vaccines was underway, this percentage rose to 82%.[113] Reported reasons for vaccine hesitancy are multifaceted, including concerns about vaccine safety and effectiveness, the accessibility of vaccination services, and mistrust of the vaccine approval process.[105, 114-116] Overcoming vaccine hesitancy is critical to the ongoing management of COVID-19, since achieving high vaccine coverage is necessary to limit future outbreaks. In recognition of this, many communities and businesses, as well as all levels of government, considered opportunities to support vaccine uptake. One example of an initiative to encourage vaccine uptake and vaccine confidence is the Vaccine Community Innovation Challenge. Through this initiative, the Government of Canada selected up to 140 creative projects that will develop and execute information campaigns to empower community leaders to increase people's confidence in COVID-19 vaccines and reinforce public health measures targeted at populations that were more greatly impacted by the pandemic.[117] This challenge is one of several programs, including others that were part of the Immunization Partnership Fund, that supported increasing vaccine confidence and addressing mis- and disinformation by engaging trusted community voices.

Canada's COVID-19 Situation in the Global Context

As of August 31, 2021, globally, there were over 215 million reported COVID-19 cases and close to 4.5 million COVID-19-related deaths.[119] Similar to Canada, many other benchmark countries in the Organisation for Economic Co-operation and Development (OECD) experienced outbreaks and resurgences after the summer of 2020, including those that were initially successful in preventing or limiting a first wave.[119] Each country's individual epidemiological trajectory is influenced by a multitude of factors, and thus their respective data must be interpreted with caution.

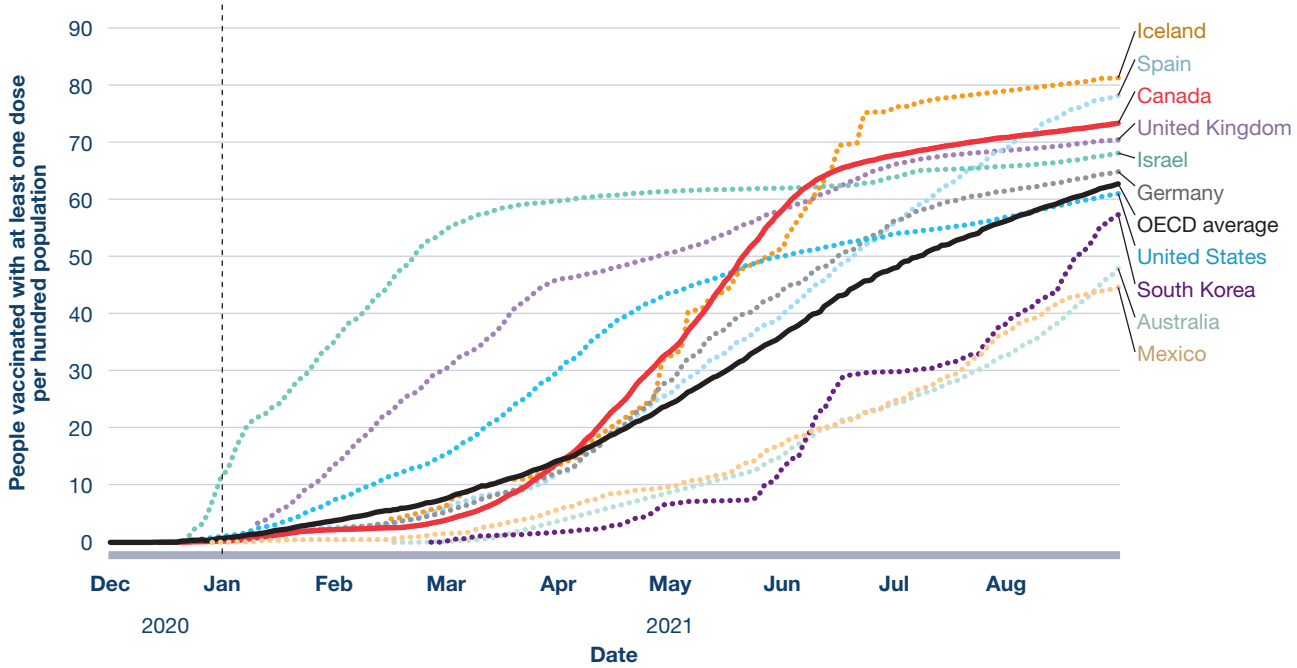
In 2021, many OECD countries transitioned to focusing their public health response on achieving high vaccination coverage. Compared to

countries such as the USA, UK, and Israel, mass vaccination in Canada began somewhat later (Figure 5).[119] However, as a result of accelerated supply, expansion of provincial/territorial vaccination campaigns, and an extended dose interval strategy, as of August 31, 2021, Canada had administered at least one dose of a COVID-19 vaccine to 73% of the total population.[40] These combined efforts contributed to Canada's ranking of #7 for highest first-dose coverage among OECD countries at the time.[119]

Canada looked to the experiences of other countries as they faced resurgences driven by more contagious variants. For example, Israel, Iceland, and the UK all experienced rapid increases in cases in the summer of 2021 caused by the Delta variant, even with relatively high vaccination coverage (Figure 5). However, as of August 2021, the number of COVID-19-related hospitalizations or deaths in all three countries was far less than those reported during previous waves.[119] The experiences of these countries, as well as emerging evidence that vaccine-acquired immunity may wane over time, emphasized the need for continued caution as vaccine coverage increased.[120] Easing of public health measures must be controlled, gradual, and responsive to the local epidemiological context, even once infection rates are brought to low levels.

As of August 31, 2021, only 40% of the world's population and 2% of people in low-income countries had received at least one dose of a COVID-19 vaccine.[119, 121] Globally, the lack of supply and access to COVID-19 vaccines means that many places will remain in the acute stage of the pandemic for the foreseeable future. Canada remains committed to working with partners to reach equitable global vaccination targets, for example through the donation of vaccines and funds to the COVID-19 Vaccines Global Access (COVAX) initiative.[122] The support that Canada provides internationally benefits Canadians as well because the future course of COVID-19 in Canada is dependent on working with all countries to end the pandemic.

FIGURE 5: Cumulative Number of People per Hundred Population Who Have Received at Least One Dose of a COVID-19 Vaccine by Country (December 2020 – August 2021)



Reporting across countries may be based on different standards and frequencies. Therefore, these data should be interpreted with caution. Vaccination coverage may include non-residents.[119]

Broader Health and Social Consequences of COVID-19 in Canada

While the influence of the COVID-19 pandemic on health can be detected in many indicators of population health in Canada, as seen in the first wave, the consequences of the pandemic are not confined to the health domain.

As with the direct COVID-19 health impacts discussed in the previous section, the broader health and social impacts of the pandemic are disproportionally experienced among some key populations in Canada. Differential impacts are often connected to pre-existing health and economic inequities as well as access to resources and supports. As a result, the pandemic further worsened many of the structural and systemic factors that contribute to the inequitable distribution of power and resources.[5, 14] This section will highlight a selection of examples that illustrate the complex and interconnected broader economic, social, and health impacts of COVID-19 and some of the governmental, community, and private sector initiatives to address them.

Overall Life Expectancy Likely Declined during the Pandemic

An examination of life expectancy can provide a broad view of the most serious health impacts of the pandemic in Canada at the population level. Life expectancy is the number of years that an individual at a given age would be expected to live, given observed mortality rates. During 2020, there was an estimated reduction in life expectancy at birth of nearly five months for both sexes nationally, attributed to COVID-19 deaths alone.[123] Life expectancy in Canada has generally been increasing by about 2.5 months per year for the past four decades.[124] Increases in life expectancy at birth began to stall at the onset of the opioid crisis in 2016.[124, 125] Even though life expectancy for 2020 was not yet calculated at the time of report writing, it is clear that COVID-19 will have a significant impact.[123, 126]

While most excess deaths can be directly attributed to COVID-19, the pandemic also had indirect consequences on mortality. This can be seen most clearly for younger populations. Although 1,600 COVID-19-related deaths were reported in Canadians younger than 65 years of age between March 2020 and May 2021, there were 7,150 more deaths than expected in this age group over the same time period.[127] The worsening opioid overdose crisis is the likely cause of a significant portion of this excess mortality.[128]

Anticipated Health Issues on the Horizon

COVID-19 has put enormous pressure on the Canadian healthcare system, and the negative long-term impact is likely to be profound.

During the pandemic, the use of some health services noticeably decreased. This may be driven both by fewer people seeking care as well as a decrease in the number and types of services available.[129] Within the first ten months of the pandemic, the number of emergency room visits and hospitalizations decreased across the country. Advice to stay home may have resulted in fewer unintentional injuries and less transmission of other communicable diseases.[129, 130] Additionally, service providers in Canada that deliver sexually transmitted and blood-borne infection (STBBI) prevention, testing, and treatment reported a 66% decrease in demand for their services.[131] This could be a result of people experiencing difficulty accessing services due to reduced hours or closures as a consequence of public health measures.

Given the pandemic's burden on the healthcare system and the impact of public health measures, some services had reduced availability.

Many jurisdictions postponed elective and other surgeries to ensure that enough resources were available for COVID-19 patients.[129] For example, in Ontario, the Financial Accountability Office estimated that, by the end of September 2021, it would take over three years to clear the surgery and diagnostic backlog that had accumulated during the pandemic.[132] Researchers also project a future surge of cancer cases once diagnostic screening and surgeries resume after COVID-19-related interruptions.[133] However, contrary to adults, childhood cancer incidence rates and early outcomes appear to have remained stable throughout the pandemic.[134] The pandemic also diverted public health resources from other programs, thereby limiting their capacity to work on other public health priorities.[7] See text boxes "Post-COVID-19 Condition" and "Public Health Measures Impacted the Spread and Management of Other Communicable Diseases" for more examples of the impact of the pandemic on health.

Post-COVID-19 Condition

Post-COVID-19 condition (also known as long COVID) is defined as symptoms that persist or recur after acute COVID-19 illness, either in the short term (4 to 12 weeks after diagnosis) or long term (more than 12 weeks after diagnosis).[135] Preliminary findings from a systematic review indicated that 56% of people who tested positive for COVID-19 reported persistence or presence of one or more symptoms in the long term.[135] While there are over 100 reported outcomes (i.e., symptoms, sequelae, and difficulties conducting usual activities), the most common symptoms include fatigue, general pain or discomfort, sleep disturbances, shortness of breath, and anxiety or depression.[135] Challenges are expected moving forward for the management of these patients, who may face long-term disability, putting additional pressure on the healthcare system. Canada has multiple specialized clinics that were created to manage post-COVID-19 condition.[136]

In partnership with Statistics Canada, academic institutions, and provinces and territories, PHAC is assessing a number of data sources that could be used to track cases of post-COVID-19 condition and related symptoms. The Government of Canada continues to monitor national and international evidence and support systematic reviews investigating the spectrum of complications associated with this condition.[137] Additionally, the Canadian Institutes of Health Research have funded prospective studies that will increase our understanding of the risk factors and long-term outcomes of COVID-19.[138]

Rapid Transition to Virtual Care

In order to minimize the risk of exposure to SARS-CoV-2, many healthcare providers quickly shifted to offering virtual care appointments. Across five provinces for which data were available, in February 2020, 48% of physicians had provided at least one virtual care service. This increased to 83% by September 2020.[139] Older adults, who are at the highest risk of adverse COVID-19 outcomes, were the main users of virtual care, and researchers expected them to benefit the most from avoiding in-person visits when appropriate.[140] However, using virtual care was challenging for individuals lacking digital literacy or reliable access to the internet or telephone.[141] Further studies are needed to determine which health issues and circumstances are the most appropriate for the use of virtual care, and to ensure it does not exacerbate inequitable access to healthcare services.[142]

Public Health Measures Impacted the Spread and Management of Other Communicable Diseases

The adoption of public health measures intended to manage the transmission of COVID-19 may have also curbed the spread of other infectious diseases. Despite increased testing, the number of laboratory-confirmed influenza cases reported between September 2020 and August 2021 was less than 0.2% of the number of cases reported during the same time period in 2018–19. Similarly, no influenza deaths were recorded in 2020–21 in the eight reporting provinces/territories, compared to 223 influenza deaths recorded in 2018–19.[143, 144]

Rates of other infectious diseases may also have been lower than previous years, although for some this could be due to decreases in testing as a result of broader COVID-19 consequences, rather than decreases in disease incidence. In 2020, both Alberta and Ontario reported a decline in incidence rates for chlamydia, HIV, and hepatitis C.[145, 146] However, not all infectious diseases experienced a downward trend. For example, the rate of infectious syphilis increased by 8% in Alberta.[145] This continues a concerning pre-pandemic trend, especially impacting younger Canadians and under-served populations.[147] Additionally, emerging evidence showed that antimicrobial use in the community dropped significantly. From March to October 2020, the average national rate of antibiotic dispensing decreased by 27% compared to the pre-COVID-19 period. This may be related to a decrease in overall physician visits during the pandemic.[148]

Canadians Experienced Worsening Mental Health during the Pandemic

For many Canadians, the pandemic experience was coupled with the stress of job loss, isolation from loved ones, restrictions on community and recreational activities, and/or the need to balance work and caregiving responsibilities. There are indications that the breadth and depth of these challenges negatively impacted feelings and perceptions of mental health and well-being of many Canadians, especially among women, younger Canadians, and frontline workers.

Data collected in March and April 2021 as part of the Canadian Community Health Survey revealed that 42% of Canadians reported that their perceived mental health was "somewhat worse" or "much worse" compared to before the pandemic.[149] Perceived worsening mental health was more frequently reported by females (44%) than males (39%), and it was also most commonly reported among Canadians aged 18 to 34 years (45%), 35 to 49 years (48%), and 50 to 64 years (40%) compared to seniors aged 65 years or older (33%).[149]

About 70% of healthcare workers who participated in a Statistics Canada crowdsourced survey during November to December 2020 reported perceptions of worsening mental health during the COVID-19 pandemic. Those who had contact with people with confirmed or suspected cases of COVID-19 reported higher rates of feelings of worsening mental health (77%) compared to those who did not report having direct contact with other people (62%).[150] While a direct pre-pandemic comparison was not available, according to the Survey on COVID-19 and Mental Health (SCMH), among Canadian adults, frontline workers were two times more likely to screen positive for post-traumatic stress disorder and 1.5 times more likely to screen positive for generalized anxiety disorder and/or major depressive disorder than those who were not frontline workers.[151, 152]

Although individuals aged 12 to 17 years were one of the age groups least likely to report feelings of worsening mental health in January and February 2021, the proportion reporting perceptions of poorer mental health doubled since September 2020.[149] While there was limited national evidence at the time of report writing, a study conducted in the Greater Toronto Area from April to June 2020 suggested that deterioration of mental health during the pandemic occurred at a higher rate in children/adolescents with pre-existing psychiatric diagnoses.[153] Kids Help Phone, an e-mental health service offering free confidential support to young Canadians, reported that the number of calls, texts, and clicks on their online resources more than doubled in 2020 compared to 2019.[154] In response, the Government of Canada provided $7.5 million in additional funding for the crisis line to provide young people with mental health support during the pandemic.[155]

Parents of young children also reported feelings and perceptions of worsening mental health. According to a survey conducted in May 2020, 44% of parents with children living at home reported worsening mental health. In the same survey, 36% of respondents without children living at home reported worsening mental health.[156] Perceptions of worsening mental health appeared highest among parents with a child less than four years of age (55%).[156]

While reported feelings of stress and anxiety increased over the course of the pandemic, preliminary evidence suggested there was not a general increase in diagnosed mental disorders.[157] As data from the pandemic continues to be collected and analyzed, changes in mental health disorders will need to be examined further.

Despite reports of worsening mental health, the SCMH conducted from September to December 2020 did not find an increase in the prevalence of respondents having seriously contemplated suicide compared to 2019.[158] Preliminary research suggested this may be for a number of reasons, including increased access to mental health services and financial supports, as well as the potential benefit of more time spent with household members.[159, 160] Some population groups disproportionately impacted by the pandemic (e.g., people who reported job/income loss, people experiencing feeling of loneliness/isolation due to the pandemic) were more likely than others to report seriously contemplating suicide.[158] As suicide rates can be influenced by lasting disruptions to civic life and the economy, it will take time to better understand the long-term impacts on suicide rates due to the pandemic, especially since cause of death reporting can be delayed.[9, 161]

COVID-19 Impacts on Substance Use

The stress and uncertainty of the pandemic, including its associated social and economic upheavals, altered the substance use patterns of many Canadians.

Dual Epidemics: The Worsening Opioid Overdose Crisis and COVID-19

The opioid overdose crisis has been a national public health priority for many years with a high health, economic, and social burden across communities, ages, and socioeconomic groups in Canada.[162, 163] Despite efforts to address the opioid overdose crisis and signs of a decline in apparent opioid toxicity deaths prior to the pandemic, the number of deaths in 2020 (6,214) exceeded the number of deaths in 2018 (4,389) at the previous peak of the crisis.[128] From April to December 2020, apparent opioid toxicity deaths increased by 89% compared to the same time period in 2019.[128] In 2020, similar to pre-pandemic trends, most apparent opioid toxicity deaths were among males (77%) and individuals aged 20 to 49 years (69%).[128] Western Canada and Ontario continued to be the most impacted; however, many jurisdictions saw increased opioid-related harms during the pandemic.[128]

While updated data were not yet available nationally at the time of report writing, data from some provinces suggested that this trend

continued. For example, there were 46% more suspected illicit drug toxicity deaths in March of 2021 in British Columbia compared to March of 2020.[164] Additionally, a model of opioid-related deaths during the pandemic predicted that the number of deaths would remain high or even increase through the remainder of 2021.[165]

The health and well-being of Indigenous Peoples in Canada continues to be negatively impacted by stigma and discrimination, the legacy of forced displacements, abuse and disruption of traditional culture in residential schools, and the associated intergenerational trauma.[166] Although First Nations Peoples made up only 3% of British Columbia's population, in 2020, 15% of all toxic substance deaths were among First Nations Peoples compared to 12% in 2019.[167] In Alberta, First Nations Peoples made up 6% of its population, but represented 22% of all opioid poisoning deaths from January to June 2020.[168] To address some of these challenges, the First Nations Health Authority in British Columbia expanded access to culturally safe harm reduction and healing strategies, such as launching the First Nations Virtual Substance Use and Psychiatry Service.[167]

Non-pharmaceutical fentanyl continued to be a major driver of the observed surges in opioid-related hospitalizations and deaths during COVID-19.[128] Increasing feelings of isolation, stress, and anxiety, and limited availability or accessibility of public health services, such as harm reduction services for people who use substances, might also have contributed.[128, 169] Public health measures implemented to manage COVID-19 also disrupted substance supply chains, which could have created additional risks for individuals who had to modify their usual substance use as a result.[169]

At the outset of the COVID-19 pandemic, the Government of Canada took action to enable the health system to better meet the needs of people who use substances. Health Canada created and extended a temporary exemption to the *Controlled Drugs and Substances Act*, including allowing pharmacists to prescribe and physicians to verbally prescribe controlled substances in order to help patients adhere to public health measures.[170] Similarly, in September 2020, British Columbia issued a public health order that authorized registered nurses to prescribe pharmaceutical alternatives in an effort to prevent people from accessing a potentially toxic street supply and to provide more opportunities for ongoing care, treatment, and support.[171] Another example of ensuring safer supply was the innovative MySafe vending machines set up in Victoria, London, Dartmouth, and Vancouver. After verifying an individual's identity with a palm scan, the machines provided access to medication for patients with existing prescriptions.[172]

Alcohol-Related Hospitalizations Increased during the Pandemic

Some Canadians appear to have increased their use of alcohol during the pandemic. Sixteen percent of respondents to the SCMH conducted from September to December 2020 reported that their consumption had increased, especially among those reporting perceptions of worse mental health.[173] Compared to 2019, from March to September 2020, overall hospitalizations for alcohol harms rose by 5%.[169] In addition to increased consumption and availability of alcohol, this may also reflect a broader trend of delaying seeking necessary care, resulting in more severe outcomes.[169] Alcohol-related hospitalizations increased the most (14%) in the lowest-income areas during the pandemic compared to no change in the highest-income areas.[169] This could be due to low-income Canadians being more impacted by the pandemic as well as having a higher prevalence of multiple chronic conditions.[5, 174]

Social Determinants of Health

The health of Canadians is dependent on a set of fundamental social determinants. The 2020 CPHO Annual Report examined how the social determinants of health, such as income, employment, and racism, influenced differential risk of COVID-19 and reinforced societal inequities.[5] Consistent with findings from the first wave, emerging evidence from the second and third waves suggested that the broader social and economic impacts of the pandemic were also being disproportionately experienced by groups who have been historically under-served, such as racialized populations, Indigenous Peoples, populations that are low-income, and women.

