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Public Health in Canada: An Overview

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Abstract

Public health is comprised of services, programs, and policies aimed at promoting health, preventing injury and chronic diseases, and responding to health emergencies. Public health professionals include front line providers, consultants, and specialists from various disciplines and professions, such as medicine, nursing, and epidemiology. Public health in Canada is provided through the collaboration between three levels of government, namely municipal, provincial or territorial, and federal. While public health is a shared responsibility of all levels of government, the volume and direction of allocated resources for related activities varies between the provinces and territories. Canada's public health history predates its founding in 1867. A turning point in public health in the country occurred following the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003. The following year, the federal Public Health Agency of Canada (PHAC) was created. Its role is to improve and maintain population health in Canada. The Chief Public Health Officer is the deputy head of the PHAC and is the government's lead public health professional. The public health landscape in Canada continues to evolve to meet the growing needs of its population and to address existing health challenges including adverse health events related to chronic diseases and unhealthy lifestyles. Moreover, it will further adapts in response to new public health threats, such as the emergence of tropical illnesses, the northward spread of infectious agents due to climate change, and disease transmission related to international travel.

Key words: **Canada, public health, history, financing, legislation, competencies, public health professionals**

Słowa kluczowe: **finansowanie, historia, Kanada, kompetencje, przepisy prawne, specjaliści zdrowia publicznego, zdrowie publiczne**

Introduction

Public health is comprised of services, programs, and policies aimed at maintaining health and protecting Canadians from morbidity and early mortality through promoting health, preventing injury and chronic diseases, and responding to health emergencies [1, 2]. Canada has adopted a population health approach which aims at improving the health of the overall population and reducing the existing health inequities by increasing the social and material statuses of the residents, as well as concentrating on the interconnected factors that impact health throughout the life course [3]. As a result, policies are aimed at improving the underlying key determinants of health [3, 4]. These have been identified as individual lifestyle choices, biological and genetic factors, social status and income, education levels, employment circumstances, support networks, the social environment, the physical and built environment, early childhood development, societal-determined roles, cultural background, and the health services continuum [3, 4]. Therefore, the population health approach focuses not only on improving

health but also encompasses strengthening of the health care system, improving the country's economic conditions, making decisions and policy recommendations based on evidence, increasing collaboration between different levels of government, and engaging Canadians in the shaping of the public health system [3].

Canada has a population of 35.5 million individuals who reside in ten provinces (from most to least populous: Ontario, Québec, British Columbia, Alberta, Manitoba, Saskatchewan, Nova Scotia, New Brunswick, Newfoundland and Labrador, Prince Edward Island) and three territories (from most to least populous: Northwest Territories, Nunavut, and Yukon) [5]. Health care services are provided to the Canadian population through provincial or territorial Ministries or Departments of Health [6]. Each province and territory determines its own health care budget, which is primarily financed by both provincial revenue through taxation and federal investment in the form of transfer payments specifically earmarked for health care [7–10]. Public health is the shared responsibility of all levels of government, including municipal, provincial or territorial, and federal governments [1, 11]. Total annual health care spending in Canada is $214.9 billion (2014 Canadian dollars, CAD) and public health represents 5% of the total national health care budget at $11.5 billion [12].

History of Public Health in Canada

Canada's public health history predates its founding Confederation in 1867 [13–15]. Throughout the eighteenth century, quarantine acts were passed as a result of infectious outbreaks of smallpox and typhus [15]. In 1832, a cholera epidemic led to the first organized public health efforts and to the establishment of a temporary Board of Health to monitor epidemics in Lower Canada [13, 14]. Another cholera outbreak in 1849 caused the formation of a Central Board of Health that was responsible for regulating guidelines for local health units [13, 15]. By the 1860s, present-day Canada had experienced numerous infectious outbreaks [13–15]. To manage each outbreak, a medical officer of health was selected or a board of professionals was created [13]. However, the monitoring bodies were dissolved following each epidemic [15]. During this time, cities and towns were responsible for the implementation of various by-laws, such as fumigation and quarantines that protected the health of their citizens during outbreaks [13]. By-laws were also developed for waste disposal, food safety, and housing to improve the overall health of the population [13]. In 1882, a permanent Board of Health was established in the province of Ontario and the Canadian Sanitary Association was formed [16–18]. The following year, French Canadians established the Société d'hygiène de la province de Québec [18]. In 1910, the national Canadian Public Health Association was created and nine years later, the Federal Department of Health was formed [13, 19].

Substantial casualties during World War I and a large number of infectious disease outbreaks in the early twentieth century led to greater public acceptance of organized government interventions on health issues [13, 15]. Awareness for the need of mental health services was increased following the return of Canadian soldiers from Europe after World War I and in 1918, the National Committee for Mental Hygiene was formed, which was the precursor to the Canadian Mental Health Association [13, 20]. Around the same time, advances in medicine and public health allowed diseases such as diphtheria, smallpox, and tuberculosis to decline [13]. These epidemiological challenges, in combination with further progress in medicine and the use of pharmaceuticals led to the concentration of resources on the treatment of diseases within Canada's health system, rather than on prevention efforts. Canada's leading research hospitals were further financed and expanded while new hospitals were established in smaller urban centres [13].

