Centre for International
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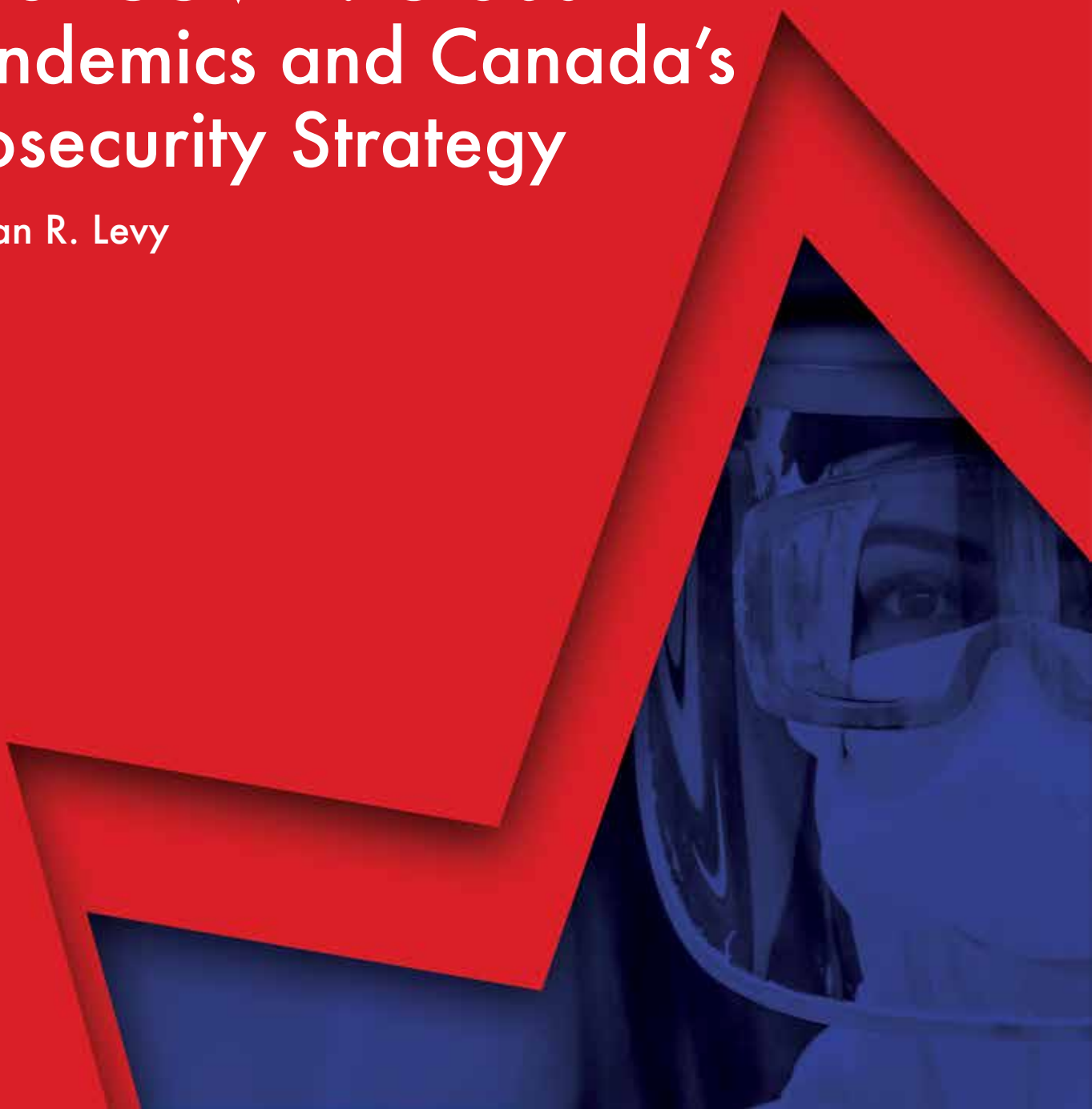
Reimagining a Canadian National Security Strategy | No. 5

After COVID: Global Pandemics and Canada's Biosecurity Strategy

Adrian R. Levy



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About the Project

Canada's approach to domestic and international security is at a profound moment of change. The shock wave of COVID-19 and its looming future effects highlight the urgent need for a new, coordinated and forward-looking Canadian national security strategy that identifies emerging and non-traditional threats and considers their interrelationships. Complex interactions between foreign policy, domestic innovation and intellectual property, data governance, cybersecurity and trade all have a significant impact on Canada's national security and intelligence activities.