The Pandemic Affected Financial Security

As a result of the economic impacts of COVID-19, millions of Canadians lost their jobs, worked reduced hours, and/or were in precarious financial situations.[175] Industries most impacted by the unintended consequences of public health measures, such as retail trade, accommodation, and food services, saw the largest job losses.[176] Since a peak of 14% in May 2020, the unemployment rate generally trended downward (8% in July 2021), but remained above pre-pandemic levels at the time of report writing.[177]

Some racialized populations disproportionately experienced higher rates of unemployment. In June 2021, the unemployment rate among Canadians designated as visible minorities was 10% compared to 6% among Canadians who were not Indigenous or a visible minority.[178] Compared to February 2020, the unemployment rates in February 2021 for youth aged 15 to 24 years had increased by nearly seven percentage points, and employment losses among women in that age group were nearly double those seen in men.[179]

Long-term unemployment is associated with negative health impacts, difficulty returning to work, and delays in acquiring work experience.[176] As of July 2021, 28% of unemployed people were experiencing long-term unemployment, an increase from approximately 12 percentage points before the pandemic.[180] COVID-19 also magnified the consequences of precarious employment conditions (e.g., low-paid work, part-time work, irregular hours) faced by many working people in Canada, who are disproportionately women, people who are racialized, immigrants, and people with disabilities. This is increasingly recognized as an important social determinant of health and has been linked to a number of adverse worker, family, and community health outcomes.[181-183]

The lowest-income earners and households in which the major income earner is younger than 35 years of age had the most pronounced wage losses in 2020.[184] However, as a result of COVID-19-related income support transfers by federal and provincial/territorial governments that were implemented to compensate financial losses, both of these groups saw the greatest increases in income in 2020 compared to 2019.[184] In particular, income for the lowest-income households in Canada increased 18% in 2020, more than other household types.[184] Furthermore, the gap between lowest- and highest-income earners decreased by 2% in 2020 compared to 2019.[184] It is important to note that some groups were not eligible for these income support programs. Nonetheless, the lessons learned from these programs may be used to facilitate discourse around a basic income across the country that could lessen financial impacts on health, especially during future health emergencies.[185]

Additional Impacts on Social Determinants of Health during the Pandemic

Changes in Canadians' financial security were just one of several ways in which the pandemic impacted social determinants of health. For many others, such as the examples highlighted in Table 3, it will take further time to gather data and understand the long-term effects of COVID-19.

TABLE 3: Additional Examples of the Potential Impact of COVID-19 on Social Determinants of Health

Social determinant of health	Potential impact of COVID-19
Food insecurity	▸ Lack of access to sufficient and nutritious foods is strongly correlated with a range of adverse health outcomes, including poor mental health and increased likelihood of hospitalization for acute and chronic conditions.[5, 186, 187] ▸ Food insecurity may have increased as a result of the pandemic.[156, 188] The Canadian Community Health Survey reported that in May 2020, 15% of respondents lived in a household where there was food insecurity, compared to 11% of respondents in 2017/2018.[188] ▸ Households with children and households with members who had lost their jobs or stopped working due to COVID-19 were more likely to be food insecure during the pandemic.[186, 188] Additionally, prior to the pandemic, the prevalence of food insecurity was much higher among Indigenous households than non-Indigenous households.[189] While data were not available at the time of report writing, COVID-19 is likely to have further magnified the disproportionate impact on Indigenous communities.
Family and gender-based violence	▸ During the first wave of the pandemic, evidence showed that Canadians were concerned about the possibility of violence in the home (10% of women and 6% of men).[190] Data from the second wave showed that concern of violence in people's own homes was lower than during the first wave (4% for women and 5% for men).[191] ▸ Tracking child maltreatment, intimate partner violence, and senior abuse has become increasingly complicated during the pandemic. LGBTQ2+ persons, especially youth, who are precariously housed, may have been compelled to return to hostile families and communities.[192] ▸ Canada's Assaulted Women's Helpline saw a 165% increase in calls between October and December 2020 compared to the same period in 2019.[193]

Social determinant of health	Potential impact of COVID-19
Stigma and discrimination	▸ At the beginning of the pandemic, Chinese, Korean, Southeast Asian, and Black respondents to an August 2020 crowdsourced survey were twice as likely to report experiencing discrimination compared to non-visible minority respondents.[194] ▸ Anti-Asian hate crimes reported to police in a number of cities across Canada increased dramatically from 2019 to 2020. This includes a 717% increase in anti-Asian hate crimes in Vancouver and a 650% increase in Ottawa.[195, 196]
Education	▸ In many jurisdictions, schools were closed for some period of time, and virtual learning was introduced as a safer alternative to in-person learning by reducing the risk of virus exposure.[197] ▸ There are health risks associated with closures, including significant physical, mental health, and safety harms for students.[198, 199] There may be long-term negative consequences of the disruption in education.[197]
Childhood development	▸ The pandemic disrupted many supports and services for children and youth with developmental disorders.[200] ▸ Delays in early diagnosis, along with access to behavioural and educational interventions, could have long-lasting impacts for children and youth with developmental disorders.[201-203]

Many Consequences of COVID-19 are Likely Still to Come

This section has detailed some of the broader consequences of the pandemic on social determinants of health, substance use, and non-COVID-19 health outcomes. In some areas, the interventions taken to mitigate challenges were focused on the short term, and the long-term impacts remained unknown. These longer-term impacts on the health of Canadians will only surface in years to come. For example, very little is known about the potential for long-lasting impacts of the pandemic on children. It will therefore be important to continue to work towards a better understanding of the broader consequences of COVID-19 and to monitor well-being indicators that encompass multiple dimensions of Canadians' quality of life.[204, 205]

As a result of the pandemic, public health is front of mind for many Canadians. Examining some of the broader consequences of the pandemic emphasizes that public health is much more than infectious disease prevention and control, and demonstrates that focused and coordinated efforts by Public Health and related sector partners are needed to address the future consequences. The following section will examine how the public health system adapted to the pandemic, including challenges and innovations, and how work needs to continue across sectors to protect population health and well-being in future public health emergencies.

Key Public Health System Challenges and Solutions Highlighted by the COVID-19 Pandemic

The COVID-19 pandemic highlighted priority areas for strengthening public health systems in Canada. It also provided a critical opportunity to address long-standing gaps through innovation and collaborative efforts. The joining of forces across all levels of government, the private sector, nongovernmental organizations, and communities was unprecedented, although there continue to be key areas requiring further attention.

Ensuring Access to the Right Data and Information to Support Complex Decision-Making

Throughout the pandemic, collecting and sharing health data, knowledge, and information to support an effective pandemic response posed a constant challenge. Obtaining consistent, timely, and complete national COVID-19 case data was difficult, given that provincial and territorial jurisdictions do not always collect or report information in the same way.[7, 206] Additionally, information on geographic location, hospitalization status, pre-existing conditions, and deaths, was not always available, highlighting historic challenges with data infrastructure, limited workforce capacity, and data-sharing agreements.[7, 206, 207] These delays in access to complete national data sets reduced the quality of analyses characterizing features, such as disease symptoms and close contacts, as well as the power of models to predict spread of the virus.[7]

Similarly, the ability to collect and link health data to socio-demographic information, such as Indigeneity, race, income, and occupation, was not available at a national level.[7, 208] This was mainly due to incomplete collection of these data at a local level, as well as the lack of an interoperable health data ecosystem that could combine different types of data while ensuring proper protection of personal information.[207]

The disproportionate impact of COVID-19 on certain populations underscores the need for timely socio-demographic information during public health emergencies to understand existing health inequities and implement the most appropriate targeted approaches.[5] To address these challenges at a local level, several public health units began publishing COVID-19 data disaggregated by race and income in the spring of 2020.[209] This allowed for the development of targeted strategies to curb COVID-19 spread and increased vaccine uptake in communities with high vaccine hesitancy.[210] It also spurred a new Black Scientists' Task Force on Vaccine Equity to develop public health recommendations to address Black community concerns.[211]

Temporary and/or local solutions, such as the one described above, were often put in place to address issues around data availability and access. Recognizing that many of these strategies were neither easily sustainable nor scalable, sparked renewed interest nationally to address long-standing gaps in Canada's health data ecosystem.

In October 2020, PHAC took the lead on behalf of the Government of Canada to work directly with provinces, territories, Indigenous organizations, and key stakeholders to develop a Pan-Canadian Health Data Strategy.[207] The strategy supported Canada's COVID-19 response by addressing immediate data needs presented by the pandemic.[212] In the longer term, it will advance efforts to vastly improve health data collection, sharing, and usage by understanding the root causes of problems, identifying opportunities for improvement, and developing a set of guiding principles.[207] This will lay the groundwork for a coherent, shared, sustainable, and impactful health data foundation that honours data protection and enables the collective use of individual and aggregate health data to improve outcomes for individuals, communities, and society.[207]

Navigating through the Pandemic's Information Landscape

The pandemic underscored the need for coherent, consistent, and transparent messaging and risk communication. Providing accurate, reliable, and timely information is critical for informing actions to protect population health, build public trust, and minimize social and economic disruption, and is a responsibility shared among all levels of government.[213] Knowledge about COVID-19 has continuously evolved as new scientific information becomes available. It took considerable effort for public health decision-makers to incorporate new expert advice, research findings, epidemiological trends, and other contextual data.

This is the first pandemic to occur during a time in which digital technology and virtual information-sharing platforms are heavily relied upon to keep people safe, informed, and connected.[214] At the same time, the extensive use of social media during the pandemic created multiple ways for competing views, mis- and disinformation, and different official messages to proliferate.[215, 216] This caused an infodemic, an overabundance of information, both online and offline, which may have contributed to poor adherence to public health measures, undermining the ability to bring the epidemic under control.[215] For example, providing too much information can generate vaccine hesitancy; whereas good communication can lead to trust in the effectiveness and safety of vaccines.[217]

Public health professionals had to find different approaches and mechanisms to counter mis- and disinformation and build trust in the public health system. Accordingly, public health leaders across the country invested considerable time and effort to communicate directly with the public in unprecedented ways, including frequent press and technical briefings, media scrums, interviews, and public awareness campaigns across multiple media formats.[218, 219]

ScienceUpFirst, a collaboration between the Canadian Association of Science Centres, COVID-19 Resources Canada, and the Health Law Institute at the University of Alberta, is one example of an innovative social media initiative to address misinformation.[220, 221] This national social media movement connects scientists, healthcare providers, and science communicators by providing credible, science-based information in creative ways to address the spread of misinformation and help Canadians navigate through the infodemic.[220, 221] See text box "Rapidly Changing Evidence Led to Innovative Academic-Practice Partnerships" for more examples of academic collaboration.

Tailoring communication to communities was also important to ensure that information was accessible and relevant to intended audiences. One example of this was a tool developed by the Centre for Wise Practices in Indigenous Health in partnership with other Indigenous health and community organizations, to support vaccine uptake called Maad'ookiing Mshkiki-Sharing Medicine. This was a community-centred resource designed to empower informed consent for Indigenous Peoples.[222] It provided culturally relevant and trauma-informed information about COVID-19 vaccines for First Nations, Inuit, and Métis communities. For instance, an infographic was created that effectively explains the various components of mRNA COVID-19 vaccines, incorporating traditional knowledge and healing practices.[222]

Targeting information based on regional epidemiological context was critical. However, there were times during the pandemic marked by jurisdictional or organizational differences across governments in key communication strategies, highlighting the need for consistent and coherent communication.[10, 223] At times, the desire for information created communication opportunities for medical professionals and scientists without comprehensive public health expertise, possibly leading to confusion and reduced trust in Public Health.[219, 223] Over the

course of the pandemic, the Council of Chief Medical Officers of Health, composed of the Chief Medical Officers of Health from each federal and provincial/territorial jurisdiction, released joint statements to help establish a unified, expert, and trusted Public Health voice speaking to all Canadians.[224] This included guidance and advice on COVID-19 in Canada from vaccination efforts to managing COVID-19 at individual, organizational, and community levels.[225, 226]

Rapidly Changing Evidence Led to Innovative Academic-Practice Partnerships

Amidst the rapidly changing COVID-19 evidence landscape, several initiatives were put in place to help public health organizations quickly find and use evidence. COVID-END, CanCOVID, and CoVaRR-Net are three examples of partnerships with academic expertise.

The COVID-19 Evidence Network to support Decision-making (COVID-END), housed at the McMaster Health Forum, was composed of knowledge synthesis and assessment experts. This network used systematic methods to produce evidence syntheses and horizon scans on a range of topics, including pandemic response, public health measures, economic and social responses, and clinical management.[227]

In April 2020, Canada's Chief Science Advisor established CanCOVID to offer "an evidence-informed response to the COVID-19 pandemic".[228] This network was comprised of Canadian researchers, "patient partners, decision-makers, and industry partners".[228] During the pandemic, CanCOVID supported PHAC by facilitating the rapid convening of experts to help bring new research and insights for discussion.

The Coronavirus Variants Rapid Response Network (CoVaRR-Net) was created as a network of interdisciplinary researchers across Canada who worked with the Government of Canada to address the potential threat of emerging SARS-CoV-2 variants. The goal of CoVaRR-Net was to rapidly respond to critical questions about the characteristics of variants, such as their increased transmissibility, severity of disease, and resistance to vaccines.[229]

Strengthening Collaboration

The scope and impact of the pandemic created an unprecedented need for collaboration across all levels of government and communities as well as across health and other allied sectors. Engaging communities throughout a pandemic response is particularly important to reach priority populations and to support equity-informed responses.[230]

A collaborative approach to the pandemic required expanding existing and creating new partnerships, roles and responsibilities, and decision-making processes. Across jurisdictions, the Special Advisory Committee on COVID-19 (SAC) has been recognized as a successful example of joint federal and provincial/territorial leadership.[206, 218, 231] All Chief Medical Officers of Health and senior public health officials met up to several times a week since January 2020 to discuss coordination across Canada's health system. SAC also published national recommendations and guidance on a wide array of pandemic-related topics.[231]

At the federal level, PHAC teamed up with other departments to ensure Canada's pandemic response was nationally coordinated and supported. For example, Health Canada expedited access to medical supplies; the Canadian Border Services Agency implemented and enforced border restrictions and mandatory quarantine measures; Innovation, Science and Economic Development Canada introduced measures to directly support businesses developing products to help with the efforts against COVID-19; and Indigenous Services Canada (ISC) worked with Indigenous partners to empower communities to implement their own customized public health emergency preparedness plans and response.[206, 232] The Government of Canada also supported several regional and/or local programs, such as providing $4.2 million for local public health units to operate safe voluntary isolation sites in Nova Scotia for individuals living in crowded housing.[233]

Of particular importance have been cross-government collaborations that were anchored in principles of self-governance. First Nations, Inuit, and Métis leaders worked with multiple levels of government to support exemplary community-led and culturally safe immunization programs.[234] For example, Indigenous leadership drove rapid and widespread rollout of COVID-19 vaccines in First Nations communities, including the guidance offered by Elders and Knowledge Keepers.[234] Métis Nation-Saskatchewan hosted easily accessible and culturally safe vaccination sites across Saskatchewan as part of the Vaccinated Métis Strong public health campaign.[235] The Manitoba Inuit Association also hosted vaccination clinics throughout Manitoba, where culturally safe clinics displayed Inuit art and signs written in Inuktitut.[236]

In addition, many Indigenous communities undertook the development of community-based rapid point-of-care testing for COVID-19 with support from the National Microbiology Laboratory (NML) and ISC. As of July 28, 2021, through the Northern, Remote, and Isolated Initiative, 302 sites were able to provide diagnostic test results within minutes. These communities worked directly with NML to acquire diagnostic testing devices and access supportive training, building capacity to design and perform their own testing to inform the implementation of local public health measures and limit outbreaks.[237]

Integrating Lessons Learned to Prepare for Future Public Health Emergencies

COVID-19 has been the most significant health crisis of the last decades. It has tested the limits and capacity of Canada's preparedness, and presented the need and opportunity to increase Canada's readiness for future public health crises.

Updated Pandemic Plans and Surveillance Systems

Federal organizations playing an important role in public health in Canada, such as PHAC and ISC, adapted existing plans quickly to respond to the pandemic.[206, 238] As the pandemic progressed, the scientific knowledge around COVID-19 increased greatly and rapidly. Additionally, the necessity became clear for public health measures to better balance minimizing morbidity and mortality with the impact on societal disruption.[14] Building on these experiences, PHAC worked with provincial and territorial governments and related partners to develop and continuously update the *Federal-Provincial-Territorial Public Health Response Plan for Ongoing Management of COVID-19*.[14] This evergreen document was instrumental to ensure a common forward planning approach. PHAC has committed to working with provincial/territorial and Indigenous partners to incorporate lessons learned from COVID-19 in updating and testing future pandemic plans.[206] The pandemic also highlighted the need for event-based surveillance systems that produce early warning signals to be better integrated with governance structures and risk assessment processes that promote coordination across surveillance functions.[206, 239]

Equity in Pandemic Readiness and Response

The disproportionate direct (e.g., SARS-CoV-2 exposure, COVID-19 mortality) and indirect (e.g., mental health, substance use) impacts of COVID-19 on key populations emphasized the need for an equity approach to pandemic readiness. During the pandemic, the Government of Canada put in place several programs to specifically address social determinants of health. For example, the temporary Canadian Emergency Response Benefit (CERB) and Employment Insurance (EI) helped more than 8.9 million individuals who lost their jobs or otherwise experienced negative financial impacts from the pandemic.[240] Additionally, to support Canadians experiencing housing insecurity who faced challenges with physical distancing and access to hygiene products, the Rapid Housing Initiative will help address urgent housing needs through the construction of 4,500 affordable housing units.[241] Future response plans need to use an equity approach and consider how impacts of a public health emergency might be driven by social determinants of health as well as worsen pre-existing inequities.[5] This also points to the importance of improving social determinants of health and supports before the next public health emergency, using the lessons learned from the pandemic.

Surge Capacity

The pandemic put an unprecedented strain on available health resources. Responding to such a large-scale and enduring health emergency is challenging since it requires a rapid expansion of health services to meet the increased demands for space, staff, and supplies (see text box "Multi-Organizational Effort to Strengthen Surge Capacity across Canada").[242] For example, many jurisdictions lacked the laboratory capacity to process large volumes of COVID-19 tests within short timeframes.[243] Particularly early in the pandemic, there were also challenges with meeting the extraordinary demand for supplies like personal protective equipment and medical devices. This pointed to the importance of a strategy for maintaining an inventory of essential items in the health system for future public health threats.[244]

Multi-Organizational Effort to Strengthen Surge Capacity across Canada

A never-before-seen mobilization of human resources with specialized skills was needed to support a complex and ongoing emergency response.[218] This need for expanded resources required significant contributions from nongovernmental and governmental partners from both within and outside the health sector.

For instance, the Canadian Red Cross (CRC) was instrumental in boosting surge capacity with large numbers of well-trained medical and non-medical personnel, and leading initiatives at more than 400 sites across the country.[245] This included providing help at vaccination clinics in at least six provinces/territories and deploying field hospitals and health equipment in Alberta, British Columbia, Ontario, and Quebec.[246] CRC also supported voluntary isolation sites for seasonal agricultural workers in Ontario and aided in the logistics and set-up of self-supervised sample collection sites at 19 Canadian land border crossings.[245] During the third wave of the pandemic, it provided supplies and on-site logistic support to 14 northern villages in Nunavik.[247]

The Canadian Armed Forces (CAF) also provided considerable support. During the first wave, CAF deployed medical and support personnel to 54 long-term care facilities in Ontario and Quebec to assist with day-to-day operations, infection control and prevention, as well as general support where needed. Between October 2020 and August 2021, Canadian Rangers were activated in more than ten First Nation communities to provide humanitarian assistance and address immediate needs as part of COVID-19 mitigation and relief efforts. During the third wave, CAF provided military medical resources to Ontario and Manitoba to augment healthcare providers in medical care facilities and was vital in assisting with the complex logistics of distributing COVID-19 vaccines all over Canada through Operation VECTOR – especially in remote areas.[248, 249]

A well-prepared public health system must have scalable, flexible, and resilient surge capacity, not only to respond to the immediate needs of a public health emergency, but also to have sufficient resources to attend to other existing or emerging health priorities (e.g., the opioid overdose crisis, climate change) without risking workforce burnout. During the COVID-19 pandemic, many responders were stretched as they dealt with multiple crises at the same time. For example, the July 2021 heat wave that caused a rapid increase in sudden deaths in Western Canada further exacerbated the emotional and physical toll of the pandemic on paramedics.[250, 251] The COVID-19 pandemic further underscored the historical need for improved surge capacity in public health, health care, and allied sectors.[252]

Future Public Health Emergencies Will Require a Whole-of-Society Response that Includes a Stronger Public Health System

The direct and indirect consequences of COVID-19 continue to impact our health and social systems. The pandemic has made even more apparent many existing gaps in public health systems, and there are additional impacts of COVID-19 yet to come.