Following the development boom, the Minister of Health and Welfare Marc Lalonde introduced *A New Perspective on Health for Canadians* in 1974, commonly referred to as the Lalonde Report [13, 14, 21]. The report had an influence on changing Canada's health agenda to focus on prevention strategies and the reduction of risk factors, such as alcohol consumption and smoking, which were associated with the development of disease [13, 14, 21]. Subsequent to the Lalonde Report, the health promotion movement within Canada further developed with the report, *Achieving Health for All: A Framework for Health Promotion*, introduced by the Minister of Health and Welfare Jake Epp, and the *Ottawa Charter for Health Promotion* [15, 22]. This charter was presented in Ottawa, Canada, at the First International Conference on Health Promotion in 1986 and aimed to improve the health and well-being of Canadians by the new millennium (year 2000) and beyond [22]. The main processes involved in promoting health were establishing healthy public policy, fostering supportive conditions and environments, empowering communities, strengthening personal skills, and focusing health care services on training, education, and health research [22]. As such, public health was recognized as requiring the collaboration of various organizations to promote health across the country through improving health outcomes, acknowledging the determinants of health, and working through a multidimensional approach to increase the health and well-being of the population [14, 22].

In the new millennium, the dangers of infectious diseases, with their rapid transmission from continent to continent and devastating population health impacts, were once again brought to light. Severe Acute Respiratory Syndrome (SARS), caused by a coronavirus, had a significant influence on the public health system and its administration in Canada [23]. The SARS outbreak occurred in two waves in the country during 2003 and resulted in a provincial state of emergency being declared in the province of Ontario. Overall, SARS led to 438 suspected and probable cases with 44 deaths [23]. The outbreak revealed weaknesses in Canada's public health system [24]. Challenges included disagreements as to whether specific cases met the diagnostic criteria for SARS infection, a lack of communication strategy

to avoid mixed messages to the public, and an uncoordinated distribution of protective equipment to health workers in community settings [23, 25]. Moreover, the illness of health professionals experienced in infectious medicine took a toll on the morale of health care workers and the availability of health professionals with expertise in dealing with SARS [23, 25]. Following an analysis of the governmental response to SARS, it was found that there were collaboration issues between the provincial and federal governments which hindered the ability to communicate information and health data regarding the SARS outbreak among the different levels of power [25]. Findings from the exploration of the governmental response to the SARS outbreak led to the conclusion that a centralization of power is required and the benefits of a coordinated public health system at the federal level became apparent [23, 24]. These concerns were addressed through the creation of the Public Health Agency of Canada (PHAC) in 2004, which gained legal authority in 2006 under the *Public Health Agency of Canada Act* [26]. The PHAC is responsible for public health at the federal level in Canada [26].

Organization of Public Health in Canada

Historically, municipalities across Canada were responsible for acting on public health issues that arose in their communities [11]. While public health leadership at the local level has remained to this day, public health in Canada is now provided through the collaboration between municipal, provincial or territorial, and federal levels of government [1, 11]. The organization of public health at the provincial and territorial levels varies between the ten provinces and three territories in Canada. In general, provincial and territorial public health is administered through Ministries or Departments of Health with an appointed Chief Medical Officer of Health, while regional public health initiatives are spearheaded by Regional Health Authorities, Public Health Units, or Health Centres [6]. Provincial and territorial governments collaborate with the federal government via the Pan-Canadian Public Health Network to exchange expertise and knowledge, cooperate efficiently, and determine best practices for public health [1]. In general, municipalities are responsible for public health events that exist within their jurisdictional boundaries. Provincial or territorial governments respond if the public health event has overwhelmed the capacity of the municipal government or spread to other jurisdictions [1]. The federal government becomes involved when both lower levels of government require additional support to respond to the public health event or when the event affects other provinces or territories, thus, becoming a national concern [1].

The PHAC is one of several agencies and departments under the 'Health Portfolio' of the Government of Canada's Minister of Health, alongside the Canadian Food Inspection Agency (CFIA), Canadian Institutes of Health Research, Health Canada, and the Patented Medicine Prices Review Board [27–29]. The ongoing mandate of the Health Portfolio is to assist the federal Minister of Health with improving and maintaining the population's health in Canada [27]. The deputy head of the PHAC, the Chief Public Health Officer (CPHO), is the lead health professional responsible for public health in Canada and acts as the main liaison for public communications and media relations while ensuring coordination across the different levels of government in Canada [30, 31].

In addition to governmental agencies, there are various organizations dealing with public health in Canada. A notable national public health body is the Canadian Public Health Association (CPHA) [19]. The organization's efforts help guide health initiatives, advise decision makers, and advocate for improved health and well-being of individuals and communities, both in Canada and abroad [19]. CPHA also publishes the "Canadian Journal of Public Health" [32]. Across the country, provincial and territorial public health associations represent public health professionals [33]. Moreover, numerous universities nationwide have Schools or Departments of Public Health and academic centres that are involved in public health research [34]. The PHAC also plays a critical role in providing financial support for other public health organizations such as the National Collaborating Centres for Public Health (NCCPH) [35]. The six NCCPH, created in 2005, contribute to the public health knowledge base, thus, serving as important bodies in helping practitioners respond to public health issues [35]. The NCCPH actively link knowledge gained through research so that it can be utilized in industry by policy makers and public health practitioners [35].