Reimagining a Canadian National Security Strategy is an ambitious and unprecedented project undertaken by the Centre for International Governance Innovation (CIGI). It aims to generate new thinking on Canada's national security, inspire updated and innovative national security and intelligence practices, and identify ways that Canada can influence global policy and rulemaking to better protect future prosperity and enhance domestic security.

CIGI convened interdisciplinary working groups, which totalled more than 250 experts from government, industry, academia and civil society, to examine 10 thematic areas reflecting a new and broad definition of national security. Each thematic area was supported by senior officials from the Government of Canada, designated as "senior government liaisons." They provided input and ideas to the discussions of the working group and the drafting of thematic reports.

The project will publish 10 reports, authored independently by theme leaders chosen by the project's co-directors. The reports represent the views of their authors, are not designed as consensual documents and do not represent any official Government of Canada policy or position. The project was designed to provide latitude to the theme leaders to freely express new thinking about Canada's national security needs.

A special report by the project's co-directors, Aaron Shull and Wesley Wark, will analyze Canada's new national security outlook and propose a security strategy for Canada.

About the Author

Adrian R. Levy is a professor in the Department of Epidemiology and Community Health at Dalhousie University. His research focuses on strengthening population health by improving equitable and rapid access to high-quality and efficient health promotion and primary, secondary and tertiary care.

Acronyms and Abbreviations

CBSA	Canada Border Services Agency
COVID-19	coronavirus disease 2019
EBS	event-based surveillance
GPHIN	Global Public Health Intelligence Network
NESS	National Emergency Strategic Stockpile
PHAC	Public Health Agency of Canada
PPE	personal protective equipment
PSPC	Public Services and Procurement Canada
SARS-CoV-2	severe acute respiratory syndrome coronavirus 2
WHO	World Health Organization

Executive Summary

The arrival of coronavirus disease 2019 (COVID-19) in 2020 has raised awareness about serious deficiencies in Canada's public health apparatus. Even while other countries were implementing protective measures to address the epidemic spread of the virus, Canadian health officials maintained that the domestic risk was low. Since then, flaws in the risk assessment process and lack of integration of surveillance information, insufficient supplies of personal protective equipment (PPE), logistics for distributing laboratory supplies, capacity shortages, problems with data quality and sharing, and untested emergency plans, have left Canadians vulnerable. Notably absent were pre-existing communication plans informing citizens of necessary public health measures such as the use of masks, social distancing, stay-at-home measures, or business and school closures.

That these problems existed before COVID-19 is on the public record. The immediate step is to address the deficiencies that have been identified. Canada's disjointed responses to COVID-19 leads to the following recommendation: there is an urgent need for a biosecurity strategy focused on how different systems in the public health apparatus are supposed to function and interact in the prevention, preparation, detection and response to microbial risks. The strategy should incorporate the following features:

- → It must prepare Canada for all biological risks, known and unknown, include communicable and non-communicable infectious diseases,[1] and address risks of species crossover, accidental release and deliberate acts by hostile agents.
- → It must incorporate a whole-of-government approach that recognizes that the health of people is closely linked to that of animals, plants and the environment.
- → It must be developed collaboratively with a diverse range of experts and stakeholders, from within and outside of government. A senior-level official should have interdepartmental responsibility for coordinating an approach to preparedness that is consistent with vital systems security. The independent review panel of the Global Public Health Intelligence Network (GPHIN) has called for a dedicated risk assessment office, which may serve this purpose.
- → It must include provincial, territorial and Indigenous partners and it must be aligned with action plans from the World Health Organization (WHO) and from other countries.
- → The federal government should lead the development of a harmonized surveillance system across the country. Such a system would serve multiple purposes, including strengthening of public health data collection and making a meaningful contribution to health while respecting jurisdictional issues in health care.
- → Canada must reinvigorate its international role by demonstrating a genuine desire to achieve excellence and position itself as an effective global partner and leader in health security.
- → Canada needs to develop a transparent system of messaging that is well understood by the public. Moreover, officials from different levels of government need a system of harmonizing messages across jurisdictions.
- → The biosecurity strategy must explicitly address equity issues through a social-determinants-of-health lens.
- → Once implemented, it must undergo regular testing through field exercises and simulations to evaluate the readiness of resources, services and personnel required for prompt, actionable responses in the face of a biological risk. The results of these exercises must be made public.

The key lesson from COVID-19 is that reimagining Canada's biosecurity strategy for future biological threats requires bold steps and strong leadership. Developing a biosecurity strategy is a wise policy option for the federal government and its partners because the investment will bear dividends for decades to come. Time will tell if Canada can learn this lesson before the next pandemic.

1 In this report, the term "infectious" refers to zoonotic transmission between animals and humans and "communicable" refers to transmission among humans.