A number of the innovative solutions to the challenges highlighted by COVID-19 were designed as immediate short-term crisis responses. Sustainable strategies are needed to forge a more resilient public health system with strengthened partnerships that works for all people living in Canada. This begins with reflecting on how Canada's public health systems are governed, organized, and resourced so that we can move forward with the right solutions.

Section 2

Public Health in Canada: Opportunities for Transformation

The COVID-19 pandemic has brought the world's attention to public health, revealing its essential role in a nation's well-being. Similar to previous pandemics, it highlighted a core function of public health – emergency preparedness and response. However, this role is only one of the many ways that public health systems protect and support the health of populations.

COVID-19 tested public health systems across Canada and the world. The continued struggles and successes during the pandemic have amplified known weaknesses, revealed new challenges, and underscored the need for resilient public health systems that can best support the health and well-being of people living in Canada. The pandemic also demonstrated that innovations and new ways of working together are needed. There have been numerous calls to reform the public health system, both historically and during the COVID-19 response, but there are additional and increasingly urgent signs that we need to act now.[7, 253-259]

Already stretched thin before the pandemic, the public health workforce is overextended and may not have the capacity to counter the next emergency. There are still unacceptable delays in getting the right data to inform public health decision-making. Society-wide inequities persist, and key social and economic policies started during COVID-19 may not be sustained. These vulnerabilities could weaken Canada's resilience to future health threats.

As Canada looks toward pandemic recovery, heavy demands on the healthcare system threaten to overshadow the equally critical need to bolster the public health system. As COVID-19 has shown, both systems must be sufficiently supported for Canada to have a reliable and responsive health system that can meet the needs of its people.

Before discussing opportunities to strengthen the public health system, a shared understanding is required of the true scope of public health, and how it touches people's lives every day.

What is Public Health?

For many people in Canada, COVID-19 opened a window into an important aspect of the work of public health systems. However, public health has long been working to keep people healthy and prevent injury, illness, and premature death, and contribute to health equity.[260] To do all of this, public health professionals take on multiple roles – as leaders, coordinators, motivators, and supporters – to address demanding health challenges.

COVID-19 is one of many pressing issues facing public health systems. Other ongoing challenges include antimicrobial resistance, the opioid overdose crisis, non-communicable diseases (e.g., cardiovascular disease), mental health, and the growing health impacts of climate change.[261-263] Tackling these complex public health issues requires a deep understanding of what makes populations healthy.[264-267]

Public health organizations view the population as the "patient", compared to healthcare institutions that provide one-on-one services to individuals. These populations are organized into different groups – neighbourhoods, specific communities, provinces/territories, or, as was clear with COVID-19, the world.

By its nature, the work of public health is often invisible and behind the scenes. However, its impact on the collective health of populations is profound.

In the 20th century alone, it has been estimated that advances in public health increased the average life expectancy at birth in Canada by 25 years (see text box "Defining Moments in the History of Public Health in Canada").[268] This has been linked to key public health achievements such as:[269]

- **Improved maternal and infant health** through advancements in hygiene, nutrition, education, perinatal death prevention, access to care, and contraception;
- **Improvements to sanitation and reduction of environmental toxins**, including sewage and water treatment systems and reduction of air pollution from motorized vehicles;
- **Fluoridation of drinking water** for the prevention of tooth decay and dental disease;
- **Tobacco control**, including the recognition of tobacco as a health hazard, advertising regulations and limits on selling tobacco, anti-smoking campaigns, and smoke-free environments;
- **Occupational safety**, including the reduction of workplace injuries and an increase in workplace health promotion;

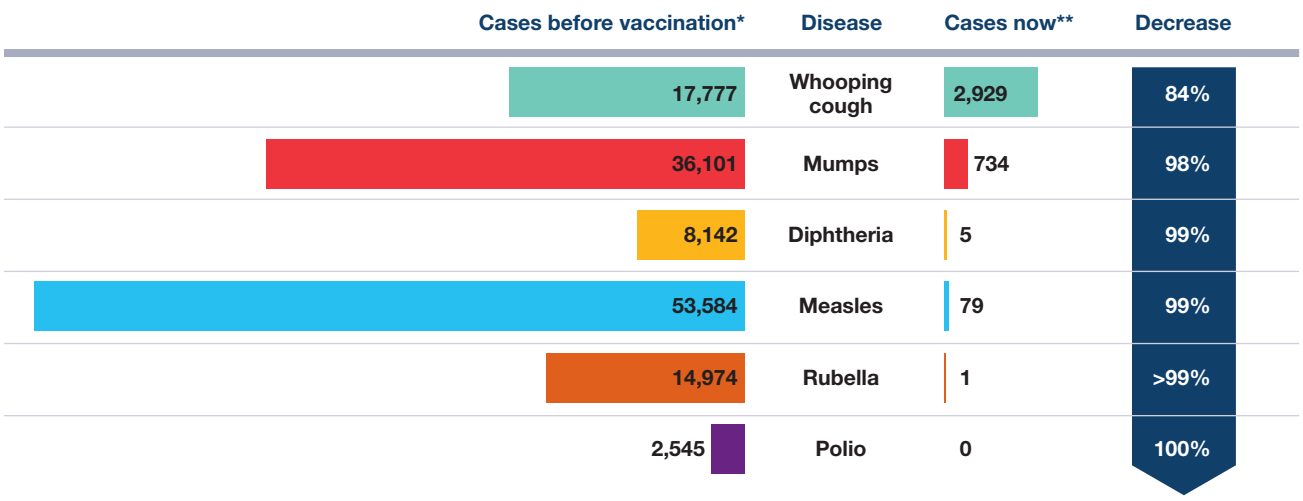
> *If you prolong the life of someone for two hours, you can know what you have done. If you prevented four million deaths because of COVID, no one will know, because [the deaths] didn't happen. It is the nature of what we are doing [in public health]: when we are successful, we are invisible."* – *Key informant interview*

- **Motor vehicle safety**, including the prevention of injury and death due to seat belt use, child safety seats, and the decrease of alcohol-related collisions;
- **Declines in deaths due to cardiovascular disease and stroke** due to a combination of advances in prevention, detection, and treatment, including lifestyle changes and risk-factor modification;
- **Infectious disease control and prevention** through interventions such as vaccines, public education and campaigns, public health measures, and antimicrobial therapies; and
- **Safer and healthier foods**, including pasteurization, food inspections, salt iodization, and better nutrition.

Vaccines are one of the most well-known and important public health interventions. The introduction of mass vaccination efforts spurred a dramatic decline in infectious diseases (Figure 6), related illnesses, and deaths.[268, 270] Notably, the success of vaccinations led to the global eradication of smallpox in 1980 and the certification of Canada as polio-free in 1994.[271, 272] Today, people routinely receive vaccines to protect against a range of diseases including pertussis, measles, mumps, rubella, tetanus, hepatitis B, human papillomavirus (HPV), influenza, and more.[273]

Without a continued concerted effort to keep vaccine-preventable diseases in check, previously controlled infectious diseases will return.[272, 274] This presents an ongoing challenge for public health, as childhood vaccination programs have been so successful that people may underestimate the risks of vaccine-controlled diseases.[273]

FIGURE 6: Impact of Childhood Vaccinations on Key Infectious Diseases in Canada



** Average number of cases reported annually in Canada during the five years before routine vaccine use, or the closest possible five years where stable reporting was occuring.*

*** Average number of cases reported annually in Canada from 2015 to 2019.*

***Sources:** Measles and rubella data were obtained from the Canadian Measles and Rubella Surveillance System, while data for all other diseases were obtained from the Canadian Notifiable Disease Surveillance System.[275, 276]*

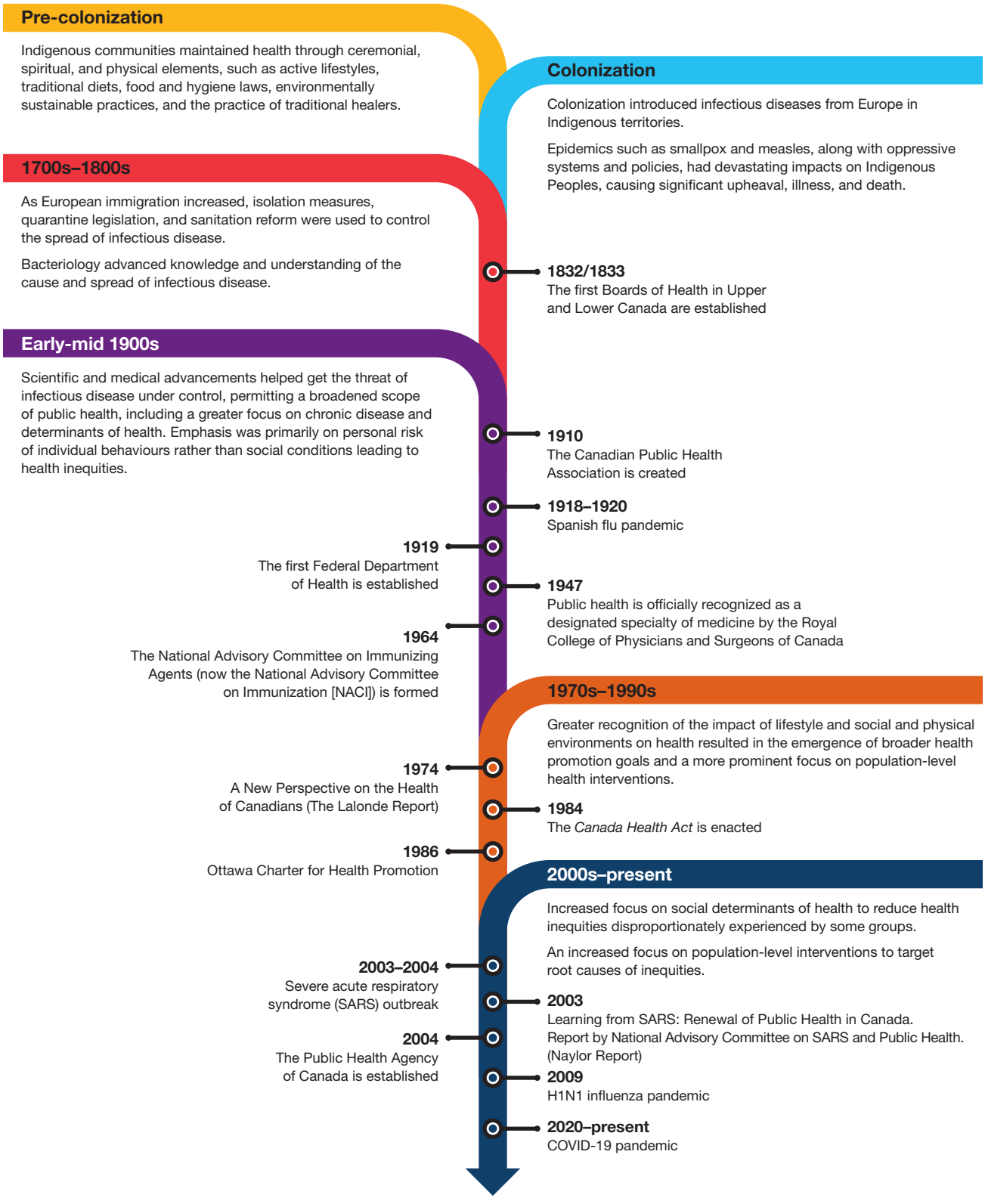
Defining Moments in the History of Public Health in Canada

Present-day public health systems in Canada are rooted in historical efforts to control infectious diseases, specifically quarantine legislation developed in the 18th century (Figure 7).[277] This history was intertwined with social reform movements and increased interest in how social conditions affect the spread of disease.[278, 279] This underscores that health inequities have been a focus of the science and practice of public health for centuries.

At the beginning of the 20th century, the scope of public health expanded to include maternal and child health, nutrition and food safety, injury prevention, environmental contamination, chronic disease, and other issues.[253, 259, 277] This occurred alongside a broader focus on health care in Canada by the mid-20th century, including rapid investment in hospitals and policies to improve access to health care.[280] Medicare was implemented in Saskatchewan (1962) and then expanded across the country with the adoption of the *Canada Health Act* in 1984.[281] This milestone in population health policy ensured that all residents of Canada were entitled to universal, accessible, comprehensive, portable, and publicly administered health services across the country.[281]

In the late 20th century, Canada gained international attention due to its formal recognition of the broader social determinants of health, starting with the 1974 "Lalonde Report", *A New Perspective on the Health of Canadians*.[282, 283] In 1986, the *Ottawa Charter for Health Promotion* was developed by participants at the first World Health Organization (WHO) International Conference on Health Promotion as a commitment to "Health for All" by 2000. The Charter was a seminal document for public health globally, representing a shift towards situating health squarely as a product of the conditions in which people live, not just as a result of their behaviours or access to health care.[277, 284] The Charter is still referenced internationally today.

FIGURE 7: Key Milestones and Shifts in Canadian Public Health



Sources: *Adapted from Canadian Public Health Association. Immunization Timeline* and *This Is Public Health: A Canadian History.*[271, 277]

Acknowledging Colonial Impacts on Public Health

The history of public health in Canada cannot be uncoupled from its colonial history. Colonization disrupted Indigenous approaches and systems for health, medicine, and well-being. Colonial policies dismantled traditional ways of knowing, cut off connections to the land, and broke family and social structures.[285-288] Intergenerational impacts of colonialism continue to affect the health and well-being of Indigenous Peoples, including experiences of systemic racism, ongoing challenges to self-determination, disconnection from the land, and barriers to high-quality, accessible, and relevant health services.[285, 286, 289-291]

Today, public health continues to be dominated by Western knowledge and practice, which does not adequately respond to the social and health realities of Indigenous Peoples.[292] First Nations, Inuit, and Métis Peoples are diverse, with rich histories, cultures, languages, and approaches to health and healing. However, there are also shared holistic and relational understandings of health and wellness across many communities.[292-294] Traditional knowledge and cultural practices have crucial roles in supporting First Nations, Inuit, and Métis Peoples. During the COVID-19 pandemic, self-determination, Indigenous leadership, and place-based knowledge all informed successful protection efforts for Indigenous communities.[292]

These approaches are central to reconciliation, an ongoing process of healing relationships.[295] Reconciliation requires, alongside self-determination and Indigenous leadership, an understanding of history and a commitment to truth and justice.[295] It also requires action to address the policies, systems, and structures that continue to cause social, economic, and health inequities between Indigenous and non-Indigenous people in Canada.[295]

The Final Report of the Truth and Reconciliation Commission of Canada highlighted the urgent need to work to eliminate the health inequities experienced by Indigenous Peoples. These findings have been echoed and preceded by many Indigenous-led reports.[285, 286, 289, 292, 296]

The Interplay between Public Health, Society, the Economy, and the Environment

Current directions in public health are converging around the interrelated nature of health challenges. This includes the connections between human and animal infectious diseases, the health risks driven by climate change, and the interplay between social, economic, environmental, and health inequities. The following two approaches consider these interrelated factors and are aligned in their continued prioritization of the social determinants of health.

One Health

The One Health approach explores ways to design and implement intersectoral research and action to concurrently promote the health of humans, animals, and ecosystems.[297, 298] Issues such as COVID-19 and climate change have highlighted the importance of addressing the complex interconnections between human health and the environment and the potential value of the One Health approach.[299] The growing threat of antimicrobial resistance (AMR) has also emphasized the necessity of addressing these complex connections with a multisectoral and multilevel approach.[297, 300, 301] Currently, the pan-Canadian framework for action on AMR and antimicrobial use is grounded in a One Health approach, requiring collaboration across levels of government, academia, industry, and nongovernmental organizations, including participation of subject matter experts in human health, animal health, and agriculture.[302, 303]

Equity, Inclusion, and the Social Determinants of Health

As was evident in Canada and around the world, the social, political, and environmental conditions that created differential risks for COVID-19 overlapped with factors that drive inequities in non-communicable diseases.[5, 304, 305] The pandemic left no question about the crucial importance of addressing these inequities.[5, 86, 306-308] Globally, many chronic diseases were associated with higher COVID-19 severity or mortality, such as diabetes, hypertension, obesity, cardiovascular disease, and chronic kidney disease.[309] These are unequally prevalent in the Canadian population based on factors such as income, education, race, or Indigenous status.[304, 305, 309-322] Infectious and non-communicable diseases are often divided in public health policies, interventions, and practices. Better understanding of the connections across social determinants of health and diverse health outcomes will help to inform public health actions to improve the overall health of populations and decrease societal vulnerabilities to future health emergencies.[323, 324] This includes attention to systemic racism and other forms of stigma that continue to impact the health of Indigenous and racialized communities, LGBTQ2+ communities, people living with disabilities, and others experiencing marginalization.[324-331]

Although public health has historically reported on the social determinants of health that lead to health inequities, concerted action and the application of health equity concepts has not been broadly institutionalized.[259, 332-335] Addressing health inequities will strengthen society's collective ability to withstand future health crises.

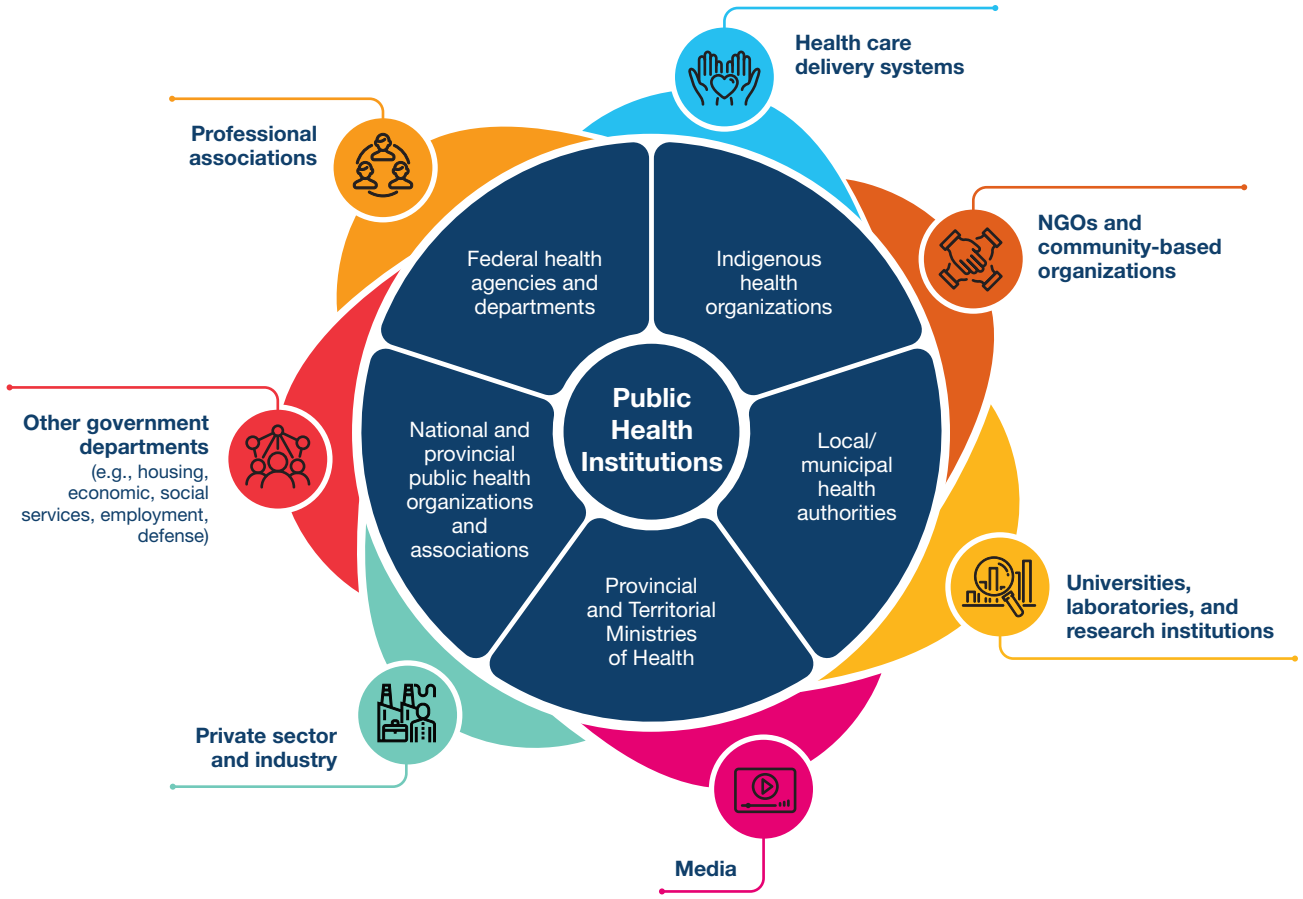
How the Public Health System works in Canada

The Public Health System of Systems

Many organizations, groups, communities, and sectors contribute to improving the health and well-being of populations (Figure 8). Public health institutions form the hub of public health systems.

