DEFINING PUBLIC HEALTH SYSTEMS

DEFINING PUBLIC HEALTH SYSTEMS: A CRITICAL INTERPRETIVE SYNTHESIS OF HOW PUBLIC HEALTH SYSTEMS ARE DEFINED AND CLASSIFIED

By:

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Lay Abstract

Public health and public health systems have been poorly understood as no clear or consistent definition of public health systems exist within the current literature. An interpretive synthesis was conducted to determine how public health systems have been defined.

Public health and public health systems have been defined in various ways. Functions and services are essential components of systems that direct its focus towards the goal of good health within populations. While components of public health systems can generally be compared using the healthcare systems arrangements framework, there are significant differences between how these systems are governed, how services are organized and delivered, and how they are funded. Partnerships and communication are essential components of public health systems, which are also shaped by political system contexts.

A public health systems framework and potential model of a population health system were conceptualized. Areas for future research are suggested.

Abstract

Background:
With recent emphasis on creating a stronger, more patient-centred, health system in Ontario, there remains no clear definition of a "public health" system, hindering the ability to integrate preventive public health and health care practices. This study aims to describe public health systems and initiate a research agenda for this field.

Methods:
A critical interpretive synthesis of the literature was conducted using six electronic databases. In addition, data extraction, coding and analysis followed a best-fit framework analysis method. Initial codes were based on two current leading health systems and policy classification schemes: health systems arrangements (based on governance, financial and delivery arrangements) and the 3I+E framework for health policy formulation (institutions, interests, ideas and external factors). New codes were developed as guided by the data. A constant comparative method was used to develop concepts and to further link these into themes. Additional documents were identified to fill conceptual gaps.

Results:
5,933 unique documents were identified and 338 documents met the inclusion criteria. 81 documents were purposively sampled for full-text review and 58 of these were included in this study. Nine documents were found to help fill conceptual gaps. Generally, public health systems can be defined using traditional healthcare systems and policy frameworks. There was also a strong emphasis on identifying and standardizing the roles and functions of public health. Partnerships (community and multi-sectoral) are common features within and between components of public health systems. A public health system framework and a model of a population health system were conceptualized.

Discussion:
Understanding public health systems can help strengthen these systems and further integrate preventive public health and primary care services. Systems are influenced by organizational and contextual factors that need to be explored to improve population health. A research agenda is proposed to move this field forward.

Dedication

In loving memory of Troy Jarvis and James Redfern Lo.

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List of Abbreviations and Important Terms

BFF - Best-fit framework synthesis

CDC - Centers for Disease Control and Prevention

CIHR - Canadian Institutes of Health Research

CIS - Critical interpretive synthesis

IOM - Institute of Medicine

MDGs - Millennium Development Goals

MOHLTC - Ministry of Health and Long-Term Care

PAHO - Pan American Health Organization

PHAC - Public Health Agency of Canada

PHSSR - Public health services and systems research

SARS - Severe acute respiratory syndrome

SDGs - Sustainable Development Goals

WHO - World Health Organization

Declaration of Academic Achievement

This thesis was written by Tamika Jarvis with input from thesis advisors Dr. E. Alvarez, Dr. F. Scott, and Dr. F. El-Jardali.

Background

Public health

Public health is generally understood to engage in population-targeted, rather than individual, health activities, and undertake a "population health" approach that recognizes that genetic, behavioural, and socio-economic factors (e.g., housing, social networks, lifestyle choices, education) influence health and well-being. (1–3) The introduction of the social determinants of health has caused a shift towards understanding health from a holistic perspective, as well as increased recognition of public health's contributions to the health of the population.

Outside of global public health emergencies such as Ebola or Zika Virus, attention to the role that public health plays in the protection and advancement of health has often taken a backseat to discussions of health system strengthening and health care reform. Public health initiatives, such as communicable disease control, sanitation, family planning, and vaccinations, have had a long and significant impact on the quality of life and increased life expectancy observed today. (1,4–8) A considerable amount of resources are given to researching the organization and structure of health care, and achievements made by public health activities are often attributed to the delivery of primary health care services and advances in biomedical interventions. (9) Considering medical care consumes the largest amounts of a nation's health care dollar, it is unsurprising that public health does not seem to be a popular item on political agendas. (10) For many, health and the health system equates to health care, namely clinics and hospitals. (11) The public health sector is relied on in times of crisis, yet its activities and organization are often misunderstood or taken for granted by citizens and professionals who work outside of public health. (12–14) As such, there is sometimes little public or political interest in strengthening or investing in public health systems until times of crisis re-emerge. Until then, public health remains underappreciated.