Introduction

Canadian officials first became aware of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the virus responsible for COVID-19, on December 31, 2019. The public health apparatus designed to detect and respond to a communicable respiratory illness such as COVID-19 were largely developed over the two previous decades, most notably with the creation in 2004 of the Public Health Agency of Canada (PHAC). On the eve of COVID-19, Canada had federal, provincial and North American plans designed for pandemic influenza. When COVID-19 started spreading globally, officials felt confident that the existing public health apparatus would keep Canada safe. On January 29, 2020, Chief Public Health Officer Dr. Theresa Tam told parliamentarians in Ottawa that "Canada's risk is much, much lower than that of many countries" (Tam 2020). Federal officials reassured those present that the threat of a major outbreak in Canada was "very low," that the measures being implemented were adequate and that the risk of the virus being spread by people without symptoms was highly unlikely.

Despite those reassurances, worrisome developments in other countries were already undermining that message of confidence. China took extraordinary measures to contain the spread of COVID-19, including the lockdown of Wuhan (a city of 11 million inhabitants) and the surrounding province of Hubei. Those measures ultimately proved unsuccessful in limiting the spread. The WHO International Health Regulations Emergency Committee, of which Dr. Tam was a member, declared a Public Health Emergency of International Concern on January 30, 2020. By February, reports were appearing that viral spread in Bergamo, Italy, was epidemic, overwhelming hospitals.

Officials in Canada spent the next seven weeks reassuring the public that the risk was "low," despite overwhelming evidence of global spread. It was not until March 20, 2020, that the federal government adopted international border controls including screening, advisories, restrictions banning non-essential travel, and quarantine and isolation orders. Since then, major shortcomings have appeared in the public health apparatus designed to control the epidemic spread of a communicable respiratory virus, among them the systems for surveillance, risk assessment, laboratory testing, contact tracing, PPE, border security, data sharing and public messaging. These shortcomings have led to preventable suffering and death and ongoing societal-wide disruptions. While a comprehensive national inquiry into Canada's public health apparatus to probe those shortcomings is clearly needed, public inquiries into several of those systems have already pointed to the lack of integration, leading to functional problems and reactive solutions.

The disjointed and reactive nature of Canada's response to COVID-19 has demonstrated that Canada urgently needs to develop a biosecurity strategy. To be sure, the existence of a new biosecurity strategy is no guarantee of a better response to a biological threat: one need look no further than the United States, which had a biosecurity plan in place almost two decades prior to 2020 and fared worse than Canada in the face of COVID-19. Developing an effective biosecurity strategy requires strong political will and meaningful bureaucratic support, should be based on a rigorous process of policy development, and must include diverse stakeholders and experts. Strong transparency, accountability and regular testing mechanisms in the biosecurity strategy will be crucial to support PHAC in its work and to identify issues requiring correction before there is a crisis.

Canada's Public Health Apparatus before and during the Pandemic

An integrated biosecurity strategy must be built on core elements of Canada's public health apparatus. This section considers the state of several of these elements before COVID-19 and describes the deficiencies identified during the pandemic.

Biosecurity Surveillance and the GPHIN

As demonstrated — once again — by the COVID-19 pandemic, biological health threats that emerge outside Canada can magnify rapidly and easily cross geographic boundaries to escalate and

become a global crisis in a matter of weeks or months. Such events can occur anywhere and must be detected at the earliest possible moment to mount an effective response. Early detection of a biological threat requires a real-time surveillance system to collect, analyze and report public health data from anywhere in the world. Since 1997, this role has been performed in Canada by GPHIN. GPHIN acts as an early warning system by undertaking what is called "event-based surveillance" (EBS)[2] that uses both human analysts and computer algorithms to monitor media reports from all countries and to provide early warning of emerging public health events. GPHIN was the first EBS system to combine human and automated analytical components and, as such, was long considered a key player in an international community of surveillance systems and health signal detection (WHO 2019). It provided a real-time assessment of open-source news stories in nine languages, scanning for reports of chemical, biological, radiological and nuclear public health threats. GPHIN identified the outbreak of pneumonia of unknown cause in Wuhan, China, that would become COVID-19 on December 30, 2019, noted it on a Daily Report on December 31, 2019, and issued a special report on January 1, 2020. Both the president and chief public health officer of PHAC alerted senior officials in the federal government and Canada's response to COVID-19 was under way. Along with other global surveillance systems, GPHIN provided the earliest global detection of this unusual pneumonia. As such, GPHIN accomplished its core function and merited its reputation as the crown jewel in Canada's biological surveillance apparatus (Wark 2021).