To serve all communities and populations, public health mandates are spread across jurisdictional public health systems. These comprise Canada's public health system, which itself is part of the country's larger federated and universal health system.[336]

FIGURE 8: Organizations in the Public Health System



Public health is organized differently within Canada's 13 provincial/territorial jurisdictions.[337] There are approximately 80 regional health authorities and municipal or local public health units across the country, depending on the provincial/territorial structure. This is where public health services are delivered directly to local populations.[253] Provincial governments are responsible for coordinating these authorities and units, and among other roles, support overall planning, administer budgets, and provide technical assistance.[253]

At the federal level, the Public Health Agency of Canada (PHAC) provides a national leadership role for public health within the broader Health Portfolio that includes Health Canada, the Canadian Food Inspection Agency, the Canadian Institutes of Health Research, and the Patented Medicine Prices Review Board.[338]

There are also six federally funded National Collaborating Centres for Public Health that serve as knowledge hubs for scientific research and other knowledge to inform public health action.

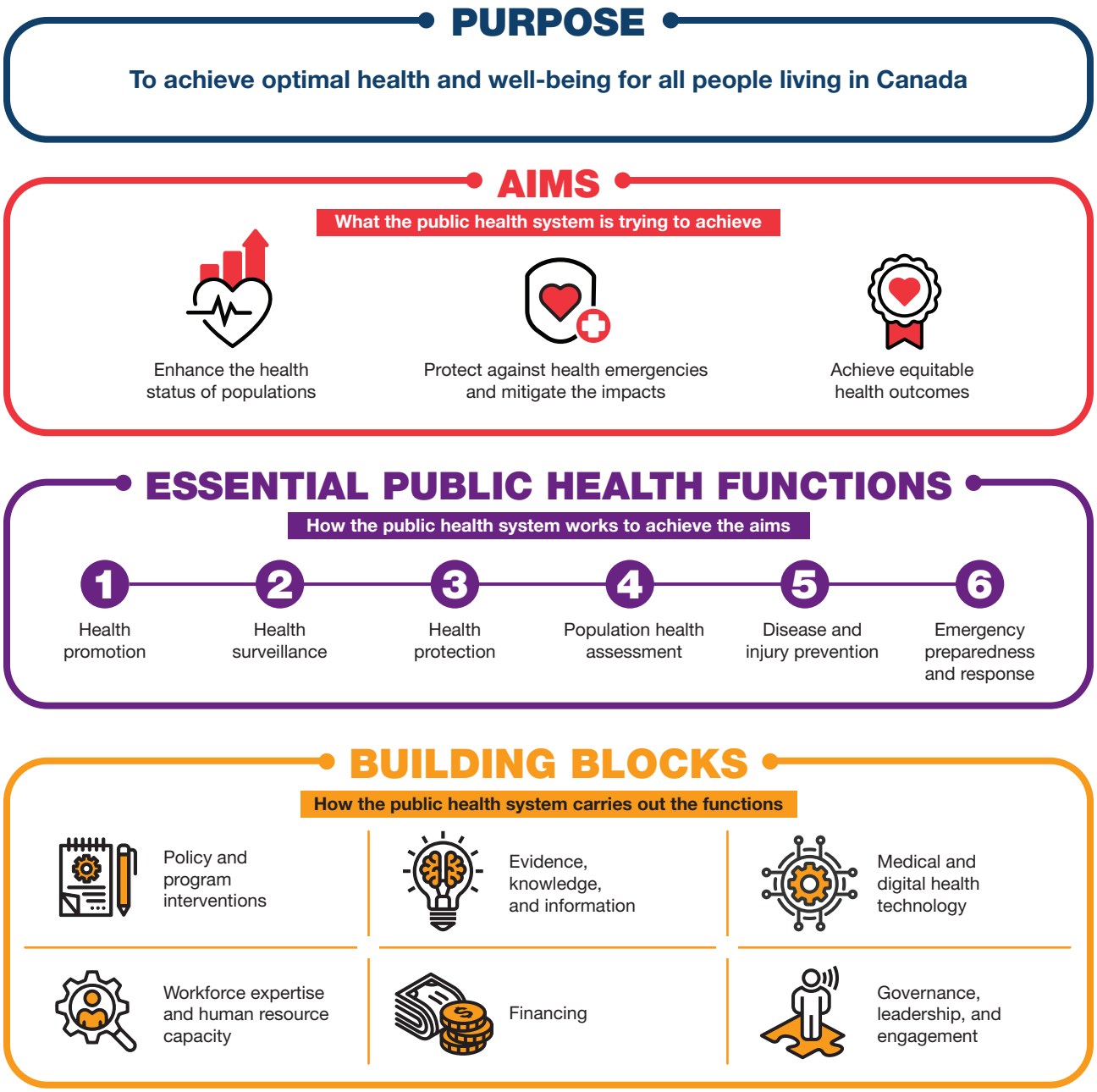
Public health services for First Nations, Inuit, and Métis communities are divided between federal and provincial/territorial governments.[339] Federally, roles and responsibilities are shared across Indigenous Services Canada, Crown-Indigenous Relations and Northern Affairs Canada, and PHAC.[340] Indigenous Services Canada funds or directly provides services, such as primary health care and health promotion programs, for First Nations and Inuit, as well as some funding and services provided for Métis communities.[257, 341] PHAC also supports health initiatives for First Nations, Inuit, and Métis living off-reserve.[340] Provincial and territorial governments complement these efforts in varying

ways. For example, the First Nations Health Authority in British Columbia, which works with First Nations, government partners, and others to improve health outcomes for First Nations Peoples in British Columbia.[342] Additionally, there are national Indigenous organizations, which represent and advocate the interests of First Nations, Inuit, and Métis Peoples across Canada.

The What, Why, and How of the Public Health System in Canada

The overarching purpose of the public health system involves working toward optimal health and well-being for all people in Canada (Figure 9). In support of this purpose are three aims centered on protecting and enhancing the health of populations while achieving equitable health outcomes.

FIGURE 9: The What, Why, and How of the Public Health System in Canada



To accomplish these aims, public health systems in Canada engage in six essential functions that help to organize and unify activities across the systems (Table 4).

Over the past three decades, there have been serious efforts to define and redefine the functions of public health within the wider health system, both in Canada and beyond.[253, 346, 347]

The functions were first developed in 2003 by the National Advisory Committee on Population Health in response to SARS.[343] Describing the functions of public health became a priority as the scope and complexity of public health practice grew considerably over the 20th century.

Public health practice continues to evolve. Given the globalized spread of emerging diseases, the increasing importance of working in collaboration to secure public trust, and the urgent imperative to address systemic inequities in health, there have been global efforts to revisit the essential functions of public health.[344-346]

TABLE 4: Descriptions of Canada's Public Health Functions

Function	Description
1. Health promotion	Working collaboratively with communities and other sectors to understand and improve health through healthy public policy, community-based interventions, public participation, and advocacy or action on determinants of health
2. Health surveillance	Collecting health data to track diseases, the health status of populations, and determinants of health trends, in order to promote health, prevent and reduce the impact of disease, and monitor health inequities
3. Health protection	Protecting the population from infectious disease, environmental threats, and unsafe water, air, and food
4. Population health assessment	Understanding the health of communities, specific populations, and the determinants of health to create better services, policies, and research to identify the most effective interventions
5. Disease and injury prevention	Promoting safe and healthy lifestyles to prevent illness and injury, and reducing risk of infectious disease outbreaks through investigation and preventive measures
6. Emergency prediction, preparedness, and response	Planning for natural or human-made disasters to minimize serious illness and death, and responding to emergencies while minimizing societal disruption

The National Advisory Committee on Population Health originally developed the list of essential public health functions in the wake of SARS. Subsequent reports, including Naylor et al. (2003) and the first CPHO report (2008) reiterated these functions.

In some cases, public health functions are actioned in a clinic or other healthcare delivery setting. For example, hospital networks collect crucial data for *health surveillance*, many primary care networks provide *health protection and promotion* interventions; and, throughout the healthcare delivery system, health education is offered in support of *disease and injury prevention*. These efforts are best accomplished in close collaboration with local public health authorities and communities.

During the COVID-19 pandemic, public health systems activated these functions simultaneously. For example:

1. **Emergency preparedness and response** to coordinate activities across the country, secure vaccine supplies, and create public health guidance and communication tools;
2. **Health surveillance** from first developing technologies to detect SARS-CoV-2 and then data systems to track the spread of the virus;
3. **Health protection** by implementing public health measures to slow the spread of the virus;
4. **Health promotion** to inform and develop policies, programs, and other interventions with communities and other sectors around mental health, food security, economic supports, etc.;
5. **Disease prevention** through vaccination and other interventions to reduce the impact of other illnesses and risk factors that exacerbate the impact of COVID-19 (e.g., mental health, substance use harms); and,
6. **Population health assessment** of the changing strengths, vulnerabilities, and needs of communities due to COVID-19 and public health measures, and rapid synthesis of research on ways to prevent infection and reduce the spread.

Building Blocks of Canada's Public Health System

If the essential public health functions illustrate how public health systems do their work, the building blocks represent how the systems are organized to support these functions (Figure 9).[c, 348] These building blocks are foundational and inherently interrelated.

For example, effective surveillance systems are the cornerstone of a strong *Evidence, knowledge, and information* building block. For those systems to be interoperable and responsive to health emergencies, components and actions are needed from all other building blocks, including: data sharing agreements *(Governance, leadership, and engagement)*; innovative and predictive digital tools and infrastructures *(Medical and digital technology)*; sustainable resources to maintain the technological infrastructure *(Financing)*; expertise to analyze the data *(Workforce expertise and human resource capacity)*; and, input from communities to understand the context of the data and how it could be used to inform interventions *(Policy and program interventions)*.

Building Block 1: Policy and Program Interventions

Population health interventions are policies, programs, services, and strategies that are developed to improve mental and physical health and health equity at the population level.[349] Public health professionals, community organizations, researchers, and other sectors design interventions for entire populations (e.g., all children in all schools) or for priority subgroups (e.g., children attending schools in economically disadvantaged areas). Actions

[c] These building blocks have been adapted for Canada's public health systems from the World Health Organization's (WHO) building blocks for health systems, which are used for monitoring health systems in many countries.

are evidence-informed and can be universal or targeted approaches delivered at the group, community, and/or population level.[350-353]

Because there are no "one-size-fits-all" solutions for addressing complex public health issues, a range of interventions implemented simultaneously are most effective. Public health systems deliver interventions directly to populations (e.g., outreach, vaccination, programming to support communities experiencing marginalization), or indirectly through supporting community and sectoral partners to take action. To implement the right combination of policies and programming, public health professionals require the best available evidence, the right resources, strong partnerships with communities, and the mechanisms to learn and course correct multiple actions in real-time.

Building Block 2: Evidence, Knowledge, and Information

Public health decision-making is informed by evidence from various sources, including research, practitioner experience, and community knowledge.[354-358] Evidence can consist of research findings from different disciplines, community health status reports, data from surveillance and health information systems, insights from communities about their lived experience, evaluation and intervention research, analysis of the policy landscape, and examination of political, social, and economic contexts.

This evidence is assessed and synthesized by researchers, public health professionals, and knowledge hubs, such as the National Collaborating Centres for Public Health.[359] The methods used to obtain and analyze evidence can be quantitative (e.g., surveillance, epidemiological research), qualitative (e.g., interviews, consultations), or a combination of both (e.g., mixed methods used in evaluations and intervention research).

Public health experts critically appraise different pieces of information as they build a picture of the issue under consideration:[355, 360-362]

- Who is affected and where?
- What is the impact?
- What is the context?
- What are the determinants, causes, and risks?
- Which interventions might be most effective?

Other groups outside of public health systems also rely on public health evidence. For example, professionals from the healthcare sector, experts from social and environmental policy sectors, key stakeholders (e.g., community organizations, the public), and population health researchers can all use this evidence and analyses to inform their work or actions.[363]

Building Block 3: Medical and Digital Health Technology

Public health professionals rely on effective medical and health technologies and supplies, a stable and responsive laboratory infrastructure, and innovative digital technologies to identify and respond to health issues. Canada's public health laboratories are a critical part of the country's medical technology ecosystem, providing backbone support for detecting, understanding, and addressing public health threats. For example, the National Microbiology Laboratory focuses on surveillance, diagnostics, applied research (e.g., mathematical modelling, geographic information system mapping), and emergency response services.[364]

Governments across Canada also have systems in place to maintain emergency stockpiles of medical supplies, technologies, and equipment (e.g., personal protective equipment, ventilators, triage and minor treatment clinics).[365] For example, the National Emergency Strategic Stockpile can be accessed at any time to support provincial and territorial responses to emergencies or be pre-positioned to ensure readiness for other public health events.[365]

Public health systems leverage digital information infrastructure and emerging technologies, such as advanced surveillance systems, computing, and artificial intelligence.[239] Canada's event-based surveillance system, the Global Public Health Intelligence Network (GPHIN), uses digital technologies to identify potential public health risks by searching reports, stories, rumours, and other sources of information.[239] Canada also contributes to, and utilizes information from, the Epidemic Intelligence from Open Sources initiative, a collaborative and international effort facilitated by the WHO.[239, 366]

Public health leaders are increasingly relying on digital innovations to support real-time decision-making. This includes the use of open source data, open source code and sharing of data, and novel approaches to modelling, visualization, and communication with the public.[367]

Building Block 4: Workforce Expertise and Human Resource Capacity

The public health workforce is diverse and distributed across different professions, working in all levels of government, the healthcare system, communities, laboratories, and academic settings. These professions include, but are not limited to:

- Public health physicians and nurses
- Health and natural sciences researchers
- Mathematical modellers
- Microbiologists and infectious disease experts
- Policy analysts
- Veterinarians
- Social and behavioural scientists
- Public health inspectors
- Public health dieticians
- Epidemiologists and biostatisticians
- Health promotion specialists
- Community development
- Communications experts
- Elders, traditional healers, and cultural Knowledge Keepers

A diversity of skill sets and disciplinary expertise is vital for ensuring that the public health workforce can respond to the varied and complex challenges in public health.

Since SARS, there has been an emphasis on structuring and building the essential components of Canada's public health workforce. For example, the Joint Task Group on Public Health Human Resources delivered the *Pan-Canadian Framework for Public Health Human Resources Planning (2005)*, setting the stage for the development of the *Core Competencies for Public Health in Canada (2007)*.[368, 369] These initiatives also contributed to the growth of graduate programs in public health schools across Canada.[370]

Building Block 5: Financing

Public health systems in Canada are financed through tax dollars at the federal and provincial/territorial levels, and in some cases municipally.[281, 371, 372] PHAC receives funding directly from the federal health budget. Conditions for federal health funding to provinces and territories are

set by the *Canada Health Act*, which focuses on health care and does not specifically address public health funding.[373] The provinces and territories are responsible for deciding where and how to invest in their public health system. There may also be ad hoc funding arrangements with federal departments, provinces/territories, or nongovernmental organizations to address emerging or pressing population health issues such as COVID-19.[374, 375]

The funding of health services for Indigenous Peoples is an area of shared jurisdiction. Jurisdictional ambiguity has led to fragmentation in funding and governance for public health systems serving Indigenous Peoples in Canada.[340]

Estimating public health funding is difficult and estimates vary, but one approximation suggests that public health spending accounts for just under 6% of total health expenditures in Canada.[376] In contrast, hospitals receive approximately 26% of total heath expenditures, and costs for medications consume 15%.[376]

An economic argument underlines the importance of financial allocations to public health. For example, research demonstrates that investing in public health can have a high return on investment (see text box "Investing in Public Health Generates Significant Long-Term Financial Benefits").[377, 378] In addition, some have argued that investing in strategies to achieve optimal health is imperative to social justice,[d] one that supports a commitment to the well-being of all citizens.[379]

Investing in Public Health Generates Significant Long-Term Financial Benefits

There are many different approaches to calculating the impact of public health interventions. In a systematic review of the return on investment (ROI) of public health interventions in industrialized countries with universal health care, researchers found that, even when considering all caveats, both local and national public health interventions are substantially cost saving:[377]

- The median ROI across all assessed interventions was 14.3, meaning that every dollar invested in public health generated more than 14 dollars in cost savings. This is achieved by preventing additional downstream costs to the health and economic sector. Importantly, public health actions that can effectively target a large part of the population, such as legislative, health protective, or national-level interventions yield the largest ROIs (27.2 – 46.5).
- In contrast to typical healthcare or social service investments, it may take considerable time before the positive impacts of public health interventions are noticeable. Therefore, long-term commitment and planning, rather than short-term political and economic considerations, are essential.

[d] The Ottawa Charter for Health Promotion (1986) sets out fundamental conditions and resources for health. They are peace, shelter, education, food, income, a stable eco-system, sustainable resources, social justice, and equity. These basic prerequisites are foundational to improving health.

Building Block 6: Governance, Leadership, and Engagement

Public health governance refers to the ways in which public, nongovernmental, or private organizations and sectors work together to support communities in preventing disease and achieving optimal health, well-being, and health equity.[380] Governance functions and actions include developing policies and strategies, legislating, stewarding resources, engaging partners and communities, and facilitating continuous improvement. All of these may be formally embedded in institutions or involve informal mutual arrangements.

All levels of government have public health roles and responsibilities and are able to legislate policies that improve the health of populations.[254, 255] Cross-jurisdictional governance involves leveraging networks to facilitate flexible intergovernmental collaboration and coordination in public health. In Canada, the most influential of these is the Pan-Canadian Public Health Network, which was established in the wake of SARS to strengthen and enhance public health policy and practice in Canada.[224, 253] As part of this network, the Special Advisory Committee on COVID-19 (SAC) was activated in 2020 to lead the pan-Canadian pandemic response.

Building Block 1: Policy and Program Interventions

Discussions with public health experts have indicated the need to have a more comprehensive, coordinated, and coherent approach to public health interventions.[381] The complexity of public health issues, combined with variations across populations and contexts, demands purposeful planning of interventions that can have the broadest impact across the determinants of health. Adopting a whole-of-society orientation to public health challenges would support the realization of this goal.[323, 382-384] Community and civil society have an essential role to play, both as partners and originators of local actions to address inequities.[323] To be most effective in this role, communities and the organizations that serve them need the right resources and connections to researchers, public health, and the wider health system.[385, 386]

Amplifying Upstream Action to Address Complex Public Health Issues

Inequitable and disproportionate COVID-19 case burdens and outcomes were a stark reminder of the ongoing need for public health systems to catalyse action on the social determinants of health. The pandemic showed that collective action across sectors is central to achieving optimal health for all Canadians.[5] This requires a comprehensive public health focus on the "causes of the causes", with action targeting structural drivers of health and the circumstances of daily life (see text box "Improving the Health of Populations Requires a Combination of Upstream and Downstream Efforts").[387] This approach would also help to orient action around the determinants of health rather than being confined to siloed disease-centred approaches.[387]

Challenges and Opportunities for Canada's Public Health System

Within the building blocks are key opportunities for strengthening Canada's public health systems, reflecting evolving ideas that have gained further momentum during COVID-19.[7, 253, 258, 259] Although not exhaustive, these opportunities represent important entry points for system-wide conversations about public health transformation. Section 3 provides the conditions required for these opportunities to come to fruition and support a world-class public health system for Canada.

Improving the Health of Populations Requires a Combination of Upstream and Downstream Efforts

The health of populations is shaped by social determinants, which then shape the conditions in which people live.[379] Public health professionals often use the analogy of a river and the relative concepts of "upstream" and "downstream" to describe how these determinants of health influence risk behaviours and health (Figure 10).