Multiple health system frameworks have been proposed within the current literature as a result of health systems and policy research, however no clear or consistent definition of public health systems appear to exist. (15) Healthcare systems can be assembled and defined through various frameworks and its arrangements can be easily identified. Hoffman et al.'s review for example, found 41 different health system frameworks that were conceptualized to understand components, functions, and goals of health systems. (16) Shakarishvili et al. noted that multiple health system frameworks were actually targeting healthcare systems, rather than health systems. (15) The belief that the healthcare system is the main domain that policymakers affect is most likely the result of the confusion surrounding what public health is and its role in protecting and advancing health within the larger health system. The diversity of frameworks available to analyze health and healthcare systems highlights the stark contrast of the frameworks available to analyze public health systems. While health systems research has been of interest to researchers and policymakers for quite some time, there is little research on public health systems.

Public health services and systems research

Public health services and systems research (PHSSR) is a multidisciplinary area of study, that examines how public health is organized, quality of services, and the organizational, financial, and delivery structures that impact health outcomes. (10,17–19) The idea of a public health system is not new, but was re-introduced to researchers and academics by the U.S.

Institute of Medicine's 1988 report The Future of Public Health. (20–22) This report was pivotal in emphasizing the importance of public health systems, and played a large role in the creation of the PHSSR discipline, along with contemporary champions such as the Robert Wood Johnson Foundation, and the Centers for Disease Control and Prevention (CDC). (10,15,16,19) A few years later, the CDC proposed strengthening the public health system by addressing public health capacity to respond to health problems. (20) This particular field of research is increasing in popularity as health systems strengthening and reform make their way onto government agendas. (18) However, public health and public health systems are poorly understood by the public, and uncertainty about the role of public health within the larger health system is still a concern on the minds of health professionals. (23,24) Most public health research has focused on evaluating interventions aimed at individual or population-level behaviours and understanding the causes and patterns of risk of ill health and disease in a population, rather than informing broader questions about the organization, delivery, or funding mechanisms of public health systems. (10,24–26) Health services and system researchers have not adequately acknowledged public health as a vital component and contributor to health systems. Several researchers, public health, and government leaders, have highlighted the need to establish a foundation that defines what public health is. Furthermore, no research thus far has attempted to align public health systems within healthcare system arrangements. (3,18,21,27–29)

Study objectives

The overall aim of this study is to conduct an interpretive review of the current literature to investigate how public health systems have been defined and classified. The specific objectives are to explore the differences between public health systems and outline different configurations of public health systems, and to assess the differences between healthcare systems and public health systems by illustrating how current public health systems align within established conceptual frameworks for health systems (i.e., health systems evidence framework of delivery, funding and governance arrangements). For the purpose of this study, a system is defined as "a set of inter-connected parts that have to function together to be effective" (30), a framework as "a basic conceptual structure" (31), a model as " a standard or example for imitation for comparison" (32), definition as "a statement that describes what something is" (33), and classification as "an arrangement of people or things into groups based on ways that they are alike". (34)

Research questions

The key compass question is: "How are public health systems defined and classified?" There are three sub-questions:

1) What frameworks or models exist to define or classify public health systems and how are these similar or different?
2) How are public health systems different than healthcare systems?
3) What is the interplay between public health, health care and health systems?

Methods

Study design

Two qualitative synthesis methods were used for this review. Critical interpretive synthesis was chosen as the overarching methodological approach for this review with the use of a best-fit framework to support and guide data extraction and analysis. As the two methodological approaches were found to be synergistic, the researcher chose to employ the strengths of both strategies, using critical interpretive synthesis for the collection of data, interpretation of newly generated codes, themes and divergent findings, and to create a new conceptual model, while using a best-fit *a priori* framework to guide rapid and structured data extraction and analysis. (35,36) The key elements within the healthcare systems evidence framework (governance arrangements, financial arrangements and delivery arrangements) were used as *a priori* codes to guide data extraction, against which data from selected studies were coded and mapped. As CIS is a flexible approach, it would allow for the best-fit framework to change if a more fitting model were identified.

Critical interpretive synthesis

The critical interpretive synthesis (CIS) is an inductive approach to qualitative data synthesis developed by Dixon-Woods et al. that was adapted from both the meta-ethnography and grounded theory traditions. (35,37,38) CIS was chosen as the most appropriate approach because it is oriented towards conceptual or theoretical development based on critical analysis and interpretation of available evidence. It is widely recognized as one of the best study designs used to provide a fresh interpretation of the data rather than a summary of results, as is often the case with other systematic review methods. CIS is an iterative process that allows the researcher to refine the key research question, critically examine the literature, and develop themes to generate new concepts, models, or theories. (35,36,39) CIS explicitly allows for inclusion of both empirical and gray literature. This is important as public health and health systems research is diverse and complex, from interdisciplinary fields, and often uses gray literature such as policy documents. (35,39) As CIS allows for the use of gray literature, documents are critically assessed and prioritized during data analysis and synthesis based on relevance to the key research question. (39,40) CIS also allows for sampling and filling of conceptual gaps, which increases the likelihood of capturing relevant documents, making CIS a useful methodology for health research. (39)