The May 2021 report from GPHIN's independent review panel reaffirmed the network's value. However, the panel identified problems in its place within the PHAC structure, reporting and management and highlighted that GPHIN was not well connected to the essential function of risk assessment, meaning that its intelligence was not being fully leveraged (Bloodworth, Breton and Gully 2021).

Risk Assessment

Credible and timely risk assessment is an essential part of the emergency management of public health crises by combining epidemiologic information with expert judgment to identify the potential impact of a threat. When faced with a biological threat with unknown epidemiology, risk assessments based on signals from EBS are critical to guide decision makers in preparing for potential health, social and economic consequences. Prior to COVID-19, PHAC's guidance stated that pandemic risk assessments were intended to guide response planning and actions proportional to the assessed level of threat as well as to the reality of the evolving situation.

When COVID-19 struck, Canada's risk assessment process failed. The Auditor General of Canada described how the agency completed five 24-hour rapid risk assessments for COVID between January and March 2020. (There is evidence that a sixth assessment was completed and lost.[3]) The agency's methodology, still in a pilot stage in January 2020, was not designed to assess the likelihood of future spread and the potential impact in Canada of the epidemic risk posed by a communicable respiratory disease such as COVID-19 (Office of the Auditor General of Canada 2021a).

Laboratory Testing Capacity

Laboratory testing is a cornerstone of controlling a biological threat because it allows public health officials to act to stop the chain of infection and contain the spread. Laboratory testing for biological threats in Canada is led by PHAC's National Microbiology Laboratory in Winnipeg, which tests specimens from provinces and territories and, in turn, works with public health laboratories nationwide to develop accurate tests. On the eve of COVID-19, each province and territory was responsible for its own testing policy.

In January 2020, modelling showed that intense laboratory recognition of new cases, combined with close surveillance through contact tracing dramatically reduced the probability of sustained transmission and the occurrence of an outbreak (Thompson 2020). By March 2020, the incidence of COVID-19 was shown to be highly responsive to early vigorous testing combined with close surveillance of human-to-human transmission

2 Event-based (or syndromic) surveillance is the rapid detection, reporting, confirmation and assessment of public health events, including clusters of disease or rumours of unexplained deaths.

3 Wesley Wark, personal communication, July 30, 2021.

in China (Chen and Yu 2020). In March 2020, the WHO provided interim guidance on laboratory testing strategy recommendations for COVID-19 (WHO 2020a) as part of the Strategic Preparedness and Response Plan (WHO 2020b). Widespread testing was shown to have a sizable effect on viral spread (Zlatić et al. 2020). For example, in the first wave of the pandemic, South Korea successfully controlled the COVID-19 pandemic through vigorous testing along with contact tracing (Lee, Hwang and Moon 2020).

In the early days of the COVID-19 outbreak, testing in Canada was limited to symptomatic individuals as laboratories ran short of supplies (Crowe 2020) such as nasal swabs (Brend 2020). In Canada, the number of tests in the first six months of the pandemic dropped by an order of magnitude and did not approach the levels of testing needed (seen in other high-performing countries such as Korea) until August 2020 (Yu et al. 2020). The inability to maintain high testing rates was likely due, in part, to shortages of laboratory supplies (Semple 2020) and logistical flaws in large testing capacity (Stone and Weeks 2020). Compared with other countries, Canada was slow to introduce COVID-19 testing for international arrivals (January 2021) and, unlike other countries, that testing has been selectively applied (to non-essential air arrivals and, later, land arrivals).[4]

Contact Tracing

Contact tracing is the process of finding and assessing people who may have been exposed to a disease (Müller, Kretzschmar and Dietz 2000; Greiner and Angelo 2014). Laboratory testing and contact tracing go hand in hand. Once a person tests positive, symptomatic contacts can isolate while asymptomatic contacts can self-quarantine and monitor their symptoms. Contact tracing was effectively used to limit the spread of severe acute respiratory syndrome in Toronto in 2003 (Svoboda et al. 2004) and of Ebola in Africa in 2014 (Swanson et al. 2018). However, to be effective, contact tracing must be implemented early, when the case load is still low (Fraser et al. 2004). At the beginning of the COVID-19 pandemic, contact tracing was primarily a provincial responsibility and was often undertaken by municipal or regional health authorities. Fragmentation of the public health system and limitations of sharing of data made contact tracing challenging. For example, the Canada Border Services Agency (CBSA) and PHAC did not collect and share access to the same data sets, nor did they have data-sharing agreements in place.