FIGURE 10: Continuum of Interventions to Address the Determinants of Health

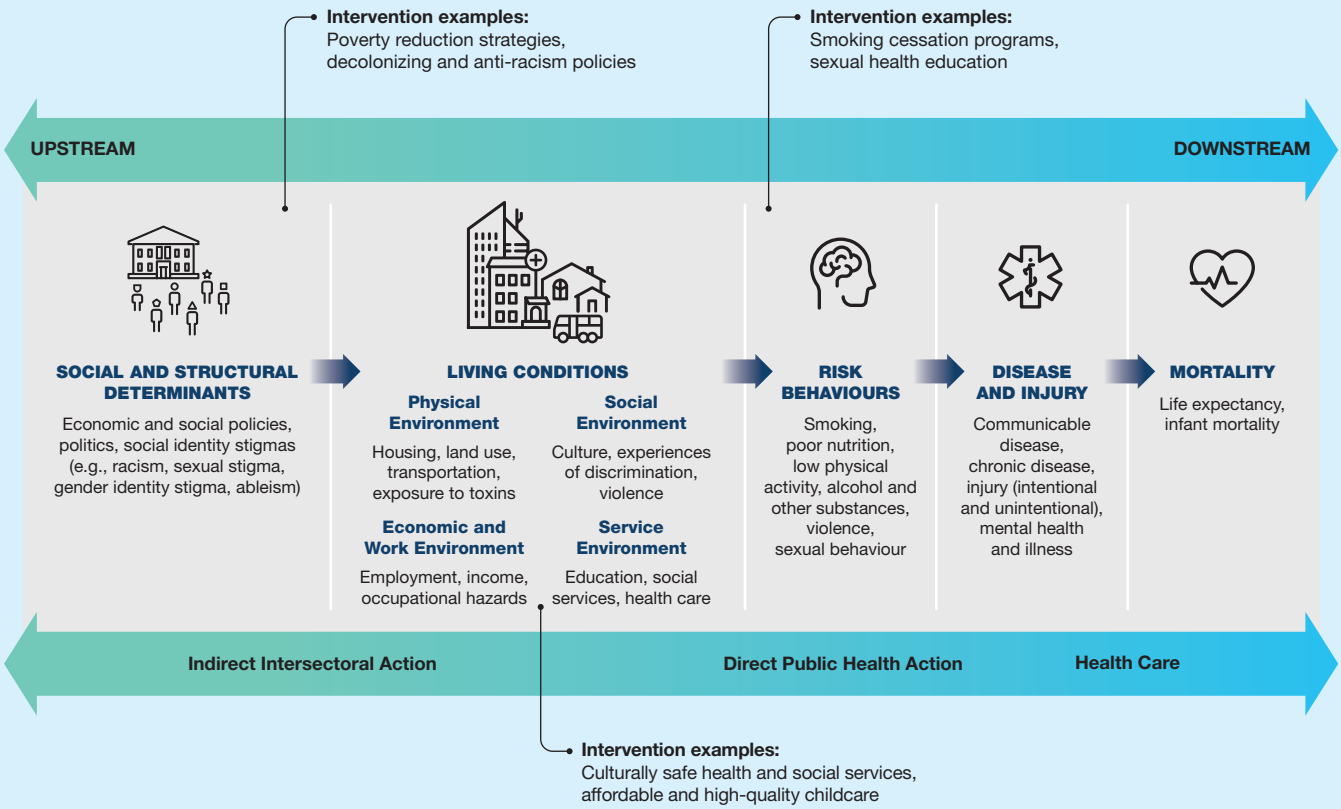


Figure adapted from A Public Health Framework for Reducing Health Inequities: Bay Area Regional Health Inequities Initiative.[388]

This analogy comes from a parable: "A witness sees a person caught in a river current. The witness is able to pull the person from the river, saving them from drowning, only to be drawn to the rescue of more drowning people. After many have been rescued, the witness walks upstream to investigate why so many people have fallen into the river".[389]

Upstream interventions target the social and structural determinants of health (i.e., stopping people from falling into the river in the first place). This means targeting the policies and underlying inequities that shape both the conditions of people's lives and their behaviours. Because these factors influence many other risk factors, addressing them can impact a number of health outcomes at once. This requires public health to provide data, analysis, and knowledge translation to inform and support upstream interventions.

Midstream interventions are aimed at reducing group vulnerabilities and mitigating existing inequities. These vulnerabilities mainly manifest in the environmental and living conditions of people's lives. Again, addressing these for affected groups can impact a number of health outcomes. Public health systems act both directly and indirectly on these issues.

Downstream interventions support people who are already experiencing the health impacts (i.e., helping people after they are caught in the current). These interventions are focused on changing individual behavioural risk factors, building skills, and/or treating the resulting health issue. Public health systems are able to provide direct action in these areas, although they are generally the least influential for broad population-level change.[350, 390]

As public health systems continue to promote and advance upstream solutions, there is a need to clearly articulate their role in intersectoral actions.[350, 391, 392] For example, public health systems often have technical expertise and knowledge that can support other sectors to take action on the social, structural, and environmental determinants of health.[391, 393, 394] However, this requires buy-in from sectors with the mandate to act on these determinants (e.g., housing, employment, and education).[350, 391, 392, 395]

Discussions with stakeholders during the development of this report echoed the importance of public health systems providing support to other sectors and the need for solidified mechanisms to encourage intersectoral collaboration.[381] There are several examples currently gaining momentum internationally and in Canada. First, health impact or equity assessments (HIA) are tools that other sectors can use to identify and consider the health and equity consequences of projects, programs, or policies.[396-399] Second, the collective impact approach recognizes that complex social and public health problems require coordinated efforts with common goals and mutually reinforcing actions across sectors.[400, 401] The collective impact framework offers concrete ways to promote and implement shared accountability across participating organizations.[400]

The right combination of interventions can effectively address the range of upstream, midstream, and downstream determinants of health. However, there are many challenges in identifying which actions are the most impactful and amendable to scaling across disease areas, populations, and contexts.[267, 402-405] Applied public health research offers important insights into the sustainability, equity, and effectiveness of public health interventions.[406] Work in this field could be strengthened by prioritizing policy-relevant research and working with practitioners to identify practical translations of research knowledge about interventions into public health action.[406]

Mobilizing Community Involvement in Public Health Decision-Making

Community involvement is central to both health equity and building a resilient public health system.[386] Community-based organizations improve the health of their populations in multiple ways, by mobilizing and empowering local communities to take action, as well as providing health and social services to meet immediate needs.[386, 407] Such organizations are also well-positioned to inform public health interventions, given their close connection to community members, community governance structures, and nimble networks.[324] Working with the public health system, communities can be partners in public health decisions, improve access to and relevance of services, and act as important on-the-ground mobilizers for public health interventions during health emergencies.[230, 408-412]

There are many examples of strong and effective partnerships between communities and public health organizations across Canada; this was particularly apparent during the COVID-19 pandemic.[386] Immediate opportunities exist to better integrate community involvement and action equitably into public health interventions. Text box "Community Leadership and COVID-19 in Toronto" offers one example. Other specific examples from the pandemic include the coalitions and voluntary organizations that worked closely with public health systems, such as the South Asian Health Network,[413] the Black Scientists Task Force on Vaccine Equity,[414] and Inclusion Nova Scotia.[415]

Key ways to support communities in their population health efforts include providing stable and ongoing resources, supporting community self-determination, focusing on equitable engagement and power sharing, building trust, co-developing processes and initiatives, and evaluating the nature and impacts of engagement.[409, 416, 417]

The opportunity exists to build on the synergistic relationship between communities, local public health systems, and primary care services, though there is noticeable variability across provincial and territorial healthcare systems. Comprehensive primary healthcare models emphasize this synergy and offer a way to consider the coordination of public health practice at the community level.[386] Local public health systems have an important role to play in bridging the expertise from this triad relationship into broader federal, provincial, and territorial tables on program and policy design.

Community Leadership and COVID-19 in Toronto

Community-led actions in response to COVID-19 emerged early in the pandemic response. Over time, both the city and province learned from these approaches and resourced community organizations directly for their leadership role in advising and carrying out trusted responses.[418] COVID-19 community ambassadors – multilingual, local, and trusted leaders – were recruited and trained to engage with the community, provide information, and connect members with vaccination options.[419] Resources were focused on supporting populations disproportionately impacted by the pandemic, including Black and Latin Canadian/Hispanic Torontonians, LGBTQ2+ communities, people experiencing homelessness, people with disabilities, seniors, South Asian, Southeast Asian and West Asian Torontonians, undocumented persons, and youth. Furthermore, Indigenous-led approaches brought culturally safe and accessible vaccination and testing services to communities across the city.[420]

For First Nations, Inuit, and Métis communities, effective engagement for interventions is rooted in self-determination and cultural safety. Indigenous public health leadership, robust engagement, co-creation of interventions, and culturally relevant evaluations will maximize the effectiveness of public health interventions.[421] Particularly important are culturally safe processes for engagement that recognize and address power dynamics in the health system.[147, 285, 422-424] Implementing these processes requires mutual trust, the elimination of bias and discrimination, systemic validation of Indigenous ways of knowing, self-reflection for non-Indigenous partners, and cultural humility.[147, 285, 422-425] With this approach, public health relationships and environments can be spiritually, socially, and emotionally safe for First Nations, Inuit, and Métis communities.[426]

Building Block 2: Evidence, Knowledge, and Information

Public health systems require high-quality and accessible evidence, supported by adaptable information ecosystems and processes. When these systems are in place, real-time decision-making and continuous improvements are possible (see text box "A Culture of Learning").

The knowledge needed to guide public health system actions, however, cannot come from the system alone. To be both effective and equitable, evidence-informed decision-making requires greater focus on the experiences and perspectives of diverse populations and increased use of various methodological approaches. This includes communities that have been historically excluded in Canada, such as First Nations, Inuit, and Métis Peoples, racialized groups, LGBTQ2+, older adults, and people living with disabilities.

A Culture of Learning

A learning health system uses data to identify and respond to health issues in a continuous manner, with the goal of improving care and reducing cost. Learning health systems do this by connecting data and research for learning, improvement, and innovation.[427, 428] Originally focused on health care, learning health systems can be adapted to address public health considerations in pursuit of population health outcomes.[427] This would require greater connections between the public health system, the health system, evolving research and evidence, communities, and ongoing, conscious efforts to embed an equity focus.[427, 429]

Building an Interoperable Data and Information Ecosystem to Support Decision-Making

> *Surveillance and monitoring is one of the core public health functions. It's our lab test, our physical exam, our way of keeping pulse on the community.*
> *– Discussion group participant*

The first step for understanding any public health issue, and a prerequisite for public health decision-making, is information on the health status, health risks, and determinants of health for the population of interest and key sub-groups.[363] Canada uses a range of indicator- and event-based surveillance systems to systematically capture and analyze data on a range of public health issues, such as infectious and chronic diseases, the opioid overdose crisis, and mental health.[430]

These information systems are crucially important to guide decisions and inform evidence-based practice. However, the national data landscape is fragmented across jurisdictions, governmental organizations, and community-level data owners. Multiple independent data systems and frameworks have evolved over time, but have limited capacities to allow for standardized data collection, sharing across systems, and broader synthesis of information.[207] These issues limit the utility of existing data systems to support public health decision-making.[7]

This fragmentation, alongside outdated technology, has especially pronounced consequences during

health emergencies when access to data for real-time decision-making is paramount.[206, 207, 253] Delays in getting the right information can hinder important public health surveillance goals early in a pandemic, such as detecting the virus and understanding how it spreads.[206]

Due to these historical and ongoing challenges, there have been numerous reviews and calls for reforms.[206, 334, 431, 432] Learning from previous attempts to reform national health data systems identified systemic barriers, such as lack of trust and clear accountabilities between data owners and users, limited public interest or involvement, differing policy goals, and a failure to "spread and scale excellence".[207, 433]

> *"There is data we don't collect, data we collect and don't share, data we share and use poorly, data we use to oppress and stigmatize, and data we have but don't use to address issues."*
> *– Best Brains Exchange participant*

COVID-19 underscored the need for effective processes around epidemiological, biomedical, and clinical data linkages. Interoperable data, information systems, and processes would support this cross-system data flow and analysis. It is important to recognize that "interoperability" does not imply one centralized system, but rather a cooperative ecosystem that honours data ownership.[207] Common goals and a shared understanding of data requirements and roles for all system partners are needed.[207] This also includes appropriate processes to ensure that data are collected, stored, processed, and used in ways that are culturally safe, as well as mechanisms to protect personal information.[434-436]

Innovative technology and analytic capacity are both necessary for this work. Interconnected data, large data sets, and complex databases require public health professionals with specialized skills in data analysis and training in health informatics.[7, 431, 437 438] The ideal technical infrastructure would be fit-for-purpose to meet data collection and management needs, and include mechanisms to network across systems.[439] Open-source data sharing in the form of innovative data platforms can help to fill gaps in current surveillance systems in relation to real-time decision-making.[367] However, many of the data systems used by public health professionals in Canada are currently outdated or offer limited functionalities.[437]

Federal, provincial, and territorial governments, alongside First Nations, Inuit, and Métis groups and key stakeholders, are co-developing a Pan-Canadian Health Data Strategy to strengthen health data foundations for better decision-making. It will take time to develop this strategy, and it is not expected to be implemented prior to 2030.[207] Therefore, more immediate actions are needed to strengthen data systems before the next crisis, for example, building on some of the short-term solutions implemented during the pandemic.[14] For instance, PHAC invested in long-term digital transformation through VaccineConnect, a digital vaccine management platform that addresses the immediate need to manage COVID-19 vaccine distribution, tracking, and administration.[440] Through its agile and scalable approach, VaccineConnect is adaptable to various operational needs and provides the foundation for future uses to meet evolving health priorities post pandemic.

Broadening the Knowledge Base for Public Health Systems

Qualitative and mixed-methods research approaches and the resulting evidence have been underutilized in public health.[441] Qualitative inquiry can help researchers explore the social aspects of health and illness, such as why people behave in certain ways and how they

understand or make sense of their experiences.[441-443] These qualitative questions add depth and context to epidemiological models and provide insights that help inform the development of interventions.[441-443] For example, qualitative methods can provide important insight into the social, cultural, and political aspects of a pandemic by helping public health professionals understand what drives risk, what influences adherence to public health measures, which unintended consequences might arise from public health actions, and how to better create community buy-in for public health initiatives.[443, 444] Further, while evidence-informed approaches in public health have historically been guided by Western science-based principles, these do not adequately include the knowledge and realities of all people living in Canada.[434, 445, 446] For example, Indigenous ways of knowing, such as oral histories and storytelling, have often been unacknowledged or undervalued.[421]

For quantitative evidence, the lack of disaggregated data, such as by race, ethnicity, sexual orientation, income, education, and gender identity has been an ongoing challenge for public health practitioners and communities.[210, 306, 334, 447] Without these data, the differential impacts across populations cannot be measured, and inequities are more likely to be remain unaddressed.[210, 306, 334] In Canada, there have been challenges to linking or pooling individual-level data, which has hindered research on these areas.[437] Similarly, core population health data sources have inconsistent approaches to identifying Indigenous Peoples across jurisdictions, and some provinces do not collect these type of data at all.[448-450]

These gaps are not just a technical issue, but also an equity issue. For decades, communities have advocated for approaches to data governance that are inclusive of community interests and redress power imbalances around data ownership.[451] Some examples of community-determined principles for data sovereignty are offered in text box "Indigenous Data Sovereignty Principles: First Nations Principles of OCAP, the Inuit Quaujimajayuquangit, and the Métis OCAS Principles." Additionally, the Black Health Equity Working Group in Ontario has released an engagement, governance, access, and protection framework for data collection, use, and stewardship.[434] Broader calls for equity-oriented data have echoed the importance of community involvement in these processes and subsequent public health action.[208, 447]

Indigenous Data Sovereignty Principles: First Nations Principles of OCAP, the Inuit Quaujimajayuquangit, and the Métis OCAS Principles

The First Nations Principles of OCAP

First Nations have a long history of collecting, using, and governing the information needed to make decisions related to health and well-being. The First Nations ownership, control, access, and possession (OCAP) principles are the standard approach to First Nations data governance and support data sovereignty.[435, 452] Given the diversity within and across Nations, expression of the principles may be asserted differently from one Nation to another, in line with world view, traditional knowledge, and protocols.[435]

The Inuit Quaujimajayuquangit

The Inuit Quaujimajayuquangit (IQ) framework represents the Indigenous knowledge of the Inuit. IQ is based on four elements: working for the common good, respecting all living things, maintaining harmony and balance, and continually planning and preparing for the future.[453] This approach forms the foundation for well-being in Inuit communities, as does the valuing, preserving, and promoting of traditional knowledge.[453]

The Manitoba Métis Principles of OCAS

Métis health information should be collected in accordance with the ownership, control, access, and stewardship (OCAS) principles, and under the ownership and control of the Métis Nation.[421] The Métis National Council supports knowledge translation agreements with federal, provincial, and territorial governments towards evidence-based interventions that benefit Métis health and well-being.[421]

Enhancing the Research-Practice Interface

Research is essential to effective public health practice.[454] However, there are gaps in this interface, between the context in which research is done and the local needs and resources of the setting in which it is applied. As a result, evidence may not be translated into the settings where it could do the most good.[454, 455]

The COVID-19 pandemic illustrated the need for rapid generation and synthesis of emerging knowledge. Closer and adaptable relationships between public health agencies, institutes, and academic institutions could lead to more solutions-driven research outcomes to directly inform public health decisions.[456] Initiatives such as the COVID-END and CanCOVID research networks were created to synthesize evolving evidence during the COVID-19 pandemic (see text box "Rapidly Changing Evidence Led to Innovative Academic-Practice Partnerships" in first section for more information).[227, 228] These may serve as models for future research-practice networks. Applied public health research is also key to supporting connections between public health research and practice. For example, the Applied Public Health Chair program – a collaboration between the Canadian Institutes of Health Research (CIHR) and PHAC – builds links between researchers and decision-makers to help support evidence-informed decision-making that improves health and health equity.[457] Continuation of this model will help ensure that applied public health research remains responsive to public health practice in Canada.

Additional areas for attention include arrangements for surge capacity during crises, collaboration on public health systems research, and public health-academic partnerships for education and training.[456, 458, 459] For the latter, student training and professional development could be aligned with priority competency areas, including equity, Indigenous health, ecological determinants of health, and leadership.[456]

If Canada is to have an exceptional public health evidence base, ongoing knowledge exchange and established arrangements between public health organizations and a range of disciplines (e.g., social science, geography, economics) must be prioritized. Interdisciplinary collaborations are particularly important for understanding and responding to the complex, layered, and interconnected determinants of health.[460-464] For example, social scientists examined the social, political, and economic factors that have influenced the COVID-19 crisis and public health response.[465]

Building Block 3: Medical and Digital Health Technology

A well-functioning health system is able to use a range of tools to support equitable access and distribution of medical products, vaccines, and technology.[466] This includes the manufacturing, procurement, supply, and storage of essential medicines, medical supplies, and other resources.[466] It also includes infrastructure, such as public health laboratories that provide critical support for detecting, understanding, and responding to new and ongoing public health threats. As the public health system learns from past and present challenges, innovative tools and processes evolve to meet the needs of populations.

As society becomes increasingly accustomed to digital solutions, aligning objectives and evaluating innovations will be important for successfully harnessing digital opportunities and technological advancements across jurisdictions.[367, 467]

Strengthening Early Warning Systems

Early warning systems identify signals of potential public health threats to support rapid response and mitigate public health impact.[239, 468] Such systems are a key part of broader surveillance systems, drawing from a number of sources, such as media, social networks, and information on animal health and environmental disasters.[468] Their operation requires the right expertise, structures, and technology. An independent review of Canada's event-based surveillance system (i.e., GPHIN) in 2021 suggested strengthening these components.[239] Expertise and structures could be improved by clarifying the role of event-based surveillance in broader surveillance and risk assessment frameworks, and improving consultation and coordination with subject matter experts, including data-modelling specialists.[239] Academic and private sector partners also have a role, including providing additional support to refine artificial intelligence algorithms for event-based surveillance.[239]

Given the international nature of public health, this work cannot be undertaken by any country alone. Global efforts to improve event-based surveillance are ongoing, and Canada can continue to contribute and learn through alignment and collaboration.[239]

Supporting Innovation in the Health Technology and Supplies Infrastructure

The COVID-19 pandemic reiterated the crucial role of testing in controlling infectious disease outbreaks and guiding public health decisions. Therefore, efforts are needed to strengthen Canada's public health laboratories.[469] During the pandemic, laboratories rapidly pivoted to support the COVID-19 response by implementing new testing protocols for SARS-CoV-2, increasing human resources capacity, and sourcing additional equipment, all in the context of high global demand for critical testing supplies.[469, 470]

The Canadian COVID-19 Genomics Network (CanCOGen) is an example of one of the innovative partnerships created during the pandemic to strengthen virus- and host- sequencing capacities in support of time-sensitive pandemic decision-making. Through CanCOGen, the Government of Canada's National Microbiology Laboratory, Genome Canada, regional public

health laboratories, healthcare partners, and academic researchers worked together to coordinate large-scale viral sequencing and epidemiological data collection of SARS-CoV-2 samples.[471, 472] These efforts support rapid learning and improved tracking of how the virus mutates and spreads, offering key insights on transmission trends that could impact viral detection or the effectiveness of treatments and vaccines.[472]

Additionally, researchers at the British Columbia Centre for Disease Control's Public Health Laboratory, in partnership with public and private laboratories across the province, combined large-scale genome sequencing with epidemiological analysis to successfully monitor the spread and evolution of virus variants of concern in vaccinated and unvaccinated populations.[473] This study demonstrated the value of innovative, cross-disciplinary, and integrative approaches by providing accurate, timely, and local data to inform public health interventions. Local tracking of virus variant transmission patterns also support national and global learning efforts, enhancing efficacy of counter measures.[474, 475] This further underlines the importance of building sufficient capacity and infrastructure to support complex analyses.