Funding for health care and public health

The federal and provincial divisions of responsibility for health care, including those of a financial and administrative nature, are based on constitutional interpretation (*Constitution Act,* 1867, 1982) and subsequent legislation (*Hospital Insurance and Diagnostic Services Act*, 1957; *Medical Care Acts*, 1966; *Federal-Provincial Fiscal Arrangements and Established Programs Financing Act*, 1977; *Canada Health Act*, 1984; *Budget Implementation Act*) [8, 11]. The beginnings of federal support for health care are seen in the *Hospital Insurance and Diagnostic Services Act*, 1957, which required the federal government to provide funding to provinces for the costs of hospital and diagnostic services [8, 36]. Expanding the basket of services receiving federal support, the passage of the *Medical Care Act*, 1966*,* provided the legislative groundwork for federal coverage of physician services administered outside of hospital settings [8, 36]. Under this legislative environment, a cost sharing arrangement where 50% of provincial and territorial expenditures on insured services (hospitals and physicians) were covered by the federal government was established [36]. However, over time, the federal government began to view these arrangements as a source of expenditure it had little control over, while provincial governments felt that the scope of coverage at the time was too restrictive, particularly as preventative programs and care provided in community settings were increasingly seen as more efficient [8].

After the passage of the *Federal-Provincial Fiscal Arrangements and Established Programs Financing Act* in 1977, federal financial support for health care became a combination of the transfer of both tax points and cash payments [36]. Known as "block funding", these new arrangements allowed for federal cash transfers specifically directed towards health, while simultaneously allowing the provinces to set and invest in their own unique health care priorities [8, 36]. Over the years, numerous *Budget Implementation Acts* were passed by Parliament to describe the implementation of the annual federal budget, including transfers to provinces for various programs such as health care [8, 37]. Passed in 1984, the *Canada Health Act* replaced the financial arrangements between the federal and provincial governments in addition to consolidating and reaffirming the principles of the two previous insurance acts (universality, portability, comprehensiveness, accessibility, and public administration) [8, 36]. These principles, along with other specific conditions, must be adhered to by the provinces in order to receive full funding from the federal government [8].

Total annual health care spending in Canada was $214.9 billion in 2014 [12]. The largest health expenditures in the country were on hospitals ($63.5 billion, 30%), drug costs ($33.9 billion, 16%), and physician services ($33.3 billion, 16%) [12]. Further health care expenditures included other institutions ($22.2 billion, 10%), other health professionals ($21.8 billion, 10%), other health spending ($13.1 billion, 6%), capital costs ($8.9 billion, 4%), and administration ($6.7 billion, 3%) [12]. In comparison, the total budget for public health was $11.5 billion in 2014 [12]. National aggregated estimates of investment in all public health activities in Canada demonstrated an increase from 3.3% of total health care spending in 1975 to 5.3% of total health care spending in 2014 [7, 12].

The federal Minister of Health's Health Portfolio operates on a yearly budget of $3.8 billion dollars spread across several health care agencies, including the PHAC [27]. The PHAC's operating budget is provided directly by the Parliament, Canada's national legislature [38]. In the fiscal year of 2005–2006, in the early stages of the PHAC, the agency had an annual allowance of $481 million (2006 CAD) [38]. In the 2015–2016 year, it is estimated that the PHAC will spend $567 million (2015 CAD), divided among Public Health Infrastructure ($115 million), Health Promotion and Disease Prevention ($297 million), and Health Security ($60 million), along with Internal Services ($96 million), which include communications, financial, legal, management, information technology, material, and property services [39]. In addition, it is expected that there will be 2,488 full-time equivalent positions at the PHAC during the 2015–2016 year [39].

While public health is a shared responsibility between all levels of government, the volume and direction of allocated resources for related activities varies between provinces and territories and by source of funding [11, 40]. The Canadian Institute for Health Information (CIHI) records public and private sector funding for health spending in Canada [41]. Funding for public health activities comes from four public sector sources – federal, provincial, and municipal levels of government, in addition to social security payments, with no reported dollars coming from private sector investment [12, 41]. Spending on public health per source of funding in Canada is presented in **Table I**. As demonstrated in the table, $11.5 billion (2014 CAD) was spent on public health, with over three-quarters of the funds coming from provincial budgets [12]. A breakdown of public spending among the ten individual provinces and three territories is shown in **Table II**. As would be expected, the most populous provinces had the highest health care expenditures. Public health spending accounted for 2.8% to 8.5% of the total health care budgets among the provinces, while among the territories, it accounted for 7.5% to 12.8% of the total health care budgets [42].

Public Health Agency of Canada

The main agency responsible for public health at the federal level is the PHAC, which coordinates a joint governmental response to public health events and can communicate with international agencies as required [1]. Across the nation, the PHAC is responsible for infectious diseases, chronic diseases, travel health, food safety, immunizations and vaccines, emergency preparedness and response, health promotion, injury prevention, laboratory biosafety and biosecurity, and surveillance, which are described further in *Appendix 1* [29]. The PHAC has undergone organizational restructuring since its creation in 2004 and is currently comprised of five branches: the Health Promotion and Chronic Disease Prevention Branch; the Infectious Diseases Prevention and Control Branch; the Strategic Policy, Planning, and International Affairs Branch; the Health Security Infrastructure Branch; and the Chief Financial Officer Branch [43–48].

Federal (CAD in millions)	Provincial/Territorial (CAD in millions)	Municipal (CAD in millions)	Social Security Funds (CAD in millions)	Total Spending on Public Health (CAD in millions)
1,794.3	8,828.9	453.2	409.3	11,485.8

Table I. *Public health spending by source of funds, 2014, in Canadian dollars (2014 CAD).*
Source: The Canadian Institute for Health Information (CIHI)[12].