When COVID-19 struck in 2020, Vietnam showed that testing and tracing were effective in keeping the first wave of the pandemic at bay (Pollack et al. 2021; Vu and Tran 2020). Taiwan's immediate response to the first wave was decisive in preventing spread (Wang, Ng and Brook 2020) and authorities there were able to report on the results of contact tracing and testing on the first 100 confirmed cases to advance important knowledge about the transmission dynamics of the disease (Cheng, Li and Yang 2020). These two low-middle-income countries are geographically close to China, yet both demonstrated a far better ability to contain the virus than Canada. The capacity for contact tracing in Canada was exceeded (Kleinman and Merkel 2020) because there was no national plan, there were too few trained personnel, the case load was too high when contact tracing began and there was a lack of centralized oversight on quarantine. Presumably to address the shortfall in contact tracers, Health Canada maintained an open call for volunteers to carry out this task. In July 2020, the Government of Canada called for an information sharing agreement between responsible government departments.[5]

National Emergency Strategic Stockpile System

The Canadian Pandemic Influenza Plan for the Health Sector, PHAC's 2006 "playbook" for influenza, called on the Canadian government to stockpile a minimum of "a consistent 16-week supply (i.e. two pandemic waves)" (PHAC 2006, 19) of vital PPE, including ventilators, N95 respirator masks, gowns, gloves and face shields. Essential supplies of PPE and medications are managed by PHAC's National Emergency Strategic Stockpile (NESS) system. In 2010, NESS supplies were stored in 11 warehouses across Canada and had been deployed 128 times in the previous 25 years (Laing and Westervelt 2020). Issues with the systems and practices used to manage and operate the NESS that were known for more than a decade were not

4 Kelly Lee, personal communication, August 22, 2021.

5 See www.canada.ca/en/public-health/corporate/mandate/about-agency/access-information-privacy/privacy/covid-19-application-quarantine-act-border-measures-arrivecan-july-2020.html.

addressed by PHAC (Office of the Auditor General of Canada 2021b, 6). At the beginning of the pandemic, supplies of PPE were unknown because the NESS lacked an electronic inventory management system. The agency did not have a process in place to establish how much of an inventory of this equipment should be stockpiled to help meet provincial and territorial needs during a public health emergency. These issues were well known.

The Auditor General of Canada reported that PHAC, Health Canada, and Public Services and Procurement Canada (PSPC) were not adequately prepared for the increased provincial and territorial needs for PPE and medical devices to address COVID 19. Rapid changes were noted after the onset of the COVID-19 pandemic, with the relevant agencies improving how they assessed needs and purchased, allocated and distributed equipment. For example, to improve the NESS, PHAC moved to bulk purchasing and outsourced much of the warehousing and logistical support, and PSPC mobilized resources and modified its procurement activities to purchase PPE.

Emergency Management Plans

The Government of Canada's role in leading and coordinating the emergency response is established under the Emergency Management Act[6] and the Federal Emergency Response Plan (Government of Canada 2011). Prior to the pandemic, PHAC had emergency management plans and national guidance to support a response for biological events (Pan-Canadian Public Health Network 2018). Pandemic plans were also available in seven provinces (Henry 2018)[7] and all of North America (Canada, the United States and Mexico 2012).

Before COVID-19, pandemic preparation was focused largely on pandemic influenza. While COVID-19 and influenza are both transmitted through the respiratory system — making a pandemic influenza plan potentially relevant — we now know that the differences between the two types of viruses affect key planning and modelling parameters. COVID-19 is like "influenza moving in very slow motion" (Barry, quoted in Branswell 2021): the incubation period (the time from infection to first symptoms), time sick and time spent shedding the virus are substantially longer. Crucially, asymptomatic transmission during the COVID-19 incubation period is one of the key differences that distinguishes it from influenza. Influenza pandemics tend to end abruptly with transmission dying out in any given location in a matter of weeks; infection patterns in COVID-19 depend on the effectiveness of physical distancing, gathering restrictions, mask mandates and, once available, of vaccines.

The Illusion of Preparedness

Before the onset of the COVID-19 pandemic, there was confidence that the existing health security structure (Tam 2018) and pandemic plans would keep Canadians safe from a biological threat, despite problems that were well known before COVID-19 and that had lingered unresolved for years. Those elements served to create the illusion of preparedness.

The lack of testing and coordination between levels of government in Canada was highlighted by the Auditor General of Canada (Office of the Auditor General of Canada 2021a). Once COVID-19 arrived, the lack of adequate planning became obvious through the reactive and fractured nature of governmental responses. Addressing the problems that manifested themselves in the pandemic is a necessary first step. As known problems were not fixed before the pandemic, is it realistic to expect the same approaches to planning and preparedness that were used before COVID-19 will be fixed before the next crisis?