The pandemic also highlighted an opportunity to improve the efficiency of vaccine delivery systems. Despite a relatively slower start compared to some benchmark countries, Canada quickly achieved high vaccination rates once vaccine shipments accelerated.[476, 477] Moving forward, general vaccine delivery processes could be strengthened by improved coordination and collaboration, as well as greater innovation in supportive digital infrastructure and workforce integration. Digital advances that support tracking of real-time vaccine supply and use may facilitate greater precision in distribution and minimize product waste.[478]

During COVID-19, many countries, including Canada, were not well-prepared for the sudden and high demand for personal protective equipment and medical devices, including test swabs and ventilators.[244] Identifying, authorizing, and procuring the necessary supplies required the Government of Canada to revise existing procurement approaches, including changing supplier and quality assurance policies or processes, and quickly mobilizing resources for purchase.[244] Through these adaptations, national investment, re-tooling, and bulk purchasing, Canada was able to increase supplies of personal protective equipment in the national stockpile and help bolster provincial and territorial inventories of medical devices.[244] Strategies to better monitor and manage emergency stockpiles, within clearly defined roles and responsibilities across jurisdictions, would improve preparedness and ensure the relevance and reliability of supplies.[244]

Leveraging Digital Health Technologies

A number of digital health technologies were used in Canada, and globally, in response to the COVID-19 pandemic (see text box "Vaccine Hunters Canada: Digital Innovation from the Ground Up"). Some were extensions of pre-existing approaches, like technology-based solutions to counter the online infodemic. For example, Google's SOS alert prioritized the WHO and other trusted public health sources in search results, and the WHO's machine learning chatbot was launched on social media platforms like Facebook to combat mis- and disinformation around COVID-19.[367, 479, 480] Others were more novel, such as the use of anonymous cellphone mobility data to understand adherence to local public health measures and digital exposure notification (e.g., COVID Alert app).[367, 481-483] These advances are notable, as public health has generally been slow to leverage digital innovations.[367] Evaluation of such apps, along with other public health measures, could yield important insights to support more successful adoption of these tools. Particularly in support of technological innovations around climate change, which are rapidly emerging to support public health, including ClimateData.ca and HealthADAPT.[484, 485]

These rapidly implemented digital health initiatives require evaluation and adequate consideration of legal, ethical, and privacy concerns.[367, 482, 486, 487] It is also important to ensure attention to potential inequities associated with using technology, such as artificial intelligence in public health, which is susceptible to issues caused by algorithmic bias and a lack of data diversity.[488-490] Moving forward, concerns of inequitable access to technology must also be addressed for these innovations to be meaningful in public health.[367, 467]

Where appropriate, successful initiatives could be integrated into broader public health systems and infrastructure,[367, 467] such as VaccineConnect, which will remain a critical tool for managing other vaccination programs. Other examples, including technological advances such as big data, machine learning, and artificial intelligence, could support the development of public health learning systems.[367, 427, 491, 492] This would help ensure that technologies remain a tool for public health, rather than a focus in and of themselves.[367]

Vaccine Hunters Canada: Digital Innovation from the Ground Up

In March 2021, volunteers committed to helping Canadians get vaccinated against COVID-19 formed Vaccine Hunters Canada. They had over 40,000 members and dozens of active volunteers across multiple social media platforms.[493]

Using digital tools to crowdsource vaccine availability, personalized support from volunteers, and accounts on Twitter, Facebook, Instagram, TikTok, Snapchat, and Discord, Vaccine Hunters Canada helped Canadians all over the country understand vaccine eligibility and find available vaccination appointments.[493]

In June 2021, Vaccine Hunters Canada launched Find Your Immunization (FYI), a new website that connects users to appointments, based on their postal code and vaccine eligibility, across a range of vaccination service sites. FYI was available in 22 languages, and as of the time of report writing, had over two million unique users.[494]

Prior to shifting to fully automated support in August 2021, Vaccine Hunters Canada announced that the open source FYI platform would be available to any country free of charge, for customizable and multilingual use.[495]

Building Block 4: Workforce Expertise and Human Resource Capacity

The public health system requires a well-trained, interdisciplinary, and sustainable public health workforce to meet the increasingly complex challenges and threats to the health of populations. The workforce must be equipped with the competencies for carrying out essential functions, in addition to mastering increasingly important skills for working across sectors and influencing public policies that address the determinants of health.[368, 456, 496]

After SARS, numerous initiatives were developed to bolster the public health workforce and develop public health expertise across organizations.[253, 369, 370, 372] Some initiatives continued, such as university graduate programs in public health, while others

stagnated or stopped.[258, 456] The COVID-19 pandemic revealed the ongoing and critical need to better support the people who protect the public's health.

Growing and Supporting the Public Health Workforce

During a health emergency, public health systems need workers who have the right training, experience, and specialized expertise. The COVID-19 pandemic amplified challenges in these areas, including system-level gaps in public health and medical expertise, emergency management, risk communications, policy and planning, and operations.[218]

COVID-19 added strain on public health professionals with in-demand expertise.[218, 470] For example, input from public health experts indicated that case managers, who were often nurses, could be pulled away from public health work to treat patients when COVID-19 case numbers rose. Such capacity issues had a number of potential consequences for public health systems, including testing delays, challenges following through with contact tracing, quality of communication products, operation challenges, and difficulties mobilizing a long-term response.[218, 243, 497] To meet these competing demands, the public health workforce must be supported by enough human resources for backup and interoperability.[498]

Workforce diversity is also essential to a well-functioning public health system and supports greater innovation in public health.[447, 499-501] Diversity and inclusion can be nurtured through initiatives such as recruitment drives for underrepresented staff, professional mentorship programs, projects to improve workplace equity, and effective processes for reporting discrimination.[499, 502]

As has been noted among healthcare workers and in international research, the pandemic impacted the mental health and well-being of the public health workforce.[503, 504] While there are research gaps on this issue in Canada, government reviews have highlighted the long hours and stress experienced by public health and emergency management staff, as well as numerous media reports of harassment and threats against public health officials and workers.[218, 505] Staff turnover and burnout among workers and experts is a very real threat to the stability of public health systems and their ability to respond to health emergencies.[506]

As noted in discussions with stakeholders, these issues were compounded by a lack of data about the number, structure, skills, and racialized and Indigenous identities of workers in public health systems, including where to find qualified personnel to perform tasks like testing and contact tracing.[381] Differences in the organization of public health structures across Canada, as well as the breadth and depth of public health practice, make it difficult to track and evaluate the nature and extent of the workforce.[252, 258] These infrastructure and data gaps hinder workforce planning and preparation efforts across federal, provincial/territorial, and municipal public health systems.[381, 507] The absence of demographic data also impedes tracking of the public health workforce against the recommendations from the Truth and Reconciliation Commission of Canada and employment equity commitments.[381]

Public health workforce capacity is an urgent area for attention given the continued burden of COVID-19 on the public health workforce and the risk of concurrent public health crises.

Strengthening Core Competencies and Scientific Expertise

Public health is a specific field of practice, and the number and variety of competencies required underlines the importance of comprehensive training and a correspondingly prepared workforce.[368] Core competencies encompass the interdisciplinary knowledge, skills, and attitudes essential to public health practice. Current competency areas include public health science, data

assessment and analysis, policy and program planning, intervention implementation and evaluation, collaboration and partnerships, advocacy, diversity and inclusiveness, communication, and leadership.[368]

Ongoing calls to clarify, and possibly expand public health competencies and/or expertise, reflect how the practice of public health has evolved and learned from health emergencies. For example, additional or enhanced competencies could include those related to working in complex government systems, collaboration for intersectoral action, healthy public policy-making, social and racial equity, ecological determinants linked to climate change, community engagement, and Indigenous health.[252, 409, 456, 496, 508-518]

Since the onset of the pandemic, additional priorities have emerged. These include navigating and communicating within an infodemic, countering mis- and disinformation, crisis communication, working within a context of uncertainty, advanced understanding and use of data and analysis technologies, risk assessment and management, priority setting, and resource allocation.[239, 519, 520] Examples of important leadership level competencies are leadership across disciplines and in the political sphere, tailoring communication to target audience, situational awareness, and decisiveness with flexibility.[511, 521] Skills in risk management and decision-making in complex environments are also important for advanced practice and leadership.[456]

Building Block 5: Financing

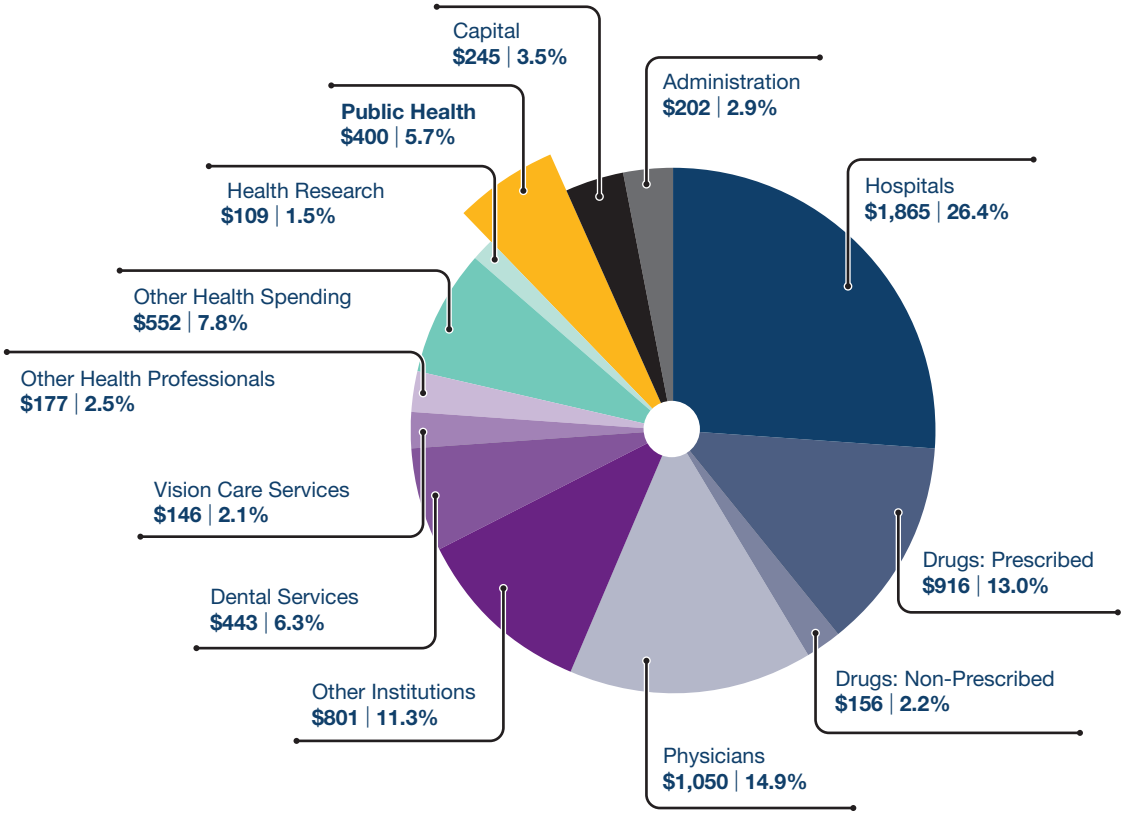
Sufficient financing is essential for health systems to maintain and improve population health and well-being.[466, 516] Public health systems require resources not only to fulfill essential public health functions, but also to work effectively with other sectors to address determinants of health. Resourcing has to be "right-sized" to ensure that public health systems can be nimble enough to respond when needed.[253] This is especially important given that emerging and concurrent health crises are expected to rise due to influencing factors, such as climate change and the loss of natural habitat.[522]

With the breadth of the work and the ongoing need to build dynamic surge capacity, public health systems need stable and dedicated resources.[521] However, it is unclear what an appropriately financed system should look like in Canada. This requires knowing how much is spent on public health, for which activities, and to what end.

Investing in the Public Health System to Match the Mandate

Despite its broad mandate, the public health system has historically had only a small share of total health spending. Estimating public health funding is difficult and there are multiple methods to do so. One assessment from the Canadian Institute of Health Information suggests that just under six percent of all annual health spending was allocated to public health systems prior to the pandemic (Figure 11).[376] Variations in how these percentages are calculated make comparisons across jurisdictions difficult. Nonetheless, funding for public health activities has been estimated to be as low as one percent of some provincial health budgets.[523, 524]

FIGURE 11: Total health expenditure per capita by health spending category, Canada, 2019 (dollars and percentage share)



Source: *Canadian Institute for Health Information, National Health Expenditure Trends.*[376]

There are several methodological issues with these estimates. The diversity and range of activities carried out by public health systems makes it difficult to separate the work of public health from other social service and healthcare activities. Additionally, standardized definitions for public health activities across the country are lacking.[373] Resulting inconsistencies lead to jurisdictional variations in how public health spending is calculated.[523] Therefore, clear limitations in reporting on, and measuring the effectiveness of, public health investments across Canada exist.[373, 523] These gaps must be urgently addressed, but methodological challenges should not impede efforts to infuse public health systems in Canada with the financial resources needed to execute the essential work of protecting populations.

Despite the difficulty in capturing reliable estimates, evidence indicates that public health funding in Canada may be insufficient and vulnerable to cuts, including previous reductions in several provincial public health budgets.[258, 373, 459, 523, 524] These funding reductions are felt particularly strongly at the local level.[252] If these trends continue, considerable additional downstream costs are likely to occur for the healthcare system and the broader economy.[377]

> *The danger is that we will have current interest (in public health) because it is pandemic related, but we have been through several cycles. Panic, and then people forget about public health. Once [COVID-19] disappears, newer political priorities and a backlog of surgeries will take over and we will shift back to investing in treatment and underinvesting in prevention."* – *Discussion group participant*

Another challenge is that funding tends to fluctuate according to health crises and election cycles, yet the aims and mandates of public health extend long beyond these timelines.[253, 459, 525] Determining how to best fund public health systems to match the scope and long-term mandate requires a shared commitment to the core functions of public health, as well as a strengthened evidence base and common understanding on how to effectively apply them.[373, 523]

It is also important to have flexible funding models and sustainable long-term actions to strengthen the public health system in a way that supports self-determination among First Nations, Inuit, and Métis communities. This would minimize jurisdictional fragmentation and increase community control over health program design and delivery.[340, 526, 527] Going in such direction also aligns the public health system with the *National Inquiry on Missing and Murdered Indigenous Women and Girls' Call for Justice* no. 3.2.[286]

Building Block 6: Governance, Leadership, and Engagement

Effective governance requires a clear vision, clarity on the authorities, mandate, roles, and essential functions of public health. Adequate and sustainable resources and capacity are necessary to enable this work. For public health governance to be equitable, commitment to core values of anti-colonialism, diversity and inclusion, transparency, and accountability will be required.[380]

Successful governance is resilient, adaptive, and built on competent leadership.[380] It also relies on the coordinated and collective action of government and other actors, including collaborations across jurisdictions within the public health system, shared expertise at the international level, supporting First Nations, Inuit, and Métis Peoples in self-determination and self-governance, partnerships with other sectors, and community leadership at public health governance tables.[384, 394, 528-531]

Strengthening Coherence across Public Health Systems

The decentralized governance structure of the health system in Canada allows for public health actions to be guided by regional and local contexts and needs. However, coordination, collaboration and regular accountability across the system and to decision-makers, including federal, provincial, territorial, and Indigenous partners, is vital for a well-functioning, strategic, and cohesive public health system. This was seen during the COVID-19 response, when pan-Canadian approaches were balanced with flexible, customized measures at provincial and territorial levels.[14] The complex multi-jurisdictional governance of public health in Canada can make it difficult to understand roles and responsibilities at different levels, sometimes resulting in confusion, inconsistencies, and gaps.[258, 373, 380] Governance for public health and leadership for intersectoral action to address specific public health challenges (e.g., AMR) add additional complexities.[380]

Governance mechanisms to improve collaboration across public health systems include pan-Canadian frameworks, strategies, or legislative acts. The *Canada Health Act* outlines shared principles, criteria, and conditions that the provinces and territories must meet to receive federal funds for healthcare services. The Act provides accountability to ensure that eligible residents of Canada have access to publicly funded health services.[532] However, unlike the *Canada Health Act* for health care, a formal legal structure with public health accountabilities for residents in Canada does not exist.

Some have argued that the lack of a legislated anchor for the public health system has prevented a consistent and coordinated approach to public health across Canada.[7] Other public health experts have noted that cross-jurisdictional discussions on shared roles, goals, and values have taken years without any final decisions or commitments.[381] For example, after SARS, the provincial and territorial Ministers of Health agreed on a set of public health goals for improving the health of Canadians, but this was not translated into defined accountabilities.[533]

> *"We need prolonged sustained commitment to the public health agenda that doesn't swing widely."*
> *– Discussion group participant*

On the international front, Canada has a long history of collaborating with other countries and multi-lateral organizations to address global health challenges (see text box "Global Solutions to Global Public Health Challenges"). Collaborative efforts were intensified during COVID-19 as the virus quickly transcended international borders.[534] This global spread reflects the reality of public health risks in today's world and has given the international community a preview of future challenges to global health security. It has also reaffirmed the need to strengthen these collaborative efforts and look beyond borders when planning for, and responding to, global emergencies.[535] Information sharing around research, knowledge, and experiences also helps the global health system learn faster and respond smarter.[536]

Global Solutions to Global Public Health Challenges

International Health Regulations

After SARS, the global health community came together to strengthen systems of cooperation. In 2005, the WHO and its member states adopted new International Health Regulations that detail the legal responsibilities of each country for major public health events, as well as systems for accountability.[537] In 2007, the *International Health Regulations* came into effect, requiring signatory countries to build and maintain the capacity to detect, assess, report, and respond to public health events.[537] It emphasized an increased focus on surveillance, informed in part by the use of the GPHIN during the 2003 SARS outbreak.[239] The structure and outputs of GPHIN were used by several countries to inform expansions to their own event-based surveillance systems.[538] Reviewing and adapting these processes to incorporate the lessons of the COVID-19 pandemic will help ensure improved readiness at global and national levels.[535]

The WHO Hub for Pandemic and Epidemic Intelligence

A 2021 WHO initiative has taken a visionary approach to fostering global cooperation and shared solutions for addressing pandemic risks. This hub leverages the WHO's unique convening role to bring together expertise and resources from nearly 200 member states.[539] Funded by the Government of Germany, the WHO Hub will use a collaborative intelligence approach to improve data and analytics and support pandemic-related decision-making. The hub will build a global trust architecture to support international data and knowledge sharing, and foster connections across political, public policy, scientific, and civil society stakeholders. Researchers, government, and private sector partners will be encouraged to create shared databases using public health, social, behavioural, media, mobility, travel, and environmental data. This innovative approach will bring researchers together for intensive investigations of specific issues, using state-of-the-art technology and multidisciplinary collaborations to help countries around the world detect, assess, and respond to outbreaks.[539-541]

Honouring Indigenous Self-Determination and Governance in the Public Health System

Public health governance requires a focus on Indigenous self-determination and reconciliation. Reconciliation is the ongoing process of building mutually respectful relationships between Indigenous and non-Indigenous populations in Canada, based on truth, justice, and healing.[287] This requires awareness and acknowledgement of the past, atonement for the harms of colonization, concrete actions for societal change, and reconciliation with the natural world.[287] The Truth and Reconciliation Commission of Canada concluded that self-determination is a precondition to reconciliation (see text box "The Right to Self-Determination").[288]

The Right to Self-Determination

The right to self-determination is acknowledged by the *United Nations Declaration on the Rights of Indigenous Peoples* (UNDRIP).[542] It states that "Indigenous Peoples have the right to determine and develop priorities and strategies for exercising their right to development. In particular, Indigenous Peoples have the right to be actively involved in developing and determining health, housing, and other economic and social programs affecting them and, as far as possible, to administer such programs through their own institutions".[542] However, these principles have not always been implemented in Canada.[340]

Legal decisions in recent decades, including Jordan's Principle and Daniels Decision, speak to addressing these gaps.[542] Additionally, Bill C-15 (June 2021) aims to begin the process of aligning Canadian law with UNDRIP.[543] This Act provides a road map for the federal government and Indigenous Peoples to work together to implement the declaration, including self-determination.