Province or Territory	Population (2014)	Health Care Spending (CAD in millions)	Public Health Spending (CAD in millions)
Ontario	13,678,700	80,709.4	4,700.1
Québec	8,214,700	46,138.7	1,310.6
British Columbia	4,631,300	27,299.2	1,820.4
Alberta	4,121,700	27,821.7	1,770.3
Manitoba	1,282,000	8,541.3	592.5
Saskatchewan	1,125,400	7,255.3	618.6
Nova Scotia	942,700	6,364.7	186.2
New Brunswick	753,900	4,797.8	177.3
Newfoundland and Labrador	527,000	3,654.2	120.6
Prince Edward Island	146,300	944.0	49.2
Northwest Territories	43,600	534.1	40.3
Nunavut	36,600	474.0	51.9
Yukon	36,500	372.8	47.8

Table II. *Public health spending across Canadian provinces and territories, 2014, in Canadian dollars (2014 CAD). Source: The Canadian Institute for Health Information (CIHI) [5, 42].*

The branches include centres dedicated to different public health areas and are headed by Assistant Deputy Ministers or Branch Heads [46, 49].

For the 2015–2016 years, the PHAC's plans and priorities were organized into three main programs to address the main strategic outcome of "protecting Canadians and empowering them to improve their health" [39]. These were Public Health Infrastructure, Health Promotion and Disease Prevention, and Health Security. The first program, Public Health Infrastructure, was comprised of three sub-programs: (1) Public Health Capacity Building, (2) Public Health Information and Networks, and (3) Public Health Laboratory Systems [39]. The second program, Health Promotion and Disease Prevention, included (1) Infectious Disease Prevention and Control [further subdivided into (a) Immunization, (b) Infectious and Communicable Disease, and (c) Foodborne, Environmental and Zoonotic Infectious Disease], (2) Conditions for Healthy Living [further subdivided into (a) Healthy Child Development and (b) Healthy Communities], and (3) Chronic Disease and Injury Prevention [39]. The third program, Health Security, was composed of three sub-programs: (1) Emergency Preparedness and Response, (2) Border Health Security, and (3) Biosecurity [39].

Chief Public Health Officer

The Chief Public Health Officer (CPHO) is the deputy head of the PHAC and is the Canadian government's lead professional in public health [31]. The CPHO is appointed by the Governor in Council and can hold office up to five years with the possibility of reappointment to additional terms [31]. The role of the CPHO is to provide advice on public health matters to the federal government and the Minister of Health, collaborate with agencies and organizations within Canada and abroad, compile a yearly report to the Canadian parliament, and inform the population on health issues [30, 31]. The CPHO is actively involved in communicating with the general public and health professionals through mass media, meetings, conferences, and the PHAC website [30]. In the event of a public health emergency, the CPHO is the mediator between the public and the Government of Canada in relaying health information to protect the population [30]. The CPHO is also responsible for directing the coordinated action of the PHAC and associated public health professionals in reaction to an emergency [30]. Furthermore, the CPHO is in constant contact with Chief Medical Officers of Health in the provinces and territories during this time [30, 31].

Public Health competencies

Seven core competency statements for public health, describing thirty-six core competencies, have been established in Canada to outline the skills, knowledge, and attitudes that are fundamental for public health practitioners [50, 51]. Through the use of these principled competencies, public health work is aligned with specific standards, which are consistent across different areas of public health and the multiple organizations providing public health services [51]. Moreover, the competencies assist organizations in achieving common goals to fulfill specific public health functions and can provide organizations with a rationale for funding particular programs and services [51].

The core competencies were drafted in 2005 by the Federal/Provincial/Territorial Joint Task Group on Public Health Human Resources [51]. The need for a strengthened public health workforce and capacity came to light in the report, *Building the Public Health Workforce for the 21st Century*, which referenced particular public health events in Canada and abroad that demonstrated a lack of appropriate response measures taken to adequately manage them [51, 52]. For instance, the report highlighted the

SARS outbreak in 2003 in Canada, the potential threats of bioterrorism after the terrorist attacks in the United States in 2001, the contaminated blood supplies in the health care system (Krever Report of 1997), and noted increases in preventable chronic diseases across Canada [52, 53]. The report specified that the PHAC would be responsible for modifying and validating the competencies as necessary, with the CPHO and the PHAC contributing leadership in the public health sector [51, 52]. In 2006, a revised draft of competencies was prepared and included feedback from relevant public health stakeholders across Canada with input from varying levels of government [51].

Following widespread consultations with government, professional organizations and representatives from various disciplines, as well as pilot testing, the seven core public health competency categories were officially published [51]. The core competency statements, described in **Table III**, encompass (1) public health sciences, (2) assessment and analysis, (3) policy and program planning, implementation and evaluation, (4) partnerships, collaboration and advocacy, (5) diversity and inclusiveness, (6) communication, and (7) leadership.

Professionals working in Public Health

Public health professionals include front line providers, consultants, and specialists, and come from various disciplines and professions including medicine, nursing, epidemiology, biostatistics, behavioural sciences, and social sciences [50, 51]. These practitioners deal with issues that are important to public health, such as occupational health, environmental health, health promotion, infectious diseases, injury, and chronic diseases to name a few [50, 51]. Public health professionals are directly involved with the general public and subsets of at-risk populations or indirectly involved with the public