Moreover, to prepare for the next biological crisis, Canada would obviously be far better served by moving from a reactive approach of fixing problems during the emergency to having a coherent and flexible plan that is regularly tested to probe for weaknesses in the public health apparatus and seeks to test the joint functioning of different elements of the public health apparatus.

6 *Emergency Management Act*, SC 2007, c 15, online: https://laws-lois.justice.gc.ca/eng/acts/e-4.56/.

7 See www.canada.ca/en/public-health/services/flu-influenza/pandemic-plans.html.

Recommendations for Developing a Biosecurity Strategy for Canada

Although there is uncertainty about where and when the next biological risks will arise, that notion must not be conflated with the idea that the risk is low: the emergence of new epidemic threats is certain. Canada needs to move from a reactive approach to one that is guided by a regularly tested biosecurity strategy.

Scope of the Strategy

Canada's biosecurity strategy must be designed to address all types of biological threats, including those whose likelihood of occurrence cannot be calculated and whose consequences are potentially catastrophic. It must be designed to guide rapid responses to unknown communicable viruses and diseases that cross from animals to humans (such as SARS-CoV-2, which causes COVID-19) and known threats (such as Ebola), which require urgent and directed responses (Calhoun 2004). It must address non-communicable infections (such as Lyme disease) and as yet unknown biological risks (such as those posed by antibiotic-resistant bacteria).

The biosecurity strategy must consider the source of infection, be it from biological mutation, species crossover, accidental release or a hostile actor deliberately seeking to inflict harm. Preventive strategies for these different sources are managed by different agencies, including PHAC, Global Affairs Canada, the CBSA and others. However, once a biological threat begins infecting humans, the preparation, detection and response remain the same, irrespective of the source. As such, Canada's biosecurity strategy must be developed using a whole-of-government approach by actively engaging the public health, intelligence, border security and other communities and effectively integrating all elements of the public health apparatus.

An effective risk-assessment process is crucial for preparing for biological threats. In the early stages of a communicable biological threat such as SARS-CoV-2, before the epidemiologic characteristics start to be described, high-quality rapid risk assessment is essential for early responses. Planning for other types of biological threats, such as the emergence of antibiotic-resistant bacteria, requires longer-term risk assessments. Canada's biosecurity strategy must include a centralized risk-assessment process that incorporates state-of-the-art event-based and indicator-based surveillance methods and assessment techniques. The GPHIN independent review panel recommended a dedicated risk assessment office within PHAC with a mandate to coordinate all health intelligence and to fill in gaps that may exist, in addition to analyzing the significance of such information (Bloodworth, Breton and Gully 2021).

Domestically, in Canada, the effects of COVID-19 were borne disproportionately by three groups: racialized peoples, the socio-economically disadvantaged and the elderly (Ali, Asaria and Stranges 2020). The biosecurity strategy must explicitly address equity issues through a social-determinants-of-health lens.

Canada's biosecurity strategy must account for the complex and adaptive ways systems interact (Kreienkamp and Pegram 2021). A modern framework for focusing on emergent infectious diseases is the "One Health" approach — a collaborative, multisectoral and transdisciplinary approach working at the local, regional, national and global levels — with the goal of achieving optimal health outcomes, recognizing the interconnection between people, animals, plants and their shared environment. Microbial stewardship is viewed in terms of interrelationships between humans, animals and plants, and the environment (Mackenzie, McKinnon and Jeggo 2014).

Integrating Canada's Biosecurity Strategy across the Federal Government

There needs to be a single governmental focal point for Canada's biosecurity strategy that spans PHAC, CBSA and Global Affairs portfolios. A senior-level official should have interdepartmental responsibility for coordinating an approach to preparedness that is consistent with vital systems security (Collier and Lakoff 2014), preparing risk advice on health security threats and marshalling

national responses when facing the next biological threat. The GPHIN independent review panel called for a dedicated risk assessment office (Bloodworth, Breton and Gully 2021). Other parts of government could contribute as appropriate, including Public Safety Canada, Transport Canada, Environment Canada and other departments. Such an approach aligns with a whole-of-government response. An example is Taiwan's biosecurity apparatus, called the National Health Command Center, which is part of a disaster management centre that focuses on large-outbreak response and acts as the operational command point for direct communications among central, regional and local authorities (Wang, Ng and Brook 2020). In the five-week period starting January 20, 2020, Taiwanese authorities produced and implemented a list of at least 124 action items related to border control, travel restrictions, case finding, PPE, communications and political responses (ibid.). The stark contrast between the actions undertaken by Taiwanese officials and the wait-and-see approach taken by Canadian officials before declaring a state of emergency on March 20, 2020, highlights what is possible when forecasting tools, foresight and willingness to act are combined.