Best-fit framework

The best-fit framework synthesis (BFF), developed by Carroll and Cooper (2011), is a unique approach to qualitative data synthesis used to simultaneously test and refine, or generate relevant frameworks or conceptual models based on systematically retrieved data. (37,41,42) BFF is described as being both deductive and inductive as it uses a secondary analysis/synthesis method, like CIS, to generate new themes. (37,40,41) Unlike CIS however, BFF first identifies an existing relevant framework, conceptual model or theory, and uses *a priori* codes to code primary data. Extracting data involves framing the data within the established framework using *a priori* codes, and then creating codes or themes by interpreting and reflecting on data. (37,41) A thematic analysis or secondary qualitative methodology is then used to generate new codes or themes for data that does not fall within the framework, and these themes are used to refine or create a new conceptual framework or theory. (43) It is useful for rapidly coding and organizing

large amounts of data, and for analysis as themes are pre-identified, increasing transparency. (37,41) It allows the researcher to generate new themes, but not be restricted by the framework, model, or theory. (41) In order to use this method an *a priori* framework must already exist, therefore this approach cannot be used to generate a completely new theory. (41) In addition, BFF only allows for the inclusion of empirical qualitative data therefore it would not capture the diverse literature in the field of public health. Because BFF also requires quality assessment, exclusively extracts data from the results section of studies, and does not allow sampling or conceptual gaps to be filled, CIS was used as the overarching approach in this project. As BFF is a fairly new approach there are few examples of this methodology, thus further empirical examples of the methodology are needed. (41)

Document identification

Identification of studies included three strategies: a systematic search of electronic databases, reference chaining of articles during analysis of included documents, and internet searching to fill conceptual gaps. Two reviewers (TJ, FJ) identified keywords and a search string was developed from these terms. Two reviewers then pilot tested the search strategy that would return relevant results (TJ, EA). Synonyms and truncations of keywords were included within the search string, and Boolean searching was used to ensure that database searches identified all relevant documents. The search string was repeatedly refined and accepted when several previously identified documents were captured within the results of the database searches. The final search was conducted on October 25, 2016 by one reviewer (TJ). Further literature to fill conceptual gaps was identified throughout analysis.

Databases searched

The following electronic databases were searched: EBSCOhost (AgeLine, CINAHL, Social Sciences Abstracts), OVID (Global Health, Ovid Healthstar), Scholars Portal, Web of Science (Core Collection), Cochrane Library and Health Systems Evidence (**Appendix A**). The databases were accessed through the McMaster Health Sciences Library website. These databases contained empirical and gray literature. No date or language restrictions were applied to database searches.

Key terms and search string

Initial keyword searches used the following search string: 'Public health AND system* AND (deliver* OR governance OR organization OR classif* OR structure* OR manag* OR fund* OR function* OR financ* OR role OR purpose OR typology OR framework* OR model* OR component* OR definition*)'. This search string was developed to capture the most relevant results. The search string was modified for each database as needed and these changes can be found in **Appendix A**.

Study selection

Search results were imported into reference management software Zotero 4.0 and duplicate items were first removed automatically in Zotero and then manually. Results that could not be imported into Zotero were downloaded into a spreadsheet and screened manually for duplicates.

Exclusion criteria

Exclusion criteria were developed during a preliminary screening of article titles and further refined based on significance to the research topic. Two reviewers (TJ, EA) pilot tested the exclusion criteria to a sample of the titles together, and then independently applied the exclusion criteria to the rest of the results. Documents returned by electronic database searches were screened and excluded from the study based on relevance of the title, and/or abstract. Disagreements on exclusion were resolved through discussion. Documents were excluded that 1) did not contain a description of a local, state/provincial/territorial, or national public health system, framework, or critical components necessary to create a public health system model or framework, 2) addressed publicly-funded healthcare systems, unless it also addressed the role of public health, 3) addressed specific healthcare or public health interventions, programs, policies, laws, or development, implementation, monitoring or evaluation tools, 4) were about the specific roles or training of public health or health professionals in public health, and 5) were in languages other than English, French or Spanish.

Purposive sampling for inclusion of relevant papers

All study designs, including quantitative, qualitative and mixed methods studies, as well as non-empirical papers, were eligible to be included for review. The documents found through the electronic database searches were purposively sampled for inclusion once irrelevant papers were excluded. Papers were sampled and prioritized for inclusion if they were clearly relevant to the research topic, to maximize diversity of papers, and to reduce repetition. Full-text documents were retrieved and assessed for eligibility by one reviewer (TJ). Additional documents were found through reference chaining of all included studies or internet searches to help fill conceptual gaps.