Core Competency Category	Description of Competency Category
Public health sciences	• Describes the ability to apply key knowledge and critical thinking skills to practice within a variety of professions within the public health sciences • Requires familiarity with the population and its health status, including determinants of health, inequities, disease prevention, and health promotion, as well as their interactions with health services at various levels from local to international • Encourages employing evidence-based information and applying it to the creation of programs and policies, as well as continuing education among professionals
Assessment and analysis	• Encompasses data collection, analysis, and communication of results with recognition of the various needs and contexts within the population • Overviews the skills necessary for monitoring the health status within populations, as well as identifying health problems that exist • Includes the ability to use data to inform policies, practices, reports, carry out investigations, and provide adequate recommendations
Policy and program planning, implementation and evaluation	• Focuses on competencies required in choosing the most appropriate measures to manage health problems, emergencies, and outbreaks • Includes the analysis of various options available in reaching the public health goals, considering the determinants of health and the resources which are available • Involves the planning, implementation, and evaluation of programs, policies, and guidelines
Partnerships, collaboration, and advocacy	• Refers to the competencies needed to collaborate with other entities working on improving the health of the population • Includes advocating for public health programs and policies that encourage the promotion of well-being and protection of health • Encompasses the formation of partnerships between agencies and health service providers to work efficiently, share resources, and divide responsibilities while completing their tasks
Diversity and inclusiveness	• Involves the recognition of determinants of health that may impact the health of certain individuals • Focuses on the recognition that these factors should be identified and addressed when delivering public health programs • Mandates that public health work be conducted in a way to ensure inclusive practices and policies
Communication	• Includes effective communication, exchange of ideas, and deliverance of information to audiences, ranging from individuals to communities, as well as between professionals working in different settings • Ensures that the relayed messages are appropriate and understandable to the target audience • Incorporates various methods of communication, including oral and written, through various means including mass media, targeted advertisements and mailing lists, and educational announcements
Leadership	• Describes the competencies needed to strengthen the performance of organizations and the climate in which public health practitioners work in • Requires the ability to conduct work by respecting ethical standards in the management of information, resources, and staff • Ensures that public health organizations are able to collaborate and interact with each other and exchange ideas, experiences, advice, and tools

Table III. *Overview of the PHAC's Core Public Health Competencies.*
Source: Public Health Agency of Canada [50, 51].

through monitoring, surveillance, or administrative work [51]. Individuals working in public health have a range of educational backgrounds including training in specific health professions (e.g. medicine, nursing), Bachelor's degrees specializing in public health or health studies, and graduate degrees such as research-oriented Master degrees or professional Master of Public Health degrees [54]. The PHAC delivers the Canadian Field Epidemiology Program, which provides applied epidemiology training to professionals in the public health field, like epidemiologists, public health specialists, physicians, and veterinarians [55]. The PHAC also offers online continuing education courses for professionals through *Skills Online* [56]. As an example of public health responsibilities in health care in Canada, two licenced health professions, namely nurses and physicians, will be described in the next two sections.

Nursing Contributions to Public Health in Canada

Nurses form the core of a variety of community health settings in Canada, including public health departments, community health centers, home care agencies, and primary care organizations [54, 57, 58]. There are three recognized categories of nurses within Canada, namely, Licensed Practical Nurses (LPNs) (known as Registered Practical Nurses within the province of Ontario), Registered Nurses (RNs), and Nurse Practitioners (NPs) [59]. According to a national report published by the CIHI (2013), approximately 10% of LPNs, 13% of RNs, and more than 50% of NPs work in community health settings [59]. In general, nurses working in these community health settings play important roles in health promotion, disease prevention and management, community development, health surveillance, and emergency preparedness and response [60]. Importantly, nurses working within community health settings focus on delivering holistic care utilizing the principles of primary health care while also considering the social determinants of health in their planning of activities [60].

With respect to specific roles of community health nurses, there is substantial variability across jurisdictions and health care settings in Canada [60, 61]. Public health nurses make significant contributions to the development, implementation, and evaluation of comprehensive interventions targeted at preventing several prevalent chronic diseases, such as cardiovascular disease and diabetes [61]. Furthermore, nurses working in public health lead important initiatives targeted at improving the overall health of Canadians. For example, nurses are engaged in breastfeeding programs that increase breastfeeding rates (e.g. Baby Friendly Initiative, a WHO/UNICEF international program overseen by the Breastfeeding Committee for Canada) [61]. They also lead various comprehensive school programs in which nurses assess the health needs of individuals belonging to a specific class, school, or surrounding community, address any health issues that arise through strategies, and support the implementation and evaluation of these strategies [61]. Importantly, nurses working within community health settings administer immunizations in accordance with the Immunization Schedules recommended by the National Advisory Committee on Immunization [62]. The roles of nurses within each regulatory designation that work in the community health sector in Canada are currently understudied [61]. Although nurses make up a large part of the workforce within the community health sector and they undertake fundamental activities that contribute to improved health of the Canadian population, there is a growing need to demonstrate their unique contributions and added value to patient care within this setting [61].

Physician Contributions to Public Health in Canada

Physician engagement in public health came in the 1800s through involvement in infectious disease outbreak management, disease prevention, and public health promotion [13, 63]. For example in Ontario, the permanent position of the Medical Officer of Health was established in 1884 [63]. Together with other health professionals and community leaders, physicians were involved in responding to public health outbreaks in their capacity as public health officers [13]. Presently, each province and territory has a Chief Medical Officer of Health (or equivalent) who is the lead public health professional in the region [6]. At the federal level, the Chief Public Health Officer is the deputy head of the PHAC and is responsible for public health nationally [31]. Public health physicians in Canada typically complete a five-year residency training program in Public Health and Preventive Medicine (formerly known as Community Medicine) accredited by the Royal College of Physicians and Surgeons of Canada, following their medical education [64, 65]. During the course of their residency training, resident physicians may complete training in Family Medicine in addition to Public Health and Preventive Medicine [65].