Integrating Canada's Biosecurity Strategy with the Provinces, Territories and Indigenous Peoples

Canada's public health apparatus must be linked with other systems that are vital for the health of the population: health-care systems such as primary care, emergency departments and hospitals, and the social care system, which includes long-term care. During the first wave of COVID-19, the virus exposed major weaknesses in Canada's long-term care facilities, resulting in a staggering death toll among residents: by June 2020, Canada had the worst record among developed countries for COVID-19-related deaths in long-term care facilities for older people (Webster 2021). As the first wave subsided, deaths in Canadian long-term care homes accounted for 81 percent of all COVID-19-related deaths, compared with an average of 38 percent in other Organisation for Economic Co-operation and Development countries (Canadian Institute for Health Information 2020, 3). Inquiries in Ontario and Quebec and a report by the Canadian Armed Forces described the inhumane conditions occurring in long-term care facilities. Long-term care is excluded from the Canada Health Act and funding is substantially below that of other high-income countries: for example, Canada invests 14 percent of health spending on long-term care for the aging population, compared to 26 percent in Sweden (Picard 2018). This type of scenario, in which perennial underinvestment in long-term care combined with high mobility of care workers could lead to rapid viral transmission and high rates of death among vulnerable persons, could have been foreseen had simulations been undertaken.

A potential benefit of Canada's federated system of government is that it allows more localized and targeted responses for the unique circumstances faced by each province or territory; however, this was not the case during the COVID-19 pandemic. Using data on provincial and territorial government response indicators and aggregate stringency indices, Emily Cameron-Blake et al. (2021) found major differences between Canadian jurisdictions, observing that "With the creation of regional zones and tiered policy triggers, most regions have adopted reactive policies and restrictions, often too late, and not without unintended confusion. To date, the authors find that the benefits of federalism have been unevenly leveraged, a lack of coordination in planning and communication between the provinces and territories is an area of opportunity for improved future pandemic planning." Meaningful engagement with the provinces, territories and Indigenous peoples will be crucial for an effective Canadian biosecurity strategy.

Integrating Canada's Biosecurity Strategy with Other Countries

Canada must reinvigorate its international role by demonstrating a genuine desire to achieve excellence and position itself as an effective global partner and leader in health security. This means embracing the reality that health security cannot be effectively achieved within national boundaries and that we must have a global scan capacity and a preparedness plan for early detection of and rapid responses to emerging biological health threats. A multinational approach is needed, with Canada forming an integral part of the global biosecurity ecosystem.

One key initiative is to build on the Group of Seven commitment to "improving early warning systems" (Group of Seven 2021) by reframing Canada's health security apparatus to create an action-oriented organization with a national security approach that

is capable of rapidly assessing threats and providing operational direction. Core functions include horizon scanning, serving as a clearing house for information by collecting and curating health intelligence data from domestic and international areas of concern; developing risk assessments that can be quickly updated; making predictions that are linked to short-term policy decisions; and coordinating complex response capacity such as vaccination campaigns. Canada should move to regain a position in global health leadership by supporting these, and other, initiatives. As articulated by both independent panels reviewing GPHIN and the WHO, "if global surveillance is to be effective, different EBS systems will need to interact. No single system will be able to catch all events, but collectively, well-integrated systems have a far greater chance of sharing information and intelligence to capture a clearer picture of an emerging event. GPHIN, as an established leader in this field, should position itself as a collaborator that can share its knowledge and expertise, and that can also learn about different approaches and new ideas being developed elsewhere" (Bloodworth, Breton and Gully 2021). GPHIN has a history of contributing to the work of the WHO and may contribute and learn from the use of artificial intelligence to meaningfully engage with the many national, philanthropic and non-governmental-organization-based surveillance systems.

Data Infrastructure

The inadequacy of Canada's health data resources is an issue that must be urgently addressed (Picard 2019). For example, Canada lacks the infrastructure to adequately track infectious disease outbreaks, manage PPE and vaccine supply chains and storage, and monitor immunity and adverse reactions (Ling 2021). A reasonable first step would be for the federal government to lead the development of an EBS system across provinces. Such a system could be designed to feed into an indicator-based surveillance system. For example, a system developed in Massachusetts[8] sends nightly feeds from electronic health records and automatically executes surveillance algorithms and reports daily counts. That system has grown to encompass both infectious and non-infectious diseases (Platt 2013). Such a system allows central coordination of data algorithms and interpretation while minimizing workload and maximizing flexibility at each hospital, emergency room, primary care office or other site. This approach can incorporate data from different electronic health records, meaning that useful information can be gleaned from disparate systems of variable quality.