Data extraction

Two reviewers pilot tested the data extraction tool (TJ, EA). The data extraction tool was created to organize bibliographic information and key themes of relevant documents using Microsoft Excel. Documents were imported into NVivo 11 software to facilitate coding and organization of data. (44) Extracted data included: Title, Authors, Source (journal, organization, publisher), Year, Peer-reviewed or gray literature, Empirical vs. conceptual, Context of Study (Country/Region), Key topic areas, Relevant findings, Code(s) applied, Themes, Further relevant references from paper. The data extraction table can be found in **Appendix B**. Terms and concepts were extracted line by line and coded to produce themes by one researcher (TJ).

Data analysis and synthesis

Initial *a priori* codes were based on two current leading health systems and policy classification schemes: healthcare systems arrangements (based on three key building blocks of governance, financial and delivery arrangements), and the 3I+E framework for health policy formulation (institutions, interests, ideas and external factors). As the goal of this research is to explore how public health systems have been defined, the healthcare systems arrangements framework was used to see if it could be applied against public health systems. Governance arrangements include policy authority, organisational authority, commercial authority, professional authority, and consumer and stakeholder involvement. Financial arrangements include financing systems, funding organisations, remunerating providers, purchasing products and services, and incentivizing consumers. Delivery arrangements include how care is designed

to meet consumers' needs, who provides the care, where the care is provided, and what support is used to provide care. (45–47)

Following the best-fit framework analysis methodology, the healthcare systems arrangements was used as a theoretical foundation to compare public health systems components. The 3I+E framework for health policy formulation was used to understand how key features of political systems influence, or have influenced, public health systems. These political system considerations are important to consider as changes in health systems are heavily based on political will and interests that influence policy implementation. (46) The 3I+E framework was used to explore how institutions, interests, ideas and external factors influenced policy development processes. Institutions are considered to be ingrained societal structures that construct formal and informal rules and norms that political structures build themselves upon. (48) Institutions include government structures, policy networks, and policy legacies. (49) Interests refer to the agendas of voluntary groups that attempt to influence public policy without seeking political power or adopt formal roles in the government and can include interest groups and civil society. The third component of the framework is ideas, which encompass beliefs about "what is" and values about "what ought to be". (48–51) Finally, external factors may have considerable influence as to how much attention a policy recommendation is given as a result of societal change, emergence of new diseases or environmental emergencies, a release of a major report, or media coverage of a policy issue. (52) The two schemes, described by Lavis et al., **Appendix C** and **D**, were used for several reasons: they are broad, easy to understand, comprehensive, and have been used in international contexts for health systems and policy research and applied work. (45,47) Most important, these frameworks provide a common terminology that is easily comparable, making them practical and simple analytical tools for others to use.

Two reviewers pilot tested the coding strategy together and then randomly selected seven documents to code independently to ensure coding was consistent and similar concepts were captured. The codes and concepts produced were tested into healthcare system frameworks for comparison purposes to note if public health system components fit into healthcare system frameworks, or why they do not, to identify what made public health systems similar or different than healthcare systems. New codes were developed, as guided by the data, and concepts that emerged during data analysis were linked into themes, which were further reviewed in a critical interpretive manner. Data analysis continued until there was data saturation and conceptual gaps were addressed. (53)

Ethical issues

No ethical approval was required as this study is a systematic review of available literature.

Results

Search results and study selection

7,559 documents were found through systematic electronic database searches. 1,626 duplicate items were removed leaving 5,933 unique documents. 5,595 documents were excluded through title and abstract reviews. From the remaining 338 documents, 81 were purposively sampled for full-text review, and 58 of these were included in this study. Nine additional documents were found through reference chaining and internet searches to help fill conceptual gaps. A total of 67 documents were included in this study. The PRISMA flow chart can be found in **Appendix E**. The characteristics of documents reviewed for this study are described in **Appendix F**. Fifty-one documents were peer-reviewed papers (76%), and 16 documents were gray literature sources (24%). From the 51 peer-reviewed papers, about half were conceptual papers (n=26, 51%), and half were empirical papers (n=25, 49%). The 26 conceptual papers included discussion papers (n=11), conceptual papers also included non-systematic reviews (n=7), commentaries (n=5), theory (n=2), and editorial (n=1). Of the 25 empirical documents, most were cross-sectional (n=9) and qualitative (n=9) papers. Case studies (n=3), systematic reviews (n=2), cohort (n=1), and mixed methods (n=1) were included. Most papers were published between 2001-2005 (n=22) and 2006-2010 (n=20). The context of papers included: global (n=7), regional (n=3), national (n=43), state/provincial (n=12), and local (n=2). Although public health systems from various countries were reviewed, Canadian and US systems were the focus of many documents. In order to interpret the current evidence, the results were organized according to the following themes:

1. Defining public health and public health systems,
2. Roles and functions of public health,
3. Public health systems and their arrangements,
4. Influence of political systems and societal contexts on public health systems
5. Integrated health systems

1. Defining public health and public health systems

Definitions of public health and public health systems are diverse. Analysis of the documents sampled demonstrates that public health systems have not been clearly defined for many reasons: 1) public health is not well understood by those outside of the public health sector, 2) public health systems have been conceptualized in various ways, and 3) there is overlap in terminology with publicly-funded healthcare systems. The diversity of definitions not only demonstrates a lack of consensus on what these concepts are, but also demonstrates how conceptualizations of public health and public health systems have evolved over time. These definitions are summarized in **Appendix G** to demonstrate the similarities and differences of how systems and their activities have been defined and conceptualized within the literature, and suggested definitions are provided.

Public Health

Seven general definitions of public health were found. Eight documents used the popular definition of public health as being the "art and science" of preventing illness and disease, and protecting and promoting health through the organized efforts of society. (8,14,54–59) The definition is unsurprising as it was first developed by the World Health Organization (WHO), and remains part of its standard lexicon. The five other definitions of public health expanded on

or emphasized different priorities and concepts within public health practice: reducing health inequalities, the promotion and protection of health within a community through proactive measures, assuring environments that allow people to thrive, and the diverse set of activities that address health needs. Defining public health in countries, particularly developing countries with weak health systems, or countries undergoing a reform, was difficult. For example, in Viet Nam, public health was relatively new and was therefore not easily defined, whereas primary health care had greater prominence and recognition. All definitions of public health include actions and intentions of activities, which are to protect health and prevent disease that can only occur through systematic processes and societal contributions. Public health was demonstrated to be a multidisciplinary area of practice, concept, and set of values that engaged in a larger population perspective. The various conceptualizations of public health demonstrate that it is a value-laden sector whose ideas of equity and equality constantly force public health to evolve to meet the current demands of the context in which it works.

Critical interpretation of available definitions has led to the suggestion that public health be defined as: an art and science, based on objective findings but responsive to the needs and contexts of populations, concerned with addressing the health needs of a community. It is a diverse set of organized activities aimed at improving quality of life and reducing health disparities to enable people to thrive. This definition reinforces previous interpretations of public health as an area of practice, a sector, and a concept. This definition has four distinctive sections: The first section depicting public health as an art and science highlights the multidisciplinary understanding and activities that it encompasses. Public health as an art suggests that it contains a creative aspect, but also that it is a science and based on empirical evidence used to develop knowledge and activities relating to its practice or understanding of health. The second section includes the target of public health activities as concerning itself with the identified needs of communities. This accounts for the variation in activities between differing contexts, but also makes a clear distinction between this sector and healthcare, that the focus of public health is on populations, and not individuals. The third section provides an understanding that the wide range of activities are purposefully developed under its authority and lens to address various needs, and the fourth section explains the goals and outcomes that the public health sector aims to achieve.

Public Health Systems

Public health systems were defined 20 times throughout the literature, with 10 unique definitions of public health systems identified. As with public health, definitions of public health systems have evolved over time, and ranged from simple to detailed descriptions. 11 documents defined public health systems as all levels of governmental and non-governmental entities which share in the responsibility for ensuring healthy environments, and is a complex network of organizations that contribute to the core functions of public health to protect and promote health within the community. (2,4,60–68) Public health systems were also defined based on their composition, level of service, contributing actors, mission and activities, or combination of these. All definitions included an element of coordination among partners to support public health activities. Public health was largely seen as a government responsibility, and most documents described public health systems as being organized by and around a government agency at the regional or local levels. Partnerships between formal (government) and informal (private sectors, volunteer) organizations were highlighted as being essential to carry out public health activities and work towards the health of communities, and engaged in some degree with program delivery, funding, leadership, and coordination across sectors.

Public health systems may be better defined as: the collective capacity of governmental, private, and other public sector entities that support the mission and core functions of public health. It is the cumulative arrangement of resources, infrastructure, and policies impacting health that exist to support public health within communities. This definition recognizes that the system not only exists to support the role of public health within communities but that a shared vision between all stakeholders exists. Embedded in this definition is the practice and power of partnership networks that support the system. Public health targets populations, thus requiring an appropriate amount of organized infrastructure, resources, and actors from within the population to provide a foundation for public health.