Public health physicians are engaged in governmental organizations at all levels (municipal, provincial/territorial, federal governments), as well as in non-governmental organizations, academic settings, clinical practice, and health administration [65]. The roles of public health physicians focus on promoting health, preventing illness, and averting premature death in communities [65]. This may be done through the identification of health needs and problems among population groups, the creation and implementation of public health programs, and policy development [65]. Public health physicians apply skills and knowledge in epidemiology, biostatics, health economics, surveillance methods, population health assessment, as well as in preventive medicine to population-based interventions designed for at-risk groups [64, 65]. In addition, public health physicians have the ability to effectively communicate health information to both general and academic audiences [64]. Physicians working in public health and preventive medicine are represented by the professional association, Public Health Physicians of Canada [66].

Further Considerations

The current organization of the public health system in Canada reflects the many challenges that were faced during the SARS outbreak in 2003 and the lessons learned from the experience which resulted in the establishment of the PHAC in 2004. As new health difficulties arise, such as the emergence of tropical illnesses, the northward spread of infectious agents due to climate change and international travel, and existing health challenges persist, including chronic diseases and unhealthy lifestyles, the public health landscape in Canada will continue to evolve to meet the growing needs of its population. Furthermore, collaboration between municipal, provincial and territorial, and federal governments will need to be strengthened to ensure the proper coordination of resources in dealing with public health problems and emergencies. Moving forward, the roles of public health professionals should be reviewed further to ensure that their knowledge and skillsets are being utilized in an efficient manner to optimize and strengthen the public health system across the provinces and territories in Canada, as well as at the national level.

Appendix 1. Responsibilities of the Public Health Agency of Canada (PHAC)

The next sections will provide brief overviews of public health areas that the PHAC is responsible for, including infectious diseases, chronic diseases, travel health, food safety, immunizations and vaccines, emergency preparedness and response, health promotion, injury prevention, laboratory biosafety and biosecurity, and surveillance [29].

Infectious Diseases

There are two main national laboratories at the PHAC dealing with infectious diseases: the National Microbiology Laboratory and the Laboratory for Foodborne Zoonoses [67]. The National Microbiology Laboratory, located in Winnipeg, Manitoba, deals with infectious disease surveillance, prevention, identification, control, and outbreak management [68, 69]. It houses facilities capable of dealing with organisms requiring level 2 to level 4 containments [68]. The Laboratory for Foodborne Zoonoses oversees risk reduction, surveillance, and research related to foodborne illnesses, environmental issues, and antimicrobial resistance [70]. The main laboratory is located in Guelph, Ontario, with additional sites found across the provinces of Québec, Alberta, and Ontario [70]. Infectious diseases in Canada are monitored through a variety of surveillance systems. The *Canadian Notifiable Diseases Surveillance System* tracks a range of nationally notifiable diseases including: health care acquired infections, diseases transmitted by the respiratory route, sexually transmitted diseases and infections caused by bloodborne pathogens, vertically transmitted infections, which are passed from mother to baby, vaccine preventable diseases, enteric, food and waterborne diseases, prion diseases, and zoonotic and vectorborne diseases [71, 72]. Moreover, the PHAC provides guidelines on infection control topics, such as preventing infection transmission in health care settings and controlling the spread of communicable diseases on modes of transportation [73]. It also publishes information on a variety of infectious diseases through the *Canada Communicable Disease Report*, a peer-reviewed journal on infectious disease topics, Advisory Committee and Agency statement summaries, and rapid communications [73, 74]. Another publication is *FluWatch*, which is a weekly (throughout influenza season) or biweekly (off-season) report that provides information on influenza surveillance in the country [75].

Chronic Diseases

Chronic diseases are the leading causes of morbidity in Canada and their prevalence is increasing, causing a substantial societal and economic burden [76–78]. Thus, the prevention and management of chronic diseases is an important area of focus for the PHAC [79]. To aid with this task, the PHAC provides resources and information on risk factors and best practices related to chronic diseases, publishes reports on the status of chronic illness in the nation, and oversees surveillance systems tasked with monitoring the prevalence of chronic diseases [79, 80]. For the general public, the PHAC provides tools aimed at increasing health literacy and supports health professionals in communicating health information [81]. The *Canadian Best Practices Portal* offers evidence-based information on chronic diseases, interventions geared at health promotion and disease prevention, and policy issues [82, 83]. Furthermore, the PHAC published a scientific journal, *Health Promotion and Chronic Disease Prevention in Canada: Research, Policy and Practice*, which focuses on research and policies related to promoting health and preventing and managing chronic diseases in the country [84]. Through the World Health Organization Collaborating Centre on Chronic Noncommunicable Disease Policy, the PHAC works internationally on chronic disease prevention and control, as well as on public health policies [85]. Chronic diseases in Canada are monitored through various surveillance systems, databases, and surveys. The *Canadian Chronic Disease Surveillance System* links administrative data to report on chronic diseases and the health service use of individuals with chronic diseases [75, 86, 87]. Furthermore, the *Canadian Primary Care Sentinel Surveillance Network* gathers data from primary care offices across the country and among other conditions, focuses on chronic diseases [88]. In addition, administrative databases collect information on chronic diseases, such as the Canadian Cancer Registry [89]. Furthermore, numerous nationally representative surveys, including the Canadian Community Health Survey, the Canadian Tobacco, Alcohol and Drugs Survey, and the Canadian Health Measures Survey conducted by Statistics Canada, are carried out to provide insight into chronic disease prevalence in the population [90–92].