Self-determination is an important determinant of health and well-being among First Nations, Inuit, and Métis communities, and is key to closing health gaps between Indigenous and non-Indigenous populations.[288] Models of self-determination in health may vary across Canada, driven by diverse needs, experiences, and interests, as articulated by different nations and communities.[340]

Health-related self-determination is about ensuring that First Nations, Inuit, and Métis populations can design, deliver, and manage their own health programs and services through Indigenous self-governance and supportive fiscal arrangements.[340] It also requires equal inclusion for Indigenous populations in broader health policy development and decision-making to ensure that self-determination is not undermined by the policies of non-Indigenous organizations and governments.[329]

No single model of governance will work across all Indigenous communities, and governments at all levels have a responsibility to support processes of self-determination.[340] One example of a reform prioritizing self-determination is the province-wide, Indigenous-governed and managed First Nations Health Authority in British Columbia (See text box "Northern British Columbia Rural and Remote and First Nations Communities COVID-19 Response Framework").[544, 545]

Northern British Columbia Rural and Remote and First Nations Communities COVID-19 Response Framework

The *Northern BC Rural and Remote and First Nations Communities COVID-19 Response Framework* (June 2020) responds to a request from British Columbia's Minister of Health to develop processes necessary to plan and deliver testing services, clinical pathways, patient transport, and other tools in response to the COVID-19 pandemic.

The Northern Framework was co-developed by leadership and representatives from Northern Health, the First Nations Health Authority (provincial and northern region), First Nations communities, local rural and remote communities, and Provincial Health Services Authority. The Northern Framework not only respects the unique realities of northern, rural, remote, and First Nations and Métis communities and its citizens, it also calls for flexibility and partnership in the actual implementation of the work.

This initiative started as a group of committed leaders, professionals, and community members – gathered virtually and in person – working together to produce the Northern Framework that would later inform the provincial *Rural, Remote, First Nations and Indigenous COVID-19 Response Framework*. But it also became a place for transforming relationships. The deepening connections between partners gained through shared goals and collective work on the Northern Framework redefined their ongoing ways of working together. Relational change, like this, enables system change and a brighter future for all.

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Stewarding Multisectoral Action and Collaboration

The COVID-19 pandemic has led to renewed calls for whole-of-government and intersectoral action on the social, structural, and environmental conditions that lead to poor health. To do this, bold and comprehensive governance models are needed. The most well-known approach that can fulfill this need is Health in All Policies (See text box "Taking a Health in All Policies Approach in Canada: Two Examples"). As a mechanism to systemize intersectoral governance, this approach ensures attention to health and well-being within policy decision-making across all sectors that influence the social determinants of health.[395, 546] It can also include engagement with stakeholders or industry.

One notable international example is the Health in All Policies approach established by the state government of South Australia in 2007, which builds intersectoral connections across government to benefit both health and partnering sectors.[547] A five-year evaluation of this approach found that prioritizing action on the social determinants of health resulted in actions and processes across sectors that can contribute to overall improved population health.[395]

Taking a Health in All Policies Approach in Canada: Two Examples

Health in All Policies refers to "an approach to public policies across sectors that systematically takes into account the health implications of decisions, seeks synergies, and avoids harmful health impacts in order to improve population health and health equity".[548]

Newfoundland and Labrador

The Government of Newfoundland and Labrador's strategic plan "The Way Forward" consists of policy actions designed to achieve four objectives: a more efficient public sector, a stronger economic foundation, better services, and better health outcomes.[549] As part of this plan, the *Protection and Promotion of Public Health Act* (2018) was put forward to support the provincial government in responding more effectively to emerging public health challenges and emergencies.

The Act is rooted in a Health in All Policies approach. It enables the Government of Newfoundland and Labrador to build health impact considerations into policy decisions and to make decisions with a focus on measurable health status improvements. This is done with the aim of improving population health determinants (i.e., employment, education, crime prevention) and reducing healthcare costs in the long term.

Quebec

Quebec has developed a series of programs, laws, action plans, policies, and other tools to serve as levers towards a Health in All Policies approach. Although this approach is not explicitly stated as a strategy in Quebec legislation, the *Public Health Act* benefits from a legal mandate and dedicated resources to support health impact assessments (HIA). It also makes the Minister of Health and Social Services an "adviser to the government on all matters of public health" and stipulates that every ministry should evaluate the health impact of their actions. If this impact is deemed significant, the ministry should consult with health and social services.[398, 549]

A local example of this approach in action is when the region of Montérégie included HIA in the 2011 regional public health action plan to support municipal decision-makers. The HIA responsibility was assumed by a full-time professional from the public health directorate who collaborated with numerous government bodies.

In developing a Health in All Policies approach, health equity metrics can be used to support stewardship among the sectors, representing priority determinants of health, and highlighting where health equity gaps need to be closed. Prior to the pandemic, Canadian initiatives to measure and analyze health equity were under way. The Pan-Canadian Health Inequalities Reporting initiative is the first national initiative to document health inequalities.[550] This collaborative effort produces the *Key Health Inequalities in Canada* report and a Health Inequalities Data Tool with 70 indicators of health outcomes and social determinants of health.[84, 551]

Other jurisdictions across the globe have integrated health equity metrics into decision-making structures. Recognizing that Greater Manchester had higher mortality rates than other parts of England prior to the pandemic, the city region placed health equity as a focal point for action using the Marmot indicators.[552] Originally published in 2011, the Marmot Indicators were revised in 2014 by the University College of London's Institute of Health Equity, in collaboration with Public Health England to support local authorities to measure and understand health and social inequities, as well as the social determinants of health.[553] The region subsequently used these indicators to develop a roadmap to "build back fairer" after the pandemic, in order to reduce health, economic, social, environmental, and cultural inequities.[554] Indicators are centred upon six themes: early years, children and young people; work and employment; income, poverty and debt; housing, transport and the environment; communities and place; and public health.[552, 555, 556]

Section 3

A Vision to Transform Public Health in Canada

It is clear that, now more than ever, Canada's public health systems require transformation in order to effectively support people in Canada to attain optimal health and protect them from current and future health crises.

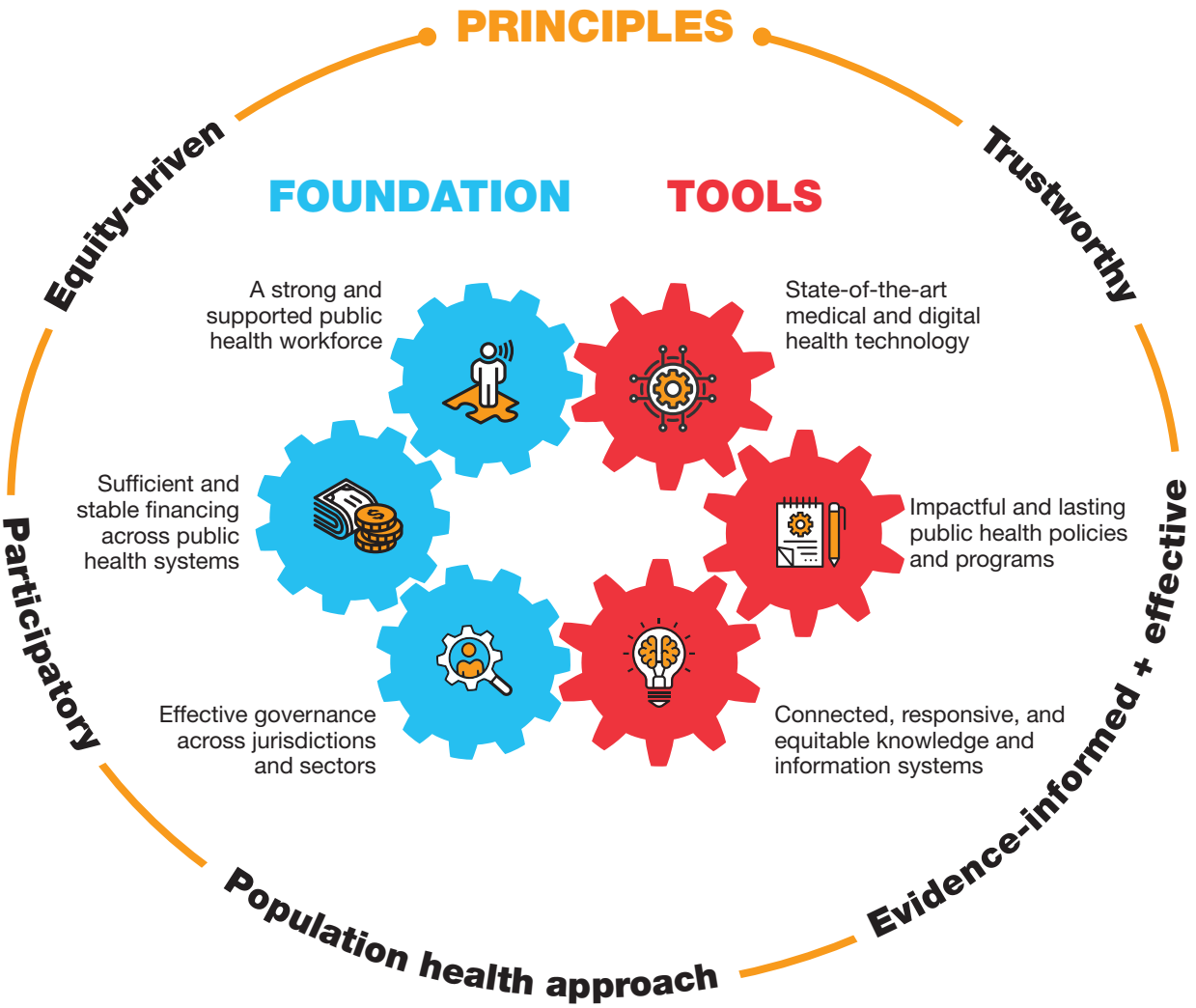
This section offers a vision for that transformed system, a vision that is anchored in evidence and knowledge from peer-reviewed literature, seminal reviews, and discussions among public health professionals, community leaders, and other experts who make Canada's public health systems work.

The work to achieve this vision cannot be done by one person or organization alone, rather it requires collective learning and a cross-system cultivation of excellence.

Achieving a World-Class Public Health System

As described in the previous section, the purpose of the public health system is to achieve optimal health and well-being for all people living in Canada. This is also the vision for transformation. Figure 12 illustrates elements of a public health system that is equipped and supported to achieve its purpose and carry out the aims.

FIGURE 12: Elements of a World Class Public Health System



Principles to Guide Transformation and Beyond

These principles illuminate overarching values that drive the work of public health systems. They can help steer the collective efforts of the people, organizations, and institutions that make up the public health systems in Canada as they move through and achieve transformation (Table 5).

TABLE 5: Guiding Principles for Canada's Public Health System

Principle	Goal	In practice
▸ **Trustworthy**	Earn trust through continuous reflection and transparency, and being accountable to the people it serves	A public health system that is credible and trusted translates into better health outcomes. Actions that promote and foster trust require open and clear communication, equitable partnerships, accountability, and transparency. A trusted public health system works to prevent unintended consequences that could compromise trust. The importance of trust was underscored in national responses to COVID-19 across countries.[557]
▸ **Evidence-informed and effective**	Value inclusive, diverse, and high-quality systems of knowledge and evidence to make the best decisions for the health of populations	Effectiveness refers to policies and programs achieving their potential impact under real-word conditions.[558] It is the ability of public health to affect positive change to improve the population's health, across a wide range of settings, while also promoting equitable outcomes.[559] Effectiveness in public health includes innovation, partnership and engagement, evidence-informed decision-making, translating science into action, monitoring and evaluation, and supporting research.[559, 560]
▸ **Population health approach**	Stimulate action across sectors to improve the health of all populations and reduce inequities among communities	Actions live at the population level, rather than the individual level.[561] The focus is on improving the health status and reducing health inequities among and between populations. Crucial to this approach is intersectoral action and the recognition that good health is a shared goal and responsibility is joint among many sectors, organizations, and actors.[253]
▸ **Participatory**	Seamlessly integrate community and citizen participation and co-creation into the core of public health practice and action	Public participation informs public health action and engages individuals and communities around issues that are important to their experiences. Strengthening community participation within public health systems across networks and scales can be achieved through consistent collaboration, ensuring clear accountabilities, and centering community self-determination through processes of engagement, co-production, and governance.[385]
▸ **Equity-driven**	Prioritize inclusion and diversity of voices at decision-making tables while striving for reconciliation	Actions are purposefully designed and implemented to address often long-standing inequities that impact the populations' health. This requires a robust agenda that includes social investments, cross-sectoral and cross-jurisdictional action, and stronger leadership within and beyond the health sector.[290] Particular attention is needed to strive towards decolonizing public health.

The Foundation and Tools of a Strong System

With the principles as guides, the building blocks introduced in Section 2 offer a frame to articulate elements that make up the foundation and tools of a stronger and more resilient system (Table 6).

While many of these ideas may not be new, when advanced together they can lead to a true culture shift, one that brings population health into focus and elevates health and well-being to a fundamental priority for society.

These ambitious but necessary elements are not the only areas that need attention. This list is intended to be a starting point to wider discussions, reflection, and action.

TABLE 6: Towards a Transformed Public Health System

Building Block 1: Impactful and Lasting Public Health Policies and Programs

- For priority public health issues, planning and intervention approaches are comprehensive and include upstream, midstream, and downstream actions with options for stimulating intersectoral action.
- Interventions to address key determinants of health are supported, coordinated, and evaluated across health, social, economic, and environment sectors.
- Innovative interventions are fostered, evaluated, and adapted through population health intervention research, as part of a continuous learning system approach.
- Reconciliation, self-determination, and cultural safety are prioritized and reinforced across policy and programming interventions with First Nations, Inuit, and Métis communities.
- Communities experiencing conditions of marginalization are supported to work with public health, primary care, and social service organizations to leverage community assets and respond to local needs.

Building Block 2: Connected, Responsive, and Equitable Knowledge and Information Systems

- Data systems used for public health action effectively interact with data systems from other sectors, providing the right information needed at the right time for communities, public health leaders, and researchers.
- First Nations, Inuit, and Métis principles of data sovereignty and ownership are successfully integrated and honoured across the data and information ecosystem.
- Comprehensive data on the health needs and experiences of underrepresented populations are systematically collected, and related analysis is available for community use and public health decision-making.
- Other ways of knowing and diverse methodological approaches are integrated into public health evidence systems.
- Interdisciplinary research-practice initiatives that rapidly respond to the evidence needs of public health systems are formalized and sustained.
- Academic institutions and public health organizations have enduring and mutually beneficial partnerships and exchanges to foster a world-class evidence base for public health.

Building Block 3. State-of-the-Art Medical and Digital Health Technology

- Partnerships are fostered to spur innovation and the adoption of emerging and cutting edge technology and approaches to public health problems.
- Event-based surveillance systems are integrated into broader surveillance systems and include strong forward-looking risk assessments.
- Canadian manufacturing, supply, and distribution systems for emergency counter measures (e.g., vaccines, treatments) are in place, up to date, and ready to respond as needed.
- Public health regularly collaborates with academic and private sector experts to strengthen combined human analysis and artificial intelligence for early warning, foresighting, and health emergency surveillance technologies.
- Canada has strong relationships with international partners, supporting innovations in technology to protect health at the national and global levels.
- Federal and provincial/territorial roles and responsibilities for Canada's health emergency stockpiles are clear, and related systems are nimble and ready to meet future needs.
- Emerging digital health and open source initiatives are assessed and quickly integrated into the broader public health infrastructure.

Building Block 4. A Strong and Supported Public Health Workforce

- Data on the composition and distribution of the public health workforce are collected and used to inform decisions on human resource development.
- Surge capacity exists across public health organizations, universities, and other sectors to support a range of health emergency response.
- The public health workforce is diverse, inclusive, and committed to cultural safety.
- Public health professionals have cross-cutting skills with a strong foundation in public health sciences, and the workforce is multi- and cross-disciplinary.
- Universities and public health institutions are aligned to support modernized public health core competencies and training opportunities to maintain specialized public health skills.
- Indigenous public health human resources are strong and have the capacity to support community organizations to lead public health and design and implement solutions.

Building Block 5. Financial Stability to Achieve Population Health

- Financing for all public health systems is secured to a legislative framework and is sufficient for the workforce to effectively perform essential public health functions to achieve effective outcomes.
- Information on public health investments is readily available and analyzed to inform accountability mechanisms and decision-making.

Building Block 6. Effective Governance across Jurisdictions and Sectors

- Federal and provincial/territorial governments and Indigenous organizations work together under a strengthened public health mandate that confirms core functions, shared goals, and accountabilities for coordinated and coherent public health systems.
- Public health is supported by a legal framework that ensures the universality and comprehensiveness of public health services for all Canadians.
- Federal, provincial/territorial, and local governance structures embed a whole-of-government approach to policymaking.
- Canada has a foundational public health monitoring system that tracks and reports annually on core public health services to support continuous improvement.
- All public health systems in Canada recognize and support Indigenous public health expertise and the rights of First Nations, Inuit, and Métis Peoples to determine what is required to be healthy and well.
- Key intersectoral health equity indicators are established in a framework for Canada and used across sectors and in public health guidance documents.
- Governance structures have diverse membership, with explicit considerations to inclusion, anti-racism, anti-oppression, cultural safety, and self-determination.

The Way Forward

COVID-19 tested public health systems across Canada and around the world. It amplified known weaknesses, revealed new challenges, and underscored the need for resilience. As we continue to face evolving and worsening threats to human health, such as climate change, the opioid overdose crisis, antimicrobial resistance, and the burden of non-communicable diseases, we need to ensure that our public health systems are better equipped to address these complex challenges. Simply put, we were not adequately prepared to face an emergency of the scale and magnitude of COVID-19. We must do better for the future.

The pandemic has underscored the importance of public health's role in preventing disease, promoting healthy behaviours, and working upstream across sectors to address the drivers of poor health. It has demonstrated how public health can protect the sustainability of the healthcare system by preventing people from getting sick and hospitals from becoming overwhelmed. It has also demonstrated that when we work to improve the living conditions and well-being of those most at risk, we are collectively safer and healthier. When kids are healthy, they learn better. When employees are in good health, they are more likely to obtain and maintain employment. Investments in public health are therefore investments in a healthier society overall.

There have been numerous calls to reform the public health system, both historically and during the COVID-19 response, but there are additional and increasingly urgent signs that we need to act now. As Canada looks toward pandemic recovery, heavy demands on the healthcare system threaten to overshadow the equally critical need to bolster the public health system. As COVID-19 has shown, both systems must be sufficiently supported for Canada to have a reliable and responsive health system that can meet the needs of its people.

We now have an important window of opportunity to begin the transformation journey. One that aims to achieve a more sustainable health system and a more equitable society.

Priority Action Areas for Public Health Renewal

The pandemic has shown the need for a strong and agile public health system that is able to innovate and adapt to new and emerging issues and challenges. As the urgency of the pandemic subsides, there will be opportunities for transformation across health, social and economic systems. Ensuring a world-class public health system that is *equity-driven, trustworthy, participatory, and effective* is Canada's best defence against future public health threats.

Building on the elements set out in Section 3, The Way Forward proposes four priority areas of action, along with a suite of "actionable ideas" to stimulate system transformation. Transformation will take sustained commitment and investment. It will also require public health to embrace a continuous system of learning, be on the

cutting-edge of innovation, and build strong bridges between communities and sectors, both locally and with our global partners.

In a nutshell, transformation will require:

- Fostering excellence in the public health workforce;
- Improving our tools;
- Modernizing our models of governance; and,
- Ensuring stable and consistent funding.

Fostering Excellence in the Public Health Workforce

The pandemic has placed unprecedented demands on Canada's health workforce including those in public health. Many have been working day and night for close to two years. Our public health professionals are highly trained in keeping populations healthy and protecting them from injuries and disease threats – but reports of burnout are increasing and resources are stretched thin.

Investing in public health workforce capacity requires urgent attention, given the continued burden of COVID-19 on public health practitioners and the ever-present risk of concurrent public health crises. The goal is to recruit and retain a workforce that has both deep expertise in public health and the ability to work across many related disciplines, including from the fields of data science, behavioural science, economics, sociology, and even engineering, in order to develop and scale innovative solutions.

As a start, we need to update our public health competencies to ensure our workforce has the diversity of skills it needs to meet today's complex public health challenges. Ensuring that staff have a strong foundation in the fundamental functions of public health (i.e., surveillance, health assessment, health promotion and protection, emergency preparedness and response, as well as disease and injury prevention) is critical but insufficient. Public health practitioners must also have the ability to work across sectors and communities, and to effectively interpret data and communicate rapidly evolving science in the information age.

Importantly, the public health workforce must lead by example and demonstrate the power of what an inclusive and diverse workforce can do. When all staffing levels of an organization represent the communities they serve, they are better able to meet their needs and reduce systemic stigma in policies and services. This is especially vital in the field of public health, which aims to reduce inequities that lead to poor health.

Finally, workforce planning must be future-oriented. This includes developing present and future generations of public health professionals and ensuring there is surge capacity, through partnerships with academic institutions and nongovernmental organizations, such as the Canadian Red Cross, in order to rapidly mobilize additional resources in times of emergency. Transition and continuity planning are also important. The success of public health relies on cultivating strong relationships both within and outside of the sector. High employee turnover and attrition not only leads to a loss of knowledge and experience, but also means that organizations must start over in forging these relationships. By prioritizing learning and development, fostering excellence among staff, and improving human resource planning, public health institutions can become magnets for new and emerging talent and be better positioned to meet future demands.