Definitions of health care, healthcare systems, and health systems were also identified within the literature. Health care was defined as the treatment of acute and chronic illnesses and disease within individuals through the provision of services in specific clinical settings, and as medical care provided by a health professional to individuals seeking treatment or advice to restore personal health. (8,58,69) Healthcare systems were defined as the diagnosing, treatment and rehabilitation of injury and illness, and as being responsible for responding to the medical needs of individuals. (3,47,70) Health systems were also included to highlight how they were defined. All definitions described the health system as a system whose overall function was to promote, maintain, and restore health through the delivery of both public health and primary care activities. These definitions all implicitly, or explicitly included both public health and primary care services in their definitions. When public health was not explicitly stated to be part of the health system, most definitions included promotion, preventative and restorative services which are considered traditional public health activities, while restorative services are traditionally primary care or clinical services. (8,9,16,21,47,71–73) The author suggests that health systems may be defined as the formal and informal actors, services, and institutions, whose activities and policies aim to promote, protect, and restore the health of individuals and populations. It was noted that the terms, healthcare system and health system were used so interchangeably, that their definitions have become unclear. Unlike health care or healthcare systems, public health systems were considered to be largely invisible to the public, but provided an efficient way of assuring positive health outcomes. Health care and healthcare systems were responsible for responding to the needs of individuals, usually to treat and restore them to a state of good health, while public health and public health systems targeted populations to prevent ill health within communities and among vulnerable people.

2. Roles and functions of public health

There was significant emphasis on defining roles and functions in public health systems. Most components of public health systems included “essential public health functions”, or activities public health is responsible for. 39 documents defined or highlighted what was identified as the “essential” functions of public health. There is a large variety in the number of roles and functions that are public health’s responsibility. While there were numerous examples of public health services and activities provided throughout the literature, functions and purposes were most easily identified and listed in almost all articles, therefore the general focus of these services was combined and presented in **Appendix H**.

Frameworks

A review of the literature demonstrates that research in various practice settings relating to governance and organization, system-level factors, such as workforce characteristics, delivery

and financing mechanisms, public health agency resources, and partnerships were also areas of interest. (2,18,19,25,26,58,61,68,74,75) Several conceptual models have been developed to monitor and measure the quality and performance of public health delivery systems (e.g. Donabedian's (1980), Turnock and Handler's (1997), and Handler et al's (2001)), however there were few frameworks that defined and conceptualized public health systems, making it difficult to identify relationships between components and describe how system organization affects delivery performance and health outcomes. (63) Based on the work of Hsaio and Siadat, Shakarishvili et al. grouped health system frameworks into four classification models: descriptive, analytic, deterministic and predictive. (15) Research on public health systems have largely taken on either a descriptive approach, to provide a general understanding of health systems, or an analytical approach, to analyze a major aspect of a system or a systems functional components. (15,17)

There were several frameworks in the literature that identified essential public health functions and were used by countries as a component of their public health system. One document (13) identified 13 frameworks used in nearly 100 countries, whose number of essential functions ranged from five to 12. Other functions and services identified ranged from as little as three to 40. In the United States, essential public health services were developed by the CDC and other national partner health organizations, and are reinforced at the state and local levels. The 1988 Institute of Medicine (IOM) report outlined three "core" public health functions namely, assessment, policy development, and assurance that were the responsibility of government public health agencies. This framework acts as an umbrella that covers a range of activities and services provided by state and local public health departments. "The 10 Essential Public Health Services" were developed to further refine the more specific set of functions and services in the US public health system. The 10 Essential Services align under the three core functions (**Appendix H**). While many countries, such as the US, Israel, India, and the Western Pacific Region, identified national standards of essential functions and services, Canada did not. These countries were largely influenced by the work of both the Pan American Health Organization (PAHO) and WHO, who established their own lists of Essential Public Health Functions. The establishment of core services has led to discourse in public health around returning to population-oriented activities, determining which services make the most sense, and the most efficient and effective services for public health to provide.

Roles and functions

Many essential public health roles and functions were defined by national, regional and local public health agencies, and outlined through legislation. Functions and services have evolved based on context, and as public health focuses on the local needs of the population, this may account for the variance in the provision of programs and services. Health promotion (n=30), health protection, which includes air, water, and food quality and inspection, environmental and occupational health activities (n=26), investigation and surveillance (n=25), emergency planning, preparedness and response (n=25), health assessment and monitoring (n=24), disease injury and prevention (n=21), and linking and providing personal clinical services, which include maternal and child health services, minority, rural, indigent, mental, clinical and community health improvement activities, to targeted and/or vulnerable populations (n=21), were listed as public health functions and services in more than half of the documents. Communicable disease control (n=18), research (n=16), regulation and enforcement (n=15), resource and organizational management included leadership, governance capacity, resource

management, and the development of organizational structure (n=14), the establishment of partnerships and advocacy in communities (n=13), evaluation of health services (n=11), policy development and planning (n=11), workforce strengthening (n=9), program implementation (n=4), laboratory services (n=3), hospital and long-term care facility licensing (n=2), and vital statistics (n=2) were also identified as being the responsibility of public health.

Public health also tends to link people to, or provide clinical services to targeted or vulnerable groups. (69) Many public health professionals have identified that public health may currently be filling gaps that consumes large parts of public health's human and financial resources. (12,76,77) For example, unlike other countries in the list, public health systems in the United States are mandated to provide clinical and personal preventative services to indigent populations.