Travel Health

The PHAC website offers Canadians planning to travel abroad the opportunity to view *Travel Health Notices*, as well as information on recommended vaccinations and advisories related to their travel destinations [93, 94]. Moreover, the expert advisory Committee to Advise on Tropical Medicine and Travel (CATMAT) reports to the PHAC's Assistant Deputy Minister of the Infectious Disease Prevention and Control Branch [95, 96]. CATMAT was established in 1990 and is responsible for advising the PHAC on tropical diseases or illnesses which may be acquired by Canadians while travelling, as well as recommending prevention and treatment strategies for these infections and determining research priorities in travel medicine [95, 96]. CATMAT has also released numerous statements and recommendations to provide health information on travel topics [95]. Furthermore, the Office of Border Health Services is accountable for preventing the spread of illness related to travel [97]. Quarantine Officers work under the auspices of the *Quarantine Act* at stations across international entry points to Canada and are in charge of screening travellers for communicable diseases through the Quarantine Program [98, 99]. The Travelling Public Program is responsible for protecting the health of travellers through monitoring the safety of food, water, and sanitation on means of transportation, as well as ensuring appropriate health safety conditions aboard transports of goods in accordance with the *Department of Health Act* (*Potable Water Regulations for Common Carriers*) and the *Quarantine Act* [100].

Food Safety

The PHAC is involved in food safety through the Centre for Foodborne, Environmental and Zoonotic Infectious Diseases, which is engaged in monitoring, evaluating the risk, and determining the social and economic burden of foodborne illness [101]. Along with the National Microbiology Laboratory's Enteric Diseases Program, the Centre monitors the occurrence of infections caused by foodborne pathogens through the *National Enteric Surveillance Program* [102]. The Laboratory for Foodborne Zoonoses is engaged in research and surveillance related to contaminated foods and the prompt identification of outbreaks [70]. FoodNet Canada, which is headed by the PHAC, is involved in sentinel surveillance at public health units, health authorities, and provincial laboratories in order to identify diseases related to the consumption of contaminated water and food, and to strengthen policies to ensure water and food safety [103]. For foodborne illness outbreaks affecting multiple jurisdictions, the PHAC along with Health Canada and the Canadian Food Inspection Agency (CFIA) created *Canada's Foodborne Illness Outbreak Response Protocol* [104]. Its role is to guide the identification of outbreaks and the establishment of a coordinated response along with municipal and provincial or territorial bodies, which are responsible for food service and restaurant inspections in their jurisdictions [104, 105]. The Government of Canada also provides publicly accessible information on safety alerts and recalls related to food through an online portal [106].

Immunizations and Vaccines

The Health Products and Food Branch of Health Canada is responsible for regulating vaccines across the nation [107]. All licensed vaccinations in Canada are listed and recorded in the Vaccine Identification Database System [108]. Recommendations on vaccination usage are provided by the National Advisory Committee on Immunization to the PHAC [109]. Based on the recommendations, each province and territory develops its own immunization programs, which are publicly funded for vaccinations listed on the immunization schedules [109, 110]. The federal government also oversees the supply and demand of vaccines and works with provinces and territories to prevent shortages [111]. The PHAC has developed educational programs through various media outlets aimed at increasing the awareness and importance of immunization programs [112, 113]. It also provides information on vaccine-preventable diseases, vaccine safety, and influenza through the *Canadian Immunization Guide* publication [112, 113]. In terms of surveillance, the PHAC's Centre for Immunization and Respiratory Infectious Diseases coordinates the Canadian Measles/Rubella Surveillance System, which monitors the occurrence of measles, rubella, congenital rubella infection, and congenital rubella syndrome [75]. Furthermore, IMPACT (*Immunization Monitoring Program ACTive*) which is coordinated by the Canadian Paediatric Society, reports diseases that are vaccine preventable, adverse events related to immunizations, and vaccine failures among children [114]. The nationally representative *Childhood National Immunization Coverage Survey* sponsored by the PHAC and conducted by Statistics Canada provides information on vaccination coverage among Canadian children for routine immunizations, as well as parental and guardian knowledge on and attitudes towards immunizations [115, 116]. The most recent survey data from 2013 taken from 24,000 participants showed that among two-year-old children, 91% were immunized against polio; 89% were immunized against measles, mumps, and rubella; 77% were immunized against diphtheria, pertussis, and tetanus; and 73% were immunized against varicella [115, 117]. Over two-thirds (72%) of twelve to fourteen year old females were immunized against human papilloma virus [115].

Emergency Preparedness and Response

Public health emergencies can arise from accidents, natural disasters, criminal activities, security breaches, or terrorist threats [118]. At the PHAC, the Centre for Emergency Preparedness and Response is in charge of coordinating responses to national emergencies, supporting provinces and territories in states of emergency, monitoring national and global outbreaks, and preparing and maintaining guidelines on laboratory safety, quar-

antine, bioterrorism, and emergency plans [118, 119]. Furthermore, the Centre is responsible for the *National Emergency Strategic Stockpile* of emergency supplies, including medical goods and pharmaceuticals [119]. Public health outbreaks and emergencies often cross international boundaries and require the harmonized response from numerous countries. Health Canada's Counter-Terrorism Coordination and Health Information Networks Section oversees the monitoring of chemical, biological, radiological, and nuclear health threats [120]. In addition, the Global Public Health Intelligence Network surveillance system provides real-time information on public health threats internationally [120]. Further to this, along with the United States and Mexico, Canada is committed to addressing pandemic influenza in a coordinated manner in accordance with the framework outlined in the 2012 document, *North American Plan for Animal and Pandemic Influenza* [121].