Actionable Ideas to Foster Excellence in the Public Health Workforce

- Modernize public health competencies to match current requirements for public health practice. This includes the ability to co-design initiatives

across communities, disciplines and sectors; to deliver risk communications to address mis- and disinformation; to translate science into policy options; and to embed cultural safety and cultural humility into public health policy and practice.

- Build surge capacity to increase system responsiveness and nimbleness. This includes standing agreements with universities and nongovernmental organizations, maintaining rosters of public health expertise, and community networks that can mobilize local capacity.
- Support dynamic on-the-job training and learning for public health students and professionals. This includes joint appointments and exchanges between academic and public health institutions, review of university curricula, and expansion of effective training programs, such as the Canadian Field Epidemiology Program, the Public Health Officers Program, and support for the development of an Indigenous field epidemiology training program.

Improving our Tools

More and Better Data

Good data and intelligence are fundamental to understanding patterns of illness, injury, and harm, and how best to target public health interventions. During a pandemic, having the right information at the right time is vital to understanding how diseases spread, to identifying those who are most at risk, and to predicting future scenarios to guide public health measures.

There is no doubt that our pandemic response was limited, in part, due to significant gaps in our public health surveillance and data systems. This includes a lack of data on race and ethnicity, a lack of comparable data between provinces and territories, and information gaps at the local level. These gaps in our system are not new. Public health reviews over the course of the past 40 years have pointed to the need to strengthen our surveillance systems. In this day and age, it is unacceptable that public health does not have the information it needs at all levels to monitor public health challenges and to effectively target intervention efforts.

A Pan-Canadian Data Ecosystem that is Interoperable, Equitable, and Ethical

In Canada, we are still working with multiple independent data systems that do not speak or connect with each other. As a result, data are fragmented across jurisdictions, governmental organizations, and communities. It is imperative that we work together to improve data sharing and comparability, in order to provide decisionmakers across the country with the intelligence they need to inform policies and programs, and to provide more transparency for Canadians on the health of their communities.

One key step will be to establish an interoperable system that facilitates the linking and pooling of data from various sources, including epidemiological, clinical, and administrative data. This could function as a cooperative network, with clear standards to ensure that data are handled in ways that are secure and culturally safe. At the heart of this system, we must prioritize and embed equity, including a commitment to gather disaggregated data, foster community collaboration, and ensure access to data in a privacy-sensitive manner. Fundamentally, such a system must respect the rights of First Nations, Inuit, and Métis Peoples, for communities to own, share, and control their own data.

Better Insights

In order to turn data into actionable insights, public health needs the right analytic tools. This includes cutting-edge predictive modeling to forecast disease patterns, and leveraging the power of technology, such as artificial intelligence, to detect early warning signals of a new public health threat.

Effective early warning, foresighting, and health emergency surveillance requires working more closely with academic and private sector experts, and with our international partners, to strengthen and combine human analysis and machine learning about emerging threats. As we have learned in the pandemic, our early warning systems need to be well-integrated with government decision-making structures and include strengthened risk assessment processes that are coordinated across jurisdictions.

Accelerating Knowledge Translation

We must continue our work to find innovative ways to close the gap between knowledge generation, policy, and practice. The pandemic highlighted the need for the rapid generation and synthesis of emerging research on COVID-19 in order to inform public health actions. Innovative initiatives, such as COVID-END and the CanCOVID networks, created to review and synthesize evolving research, as well as the COVID-19 modelling network and the Canadian COVID-19 Genomics Network, can serve as models for the future by connecting public health leaders, university scientists, and governments across the country. The National Collaborating Centres for Public Health act as a knowledge hub for policy and practice across Canada. Moving forward, we need to find more effective ways to mobilize the work of knowledge translation hubs, both within the public health community as well as with partners and actors in other sectors that influence population health.

When evidence is quickly evolving, healthcare workers and service providers need clear, timely and culturally safe guidance on how best to prevent the spread of infection and how to most effectively treat infected patients. While there are well-established, independent expert committees, such as the National Advisory Committee on Immunization, that have provided advice to public health officials prior to and during the COVID-19 pandemic, there is no mechanism to regularly update clinical management guidelines at the national level. Moving forward, we need to ensure that the right advisory bodies and supports are in place, including surge capacities, to rapidly develop a range of technical guidance for the prevention, control, and treatment of emerging infectious diseases.

A Stronger Public Health Research Agenda

Public health is a science-based field that prides itself on working from the best available evidence, but there is still a lot that we have yet to learn about public health policy and practice in Canada and around the world. For example, more research is required on public health governance, organization models, and standards, to build on our understanding of which models work best to improve health and reduce inequities.

We also need more interdisciplinary research to measure the impact of upstream actions on health outcomes. It has often been said that Canada is a nation of pilot projects, with different interventions being tested in different parts of the country to address public health issues or social factors that affect health, such as precarious employment, harms from opioid use, or maternal health. Working with the Canadian Institutes of Health Research and other partners, we need a research agenda to more systematically evaluate the effectiveness and sustainability of local interventions in order to be able to identify, scale, and spread best practices across the country in partnership with communities.

A More Inclusive Knowledge Base

Finally, we must reconsider our knowledge base in public health and broaden its scope. For example, traditional Indigenous concepts of health and well-being are holistic and relational in nature, connecting individual health with the health of the land, the environment, the community, and the vibrancy of one's culture. Historically, Indigenous ways of knowing, such as oral histories, storytelling, and community participation have often been unacknowledged or undervalued. Collaborations that include and value First Nations, Inuit, and Métis knowledge can enrich both the science and practice of public health in Canada and lead to innovative services that better address the needs of communities.

Improving our Pipeline of Biomedical Solutions

COVID-19 underscored the need to work with domestic and global partners to undertake research, scale up production, and address barriers to equitable access to state-of-the-art vaccines, diagnostics, and therapeutics. The pandemic ushered in new era of health innovation and catalyzed important partnerships between public health institutions, academia, and industry. Looking to the future, this collaboration should be sustained and enhanced. Ensuring that Canada is able to respond to emerging health threats requires all actors across the research, development, and production pipeline to work together in order to define health technology requirements and drive solutions that protect the public's health. Through international cooperation and collaboration in this arena, we not only contribute to health security globally, but also to ensuring that the people of Canada are protected both at home and abroad.

The Government of Canada's Biomanufacturing and Life Sciences Strategy is an important step in this direction. Governments must continue to work closely with scientists and industry to develop Canada's talent pipeline, manufacturing, and distribution capacity to produce state-of-the-art emergency tests, equipment, vaccines, and treatments that can rapidly be deployed. As part of this work, public health institutions need to be systematically engaged to define public health priorities and translate these into guidance for economic and industrial policy, and ultimately, into life saving products and technologies.

Actionable Ideas to Improve Public Health Tools

- Accelerate the implementation of the Pan-Canadian Health Data Strategy with clear phased milestones. This includes prioritizing systems for interoperable use, such as a national network of vaccine registries that includes socio-demographic data as well as linkages across epidemiological, laboratory, clinical, and health administrative data.
- Re-invigorate national and cross-jurisdictional threat detection and foresight systems, including risk assessment, modelling, scenario planning, and situational awareness.
- Prioritize implementation of ownership and control principles for First Nations, Inuit, and Métis Peoples across all data systems.
- Enhance rapid and ongoing population health intervention research for prevention and well-being initiatives and strengthen interdisciplinary knowledge synthesis models such as the National Collaborating Centres for Public Health.

- Leverage Canada's Biomanufacturing and Life Sciences Strategy to systematically engage the public health and research and development sectors to identify strategic and critical health technologies and countermeasures to inform industrial policy and decision-making.

Modernizing our Models of Governance

Stronger Mandate and Accountability for Public Health Across Federal, Provincial, and Territorial Governments

Public health is a shared responsibility between federal, provincial, and territorial (FPT) governments. While COVID-19 has demonstrated the strengths of our collective response, it has also highlighted gaps in our pandemic preparedness plans and the need to revisit our governance models in order to be better prepared for the future. This starts with strengthening the mandate of public health within the FPT health system and making governments more accountable for public health objectives and outcomes.

As a critical first step in this transformation process, we need to clarify the role of public health across jurisdictions and ensure essential functions are consistent with evolving global definitions to meet today's complex cross-border challenges, from antimicrobial resistance to climate change. Governments must then work together to identify common public health priorities and outcomes, tied to funding commitments, that can be measured and reported back to Canadians in an annual report card. This will require the development of comparable performance indicators to measure the effectiveness and outcomes of public health policies. This level of accountability will help identify areas in need of improvement, and ensure that public health is better equipped to reduce health inequities and better prepared for the next emergency.

Finally, it is important that public health governance mechanisms include Indigenous public health expertise and perspectives to enable self-determination, for First Nations, Inuit, and Métis Peoples. This means ensuring that Indigenous communities and partners are adequately supported to develop and implement their own public health plans and priorities, including holistic, community-based local solutions in partnership with public health authorities.

A Stronger Voice for Public Health at the Decision-Making Table

Public health leaders have provided valuable scientific advice to decision-makers throughout the COVID-19 pandemic. It will be important that public health leaders continue to have regular access to decision-makers in the future, in order to ensure that Canada is prepared to address the next public health crisis, that the health system is oriented towards enhancing wellness, and to continue the critical work of reducing health inequities. Within the FPT health arena, this includes ensuring that public health continues to have a more prominent place on the FPT health agenda and ongoing support for the participation of Chief Medical Officers of Health in governance discussions. Engagement with other governance tables beyond health should also be encouraged.

Strengthening Intersectoral Connections

The pandemic put in stark relief the complex interaction of the social determinants of health – factors such as education, economic stability, job security, and stable housing – in shaping health outcomes and driving health inequities. Perhaps now, more than at any other point in recent history, the vital connection between good health and social, environmental, and

economic conditions has become apparent to both decision-makers and the public alike.

It is, by now, a well-accepted fact that much of what makes us healthy lies outside of the health system. Those most at risk of COVID-19 are also those most affected by structural inequities and other chronic illnesses. While biomedical solutions, such as vaccines, have been important tools in combatting COVID-19, social solutions, including income support, paid sick leave, and other housing and employment supports, have also been critical.

New ways of working are required to improve the social conditions that drive health outcomes. The pandemic has made visible the importance of bringing together all sectors of society in the fight against COVID-19 – including businesses, civil society, and other government departments. We must now bring that same energy of collaboration to create upstream policy alliances to reduce health inequities, where collective action is based on clear and measurable indicators. One encouraging approach from the field of social innovation is "collective impact". This provides a framework for addressing health and social priorities by developing common goals and coordinating mutually reinforcing action across sectors, all driven by shared accountability.

Harnessing the Power of Communities

Public health's patient is the population. To be effective at protecting the health of populations requires strong collaboration and decision-making across sectors and jurisdictions, including with communities across the country. From organizing vaccine campaigns, to food deliveries for those in need, community leaders have been instrumental in developing tailored solutions that take into account the lived experience, unique challenges, and specific needs of their members.

The leadership of Indigenous communities in developing holistic well-being and tailored pandemic planning offers a glimpse of what can be done when Indigenous public health leaders and organizations are supported to own governance of Indigenous health. The power of African, Caribbean, and Black Canadian leadership in improving vaccine uptake demonstrated that community-determination has a strong role in achieving positive health outcomes.

Community-first initiatives require innovative new models of shared governance and collaboration that allow local expertise. The closer we work to bridge local realities with global evidence, harnessing our collective expertise, the better equipped we will be to organize quickly and respond to emergencies effectively.

Actionable ideas for modernizing governance

- Modernize essential public health functions (or public health roles across the country) to respond to changes in the current public health landscape and in alignment with global reflections.
- Develop a pan-Canadian mandate on public health with clear priorities, objectives, essential functions, and roles to guide FPT decision-making and investments. This would include annual reporting on progress towards meeting common goals. Also ensure that First Nations, Inuit, and Métis public health planning and priorities are supported to meet needs in a proactive and flexible way that supports self-determination and holistic local solutions.
- Develop a public health systems research strategy to inform updated performance indicators and annual reporting on public health policies and services across Canada.

- Re-tool pandemic plans to include health, social, and economic sectors, and ensure pandemic preparedness with sustainable funding, testing, and annual public reporting on state of readiness.
- Create a health equity monitoring and reporting system with intersectoral leaders to improve and track the social factors that can protect populations from future pandemics and other health challenges.
- Build community and equity into public health decision-making processes by incorporating accountabilities for community engagement, co-design, and implementation at the community level.

Ensuring Stable and Consistent Funding

Future-proofing our public health system requires appropriate investments in our people, our tools, and our governing structures. It also requires more consistent, stabilized funding to meet today's complex crises and better prepare for tomorrow.

Public health resources are often scaled back after public health emergencies as governments move to address other priorities. This is referred to as the "boom and bust" cycle of public health spending. This places the public health system at a disadvantage at the onset of each crisis by not having the capacity or the networks required for rapid response.

Investing in public health is a smart investment with direct and indirect impacts to both social and economic well-being. Public health is the outbreak that did not happen, the traumatic injury that did not occur, and the overdose that was avoided. Public health protects the sustainability of our healthcare system by reducing demand for costly medical treatments, and helping people to stay healthy and well. As the pandemic has clearly demonstrated, when we fail to prioritize public health, people get sick, the healthcare system can become overwhelmed, and the economy suffers.

Though difficult to measure precisely, the Canadian Institute of Health Information estimates that in 2019, just under six percent of all health spending was allocated to public health in Canada. We must ask ourselves if this a sufficient level of investment give the critical role that public health plays in keeping Canadians healthy and safe.

Spending on public health needs to be more transparent in government budgets and tied to clear performance objectives to make it more visible and accountable to the public. Flexible funding models are also required to support First Nations, Inuit, and Métis self-determination, and ensure Indigenous communities are supported to develop approaches and interventions, tailored to their needs.

Actionable Ideas for Funding

- Step up funding to reach permanent budget levels that match the public health mandate.
- Work with FPT governments to ensure that budgets clearly identify priorities and funding for public health policies and services, as public health investments reduce healthcare costs and lost economic opportunities.
- Support First Nations, Inuit, and Métis health and well-being with targeted funding for Indigenous-led public health programs.
- Use federal funds to achieve common public health priorities and objectives, and develop indicators to report on outcomes at the FPT level.

A Call to Action

We are now at a pivotal moment. Public health in Canada has risen to the challenge of COVID-19, but its resources are stretched thin.

Reflecting on our pandemic experience, we can decide what kind of public health system, and ultimately, society we want to build moving forward. A world-class public health system that is resilient and protects all of us equitably will be our best insurance policy against future public health crises. It will also ensure that we are well-equipped to navigate the increasingly complex health threats that we see on the horizon.

As we speak, countries around the world are beginning to undertake similar critical reflections. Lessons learned, and emerging best practices can be shared across borders and help to inform our path forward to transform our health system and achieve optimal health for all people in Canada.

The pandemic has awakened many to the understanding that our health system is more than managing illness through medicines and hospital procedures—it means preventing these illnesses from happening in the first place, whenever possible.

By working together, learning from one another, across communities, governments, sectors, and society, and collaborating with others around the world, we can begin the process of building a world-class public health system and a healthier and stronger society at large.

Appendix A. Methodology

Process

The 2021 Chief Public Health Officer of Canada (CPHO) Annual Report was drafted based on a review of the best available evidence, including evidence from research, academic expertise, community expertise, practical and applied public health expertise, and traditional ways of knowing. Instead of completing rapid reviews based on a point-in-time search, the identification and synthesis of new knowledge occurred during the entire writing process to allow for adoption of the continuously changing state of the evidence and cumulative experience. In response to content priorities, some of the information presented in the report was synthesized from commissioned, independent evidence reviews and pertinent themes emerging in expert consultations. For research, sources beyond systemic reviews were required, including primary research through peer-reviewed publications, pre-prints, grey literature, and expert consultation. Where possible, Canadian research and representative data were prioritized. Epidemiological data were derived from federal, provincial, territorial, or municipal government sources, as much as possible.

Developed during the ongoing COVID-19 pandemic, the information about COVID-19 reflects the evolving nature of the science and our understanding of the virus and its impacts.

The evidence was identified through:

- Research reviews
  - Ongoing and frequent literature searches, completed by sub-topic using online databases such as Medline and Scopus, as well as identifying new and existing research maintained by various academic publishers, such as BMJ, the Lancet, and Elsevier
  - Rapid review initiatives across Canada such as the COVID-19 Evidence Network to Support Decision-Making (COVID-END), CanCOVID, and the National Collaborating Centre for Methods and Tools evidence platform
- Surveillance updates, public health reports, and other grey literature
  - A review of national, provincial/territorial, and municipal public health publications, particularly epidemiological and public survey reports
  - Grey literature and policy reviews of trusted sources, such as: public health organizations (e.g., World Health Organization) and government publications (e.g., Public Health Ontario)
  - Epidemiological information, as per the following order of priority: COVID-19 case report information shared with the Public Health Agency of Canada (PHAC) by provincial/territorial governments and national research networks, publicly reported data from provincial and

territorial websites, press briefings by health authorities, and media reports

- Information published or shared by other federal departments, such as Statistics Canada and Indigenous Services Canada

- Engaged evidence reviews
  - Commissioned reports from independent public health experts:
    - *An Evidence-Informed Vision for a Public Health Data System in Canada* by Dr. David Buckeridge
    - *Governing for the Public's Health: Governance Options for a Strengthened and Renewed Public Health System in Canada* by Dr. Erica Di Ruggiero, Ms. Dominika Bhatia, Ms. Imaan Umar, Ms. Emmanuelle Arpin, Ms. Clara Champagne, Dr. Carole Clavier, Dr. Jean-Louis Denis, Dr. David Hunter
    - *Visioning the Future: First Nations, Inuit, & Métis Population and Public Health* by Dr. Margo Greenwood (Editor), Dr. Evan Adams (Editor), Dr. Marcia Anderson, Donna Atkinson, Dr. Danièle Behn Smith, Dr. Sarah Funnell, Theresa Koonoo (with contributions from: Rebecca Lonsdale, Sarah MacRury, Igah Sangoya, Meeka Kiguktak, Janice Panimera, and Jeanie Aulaqiaq), Dr. Shannon McDonald, Clara Morin Dal Col, Dr. Christopher Mushquash, Dr. Janet Smylie, Dr. Shannon Waters, Dr. Eduardo Vides, and National Indigenous Organizations: Assembly of First Nations, Inuit Tapiriit Kanatami, and Métis National Council
    - *Strengthening Community Connections: The Future of Public Health is at the Neighbourhood Scale* by Dr. Kate Mulligan

- Discussion groups and key informant interviews
  - Collaboration with internal and external expert stakeholders, Public Health Agency of Canada (PHAC) programs and surveillance leads, and the Canadian Institute for Health Information (CIHI)
  - A targeted consultation process, engaging a diversity of stakeholders from public health organizations, academia, community-based organizations, and government. The summary of the key themes from these discussions was published in a "What We Heard" Report entitled A Renewed and Strengthened Public Health System in Canada. This stakeholder engagement process included:
    - A Best Brains Exchange meeting, co-hosted between PHAC and the Canadian Institutes of Health Research (CIHR)
    - Five discussion groups, each focussing on a different group of participants:
      - Researchers and thought leaders involved in systems thinking and social innovation;
      - CIHR grantees involved in research on public health system and infrastructure innovation;
      - Members of the CPHO Health Professional Forum;
      - Members of the Special Advisory Committee on COVID-19; and
      - Local Medical Officers of Health
  - Six key informant interviews with public health experts and leaders

- Informed by the national consultation process, "Community Dialogue on the Future of Canadian Public Health Systems" led by CIHR's Institute of Population and Public Health.

Limitations

Scope and Literature Search

The 2021 CPHO Annual Report explores the broad impacts of COVID-19 and a vision for the future of the public health system in Canada. Since the purpose of the report is to provide an overview of presented topics and concepts, there are necessary restrictions on the level of detail provided in each section. Given the available evidence at the time and the tight timeframe for producing the report, this document does not represent an exhaustive evidence review or extensive consultations across all public health systems' stakeholders in Canada. Only literature published in English and French was reviewed. A detailed assessment of study quality and risk of bias was not conducted in this review, and this may be particularly consequential given the preliminary nature of some resources and findings.

Language

To the extent possible, we attempted to use standardized, inclusive, and culturally appropriate language when drawing on evidence related to different communities and their experiences of health. However, in some instances we relied on the terminology included in the source documents (e.g., visible minorities), if appropriate alternative language could not be identified.

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- Dr. Kate Mulligan, Assistant Professor (status), Dalla Lana School of Public Health, University of Toronto

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