Emergency preparedness is a function of public health that has increased in popularity, likely in response to increasing disease outbreaks, extreme weather conditions, and natural and man-made disasters. Response activities included evaluating health risks, conducting health assessments, and providing health protection recommendations to prevent any further illness or injuries (e.g., boil water advisories). Emergency planning included managing threats to public health and infrastructure. Research was also seen as an important public health activity in almost half of the documents studied, as it provided the foundation and evidence for epidemiology and surveillance activities, as well as best practices.

3. Public health systems and their arrangements

The features of public health systems that could be identified throughout the literature were summarized and aligned within the health systems arrangements framework below with country, state/province, and local examples. The results are summarized in **Appendix I**. While healthcare systems arrangements frameworks may be used to outline public health systems it became evident that this framework was insufficient to describe, or define, public health systems. As such, a refined framework for public health systems is suggested (**Appendix J**).

Governance arrangements

Within public health systems, governance was used to refer to various aspects of authority. For example, Marks and Hunter (78), defined governance as "processes for ensuring accountability and managing risk within organizations, the systematic application of procedures" [pg. 55] or the associated set of principles that exercise legitimate authority through law and regulation.

Policy Authority

There were numerous examples of policy authority arrangements throughout the literature. There are four levels of policy authority identified in public health systems: international, national, regional, and local. In many countries, apart from India, the devolution of decision-making was standard practice within states/provinces and municipalities, giving policy authority to establish, expand, and enforce policies within the boundaries of national and state/provincial legislation. (14,61,79) Many documents noted that the degree of decentralization within a country or state/province determined the responsibilities and structural organization of local public health agencies within public health systems. (61,64,68,77,80–84) Policy authority was determined by national and state/provincial legislation, and various acts mandate performance and reporting mechanisms through established procedures and processes. (62,79,85)

Governmental public health agencies, particularly at the federal level, function to support and facilitate the advocacy, coordination, monitoring, and oversight of the public health system. Governmental public health agencies were found to be responsible for providing guidance, and act as a source of expertise, while giving states/provinces authority to organize public health, within national legislation. (11,14,28,59,62,86,87) Many state/provincial governments established overall priorities, strategic direction, policies, strategies, standards, and funding models for local public health agencies. (28,54) Chief medical officers of health, or equivalents, such as directors of the public health branches, were given policy authority within government and local public health agencies on matters relating to: communicable and infectious disease control, health promotion, chronic disease and injury prevention, and environmental health. (11,14,28,47,86,87)

Organizational authority

Many documents identified regional or local health units as planning and implementing the majority of services. (87) Boards of health are the most common governing entity in public health systems. For example, in Canada, provinces with Regional Health Authorities and Boards of Health have organizational authority and are legally required to provide established services within their geographic boundaries. (11,47,54,88) In Ontario, two-thirds of Boards of Health are independent bodies, and one-third are municipal or regional councils who act as Boards of Health. Board members are largely appointed by elected representatives from local municipal councils. (47,54,87) The degree of governance was also influenced and determined by funding levels. (27,64,68,77,89) In the US, most local public health agencies were governed by state or local boards or councils of health. These boards of health develop policies, serve in an advisory capacity for officials, and communicate legislation. Boards of health are elected or appointed members consisting of public health professionals, citizens, consumers, educators, policymakers, and business professionals. (27,68,77,84,90)

Leadership within the public health system provides direction and support from policymakers, major stakeholders, and partnering ministries across sectors to address system problems and health outcomes. (21,59,65,82,91,92) Establishing leadership was identified as a necessary area for the development of public health systems. (20,21,59,65,79,92) Leadership in public health is about more than hierarchies and reporting structures, but requires a proactive vision and goal, the establishment of accountability, and deep engagement to advocate for the needs of the community and the public health system. (84,92–94) Political and financial influence and support can persuade agencies to target specific public health objectives and to hold specific values, but public health is based on local action and support. (85,95) This involves determining present and future infrastructure needed to maintain and provide services. Overall, leadership was concentrated within local government public health agencies who were responsible for resource stewardship and oversight as they had closer ties to the communities they serve. (84)

Commercial authority

Commercial authority in public health systems was not identified within the literature.

Professional authority

Regulated professionals working within, or with, public health systems retain their professional titles granted to them by regulatory colleges and remain under their authority.