Health Promotion

The goal of health promotion is to improve the health and well-being of the population and to achieve the PHAC collaborates with other national organizations through various programs to address public health issues and risk factors [122]. Since a third of Canadians reside in remote or rural areas, programs have been set up to educate the public on rural health-related challenges, accessing health services and information through *Telehealth* technologies, and agricultural health and safety [123]. The Healthy Living Unit within the PHAC provides programs to promote healthy living, address physical inactivity and poor diets, prevent chronic diseases, and ensure early disease detection in accordance with the Integrated Pan-Canadian Healthy Living Strategy and the *Integrated Strategy on Healthy Living and Chronic Disease* [124]. One of the focus points of the strategies is childhood obesity prevention and healthy weight promotion to improve quality of life [125]. Furthermore, the Canadian Society for Exercise Physiology, in collaboration with the government of Canada, created national, evidence-based physical activity guidelines for children, youth, adults, and older adults in Canada, as well as activity recommendations for toddlers and preschoolers [126–128]. Various initiatives in health promotion and disease prevention are delivered by the PHAC with a core focus on prenatal care, healthy infancy and childhood, and child and youth rights [122, 129–133]. The PHAC provides education, intervention strategies, and tools for abuse prevention and screening in communities [134, 135]. Child abuse and domestic violence are monitored via the *Canadian Incidence Study of Reported Child Abuse and Neglect* [134].

Injury Prevention

The PHAC oversees the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) which collects information on poisoning and injuries from emergency departments at four general hospitals and eleven paediatric hospitals across the country, recording patient demographics and injury information [136, 137]. The collected data are analyzed and used to raise awareness about injuries, prevention mechanisms, and strategies to avert injuries particularly among children, through scientific publications and CHIRPP Injury Reports [136, 138]. Common injury information and prevention strategies are also available through the PHAC's reports and fact sheets [138]. The PHAC is active in injury prevention among the elderly through the Division of Aging and Seniors, providing educational materials on avoiding injuries, fostering safe environments at home and outside, and developing policies on injury prevention [139, 140]. The Pan-Canadian Age-Friendly Communities Milestones have been developed by the PHAC with other collaborators to outline the required steps for communities to become more age-friendly and accessible for seniors [141]. In line with the milestones, seniors across the country are creating advisory committees with active engagement from municipal councils to devise action plans and implement changes [141].

Surveillance

An important part of public health practice is the availability of mechanisms to monitor the health of the population and to alert authorities about anomalies or outbreaks [75]. There are numerous national surveillance programs headed by the PHAC that provide information on the health of Canadians and track specific conditions [75]. In addition to the surveillance systems described in earlier sections, the PHAC, along with other organizations, monitor maternal and child health through the Canadian Perinatal Surveillance System, the Canadian Congenital Anomalies Surveillance Network, and the Canadian Paediatric Surveillance Program [75]. The Canadian Nosocomial Infection Surveillance Program monitors health care facility-related infections across all ten provinces [75, 142]. In terms of monitoring adverse events related to blood transfusions and transplantation, surveillance systems such as the Blood Safety Contribution Program, the Transfusion Transmitted Injuries Surveillance System, the Cells, Tissues and Organs Surveillance System, and the Transfusion Error Surveillance System are in place [75, 143]. Due to Canada's northern geography, the country is part of the International Circumpolar Surveillance System along with other circumpolar countries (the United States, Greenland, Iceland, Norway, Sweden, Finland, and Russia) and monitors the occurrence of invasive bacterial diseases in the northern regions in real-time [75]. Another surveillance program carried out by the PHAC is West Nile virus surveillance which is on-going since the first human cases in Canada in 2002 [75, 144]. Other conditions that are monitored in Canada include respiratory viruses (Respiratory Virus Detection Surveillance System), human immunodeficiency virus and acquired immune deficiency syndrome, invasive meningococcal disease (National Enhanced Invasive Meningococcal Disease Surveillance System), and Creutzfeldt-Jakob Disease (Creutzfeldt-Jakob Disease Surveillance System) [75].

Laboratory Biosafety and Biosecurity

Biohazardous materials must be tightly regulated to avoid potential adverse consequences to public health. Within Canada, laboratory biosafety and biosecurity are currently administered and enforced by the PHAC and the CFIA [145]. These agencies jointly created the Canadian Biosafety Standards and Guidelines (CBSG), which outline the physical and operational requirements for handling and storing biohazardous materials, including human and animal pathogens, prions, and biological toxins [146]. Laboratories and facilities that possess, handle, store, or use biohazardous materials must comply with the standards and guidelines outlined in the CBSG in order to maintain their certification with the PHAC or the CFIA and to avoid being penalized by these regulatory bodies [146, 147]. Importation of biohazardous material is also regulated by the PHAC and the CFIA according to the *Human Pathogens and Toxins Act*, the *Human Pathogens Importation Regulations*, the *Health of Animals Act*, and the *Health of Animals Regulations* [148]. The PHAC and the CFIA offer online training modules for employees who handle biohazardous materials to improve the level of biosafety and biosecurity in the workplace [149]. The agencies also provide information on the hazardous properties of specific biohazardous materials to inform laboratory personnel about potential risks and precautions that should be taken when working with these agents [150, 151]. Furthermore, the PHAC and the CFIA develop directives for pathogens or toxins whose containment levels do not align with their risk groups, and they issue advisories when the risk assessment of a pathogen identifies new requirements that are necessary for its safe handling and storage [152].

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