Communications

Even with different types of crises, government officials face similar challenges: a paucity of accurate information as the crisis unfolds, difficulty in communicating among decision makers and a confusing array of authorities, leading to contradictory messaging. As we have observed with COVID-19, pandemics are characterized by many areas of uncertainty in accepted knowledge and evolving details about the scale, risk and severity of the outbreak; the patterns of mortality and types of vulnerable individuals; and the response efforts from authorities (Morens and Taubenberger 2011). This situation creates substantial hurdles for clear, consistent and understandable messaging (Driedger, Maier, and Jardine 2018). To meet these challenges, Canadian pandemic plans (see Health Canada 2006) incorporate best practice guidelines from the WHO (see WHO 2005). Despite this, inconsistent communications from Canadian officials during COVID-19 led to confusion and induced mistrust toward health professionals (Zhang et al. 2021).

Lessons from other jurisdictions show the value of coordinated messaging from authorities: despite identifying the first confirmed case of COVID-19 and experiencing the first major outbreak in the United States, Washington State had the lowest death rate among all states that had major outbreaks in the first wave of the COVID-19 pandemic, due, in part, to clear messaging about a coordinated response plan from authorities (American College of Surgeons 2020). As an integral part of its biosecurity strategy, Canada needs to develop a transparent system of messaging that is well understood by the public. Moreover, officials from different levels of government need a system of harmonizing messages across jurisdictions. This issue is becoming increasingly acute as disinformation and fake news become more widespread and destructive.

Testing the Biosecurity Strategy

Each element in the public health apparatus must regularly undergo readiness testing to ensure that it functions as required. Such testing must involve

8 See www.esphealth.org/.

the evaluation of resources, services and personnel that lead to prompt, actionable responses. More complicated testing considers a systems perspective to assess how specific system elements interact when faced with a crisis (Rittel and Webber 1973). Ideally, when the next biological crisis arrives, there are no differences, either operationally or emotionally, between reality and previous training simulations (Kupperman 1983, 202).

A demonstration of the potential value of simulations recently came to light in England. Carried out in 2016, the report describes a simulated coronavirus outbreak in London and Birmingham (Booth 2021). Seemingly prescient, the report warned of the need for stockpiles of PPE, a computerized contact tracing system and screening for foreign travellers (Public Health England 2016). Two more key lessons that can be gleaned from this report are that, like Canada, UK government officials have admitted that pandemic planning focused on influenza, despite the known differences and risks of a coronavirus, and that the UK government was obliged, through a freedom of information request, to release the report after it refused to make it public.

Conclusions

There are myriad challenges to developing and implementing an effective biosecurity strategy, both in terms of the preparation for biological threats and the specifics of the Canadian public health system. Surveillance and assessment of biological risks are complicated by the challenge of finding the truly dangerous pathogen among the very large number of potential signals that end up being benign. Devoting resources to prevention and preparedness of events that have not yet occurred means that if the process is effective in averting an epidemic outbreak, the event may never occur, and the benefit is not necessarily visible.

In Canada, developing a biosecurity strategy means involving many governments that must value participating in the process. As such, to be successful, the endeavour must be non-partisan and transcend political considerations, including level of government and political affiliation.

Critical assessment of the biosecurity approaches in other countries will be foundational for Canada's biosecurity strategy. On October 1, 2021, Public Health England launched a new entity called the UK Health Security Agency that focuses on "external threats" to address "pandemics and future threats."[9] In Taiwan, the National Health Command Center serves as a comprehensive platform for preventing major epidemics by addressing "public health emergency and provides disaster information for decision-makers. It is a unified central command system that includes the Central Epidemic Command Center, the Biological Pathogen Disaster Command Center, the Counter-Bioterrorism Command Center and the Central Medical Emergency Operations Center."[10] Like the United Kingdom, Canada's biosecurity strategy must remain distinct from strategies to strengthen health systems, and like Taiwan, it should establish formal links between public health, intelligence and security functions within the federal government.

Esse Quam Videri (To Be, Rather Than to Seem)

It is folly to think that the same inadequate approaches to pandemic preparedness used prior to COVID-19 are likely to result in a better outcome in the face of future zoonotic threats. Developing a biosecurity strategy is a wise policy option for the federal government and its partners because the investment will bear dividends for decades to come. Canada needs to develop a unified approach to preparing, detecting and responding to biological threats that attracts real talent, has specific mandates and wields the authority to implement protective measures. The key lesson is that reimagining Canada's biosecurity strategy for the future requires bold steps. Time will tell if Canada can learn this lesson before the next pandemic.

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9 See www.gov.uk/government/organisations/uk-health-security-agency.

10 See www.cdc.gov.tw/En/Category/MPage/gL7-bARtHyNdrDq882pJ9Q.

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