Consumer and stakeholder involvement

Consumers in public health systems may refer to individuals, targeted populations, and communities. Stakeholders in public health systems include: other government sectors, communities, service providers in and outside of the health system, the private sector, and individuals. (87) Stakeholder and advocacy organizations are given a voice in policy and organizational decisions. (47) Public health works alongside or in partnership with key stakeholders involved in the planning of public health services, and private citizens may serve on local boards of health in some countries. Many boards of health include public health professionals, citizens, consumers, educators, and business professionals. (27,68,90) Individuals also participate in the system when providing informed consent when participating in public health services that are provided at the individual level (e.g., cancer screening, sexual health clinics, and immunizations). (47)

Public engagement and community partnerships were recognized as important activities. Communities were identified as influencing the operation of local public health agencies. The establishment of partnerships and community engagement are brought together through public health systems. (20,60) Community action and interdepartmental activity was recognized as being important for public health. (55) For example, major documents, such as the Ottawa Charter for Health Promotion (1986) and Achieving Health for All, and programs targeted at communities, such as Health Canada's Climate Change and Health Adaptation Program for Northern First Nations and Inuit Communities, stressed the idea that health was best solved at the community level, hence increasing community action and participation is necessary to improve individual and community health. (7,8,11,65,87,94) Governance also tended to happen at the community-level. Private citizens and community advocates participate and are members in local boards of health, which enables communities to develop solution to local problems, tying communities into decision-making processes and establishing community ownership. (4,65,96) Ellison (60) and Wholey et al. (64) determined that accountability within communities supports state/provincial and local public health efforts. For example, involving communities in promotion and protection strategies ultimately holds communities responsible for participation, while working towards health outcomes, particularly if these issues were social issues (e.g., firearm injury, teen pregnancy, HIV/AIDS testing).

Delivery Arrangements

When considering delivery arrangements in public health systems, terms such as "programs" or "services" can replace the term "care" in order to accurately reflect the wide range of activities and role of public health within the larger health system, as noted by Lavis et al. (45)

How care is designed to meet consumers' needs

Public health policy, programs and services are delivered at the population-level and at the individual level for specific groups. Public health functions were carried out by all levels of government, federal, state/provincial, local, but most activities are carried out at the state/provincial level, or locally in many countries. All levels of government were actively involved in providing programs and/or services as they are in ideal positions to perform or support public health activities. For example, public health programs were often designed at the state/provincial and local levels, and individual public health services were delivered locally, while most population based interventions were conducted at the state/provincial, and sometimes federal level. (3,12,23,27,58,59,62,66,79,83,86,87,89) Although public health and health care

were largely independent of one another, public health increasingly provided personal health services, often due to the perceived lack of access to the healthcare system. (97) Financial support and spending on individual and population public health programs is determined based on the provision of core public health services. In the US, states matched funds based on the provision of traditional population-oriented services, therefore departments and clinics are moving towards providing fewer personal health services. (47,58,97) Responsibility for the delivery of public health services often rests at the local public health agency level. In some instances, delivery of services lay at the state/provincial level or through separate government or private organizations who organize and deliver public health programs and services. (58,62,86,89)

The size of jurisdictions also varies drastically, and may not allow for the support of specialized staff. This limits ability to carry out the wide range of public health activities as public health workers are not evenly distributed among geographic regions. (61,98,99) Size of jurisdictions may strain resources, particularly in smaller jurisdictions. (5,11,14,47,54,58,61,88,89) Organizational structures likely influence delivery of essential services: centralized systems deliver services and operate under state/provincial authority, and in decentralized systems services are provided by regional or independent public health departments. (2,68)

By whom care is provided

In public health systems, care is provided by governmental, non-governmental, private and community organizations, and individuals, often through partnerships. Care is delivered by multiple organizations outside of government: faith-based, private businesses, social services agencies, and healthcare providers. (61,95) There are a number of regulated and unregulated professionals, and community organizers who provide public health support and deliver services. Many documents reported determining the size of their public health workforces as difficult to establish. Optometrists, dieticians, social workers, dentists, etc. deliver individual services, but their work is often included in public health outcomes. Care is provided by both regulated and unregulated professionals including: medical officers of health at the regional and local levels, community leaders, nurses, physicians, social workers, dentists and dental hygienists, laboratory technologists, dieticians, epidemiologists, etc. (47,76,87,95,100)

The size of jurisdictions may be too small, or too large, to provide adequate services or resources, therefore partnerships, and contracts with non-governmental and community organizations in public and private sectors are established. (64,66,83) Health care and other sectors support public health in its missions for example, by reporting outbreaks and sending samples to public health laboratories. To respond to emergencies, public health systems require partners within public health, the health system and other sectors who work to ensure there are: defined preparedness plans, communication services to accurately inform the public in a timely manner, information systems for rapid analysis and communication of health-related data, epidemiology and surveillance to track and predict events, and laboratory services to identify agents and hazards. (57,95,101)

Where care is provided

Delivery of public health services occurs in multiple public and private settings as programs and services. Public health services are delivered in public and private spaces, which include schools, homes, offices, clinics, public health laboratories, local public health agencies

and offices, and various indoor and outdoor spaces within the community. (11,47) Most health care services on the other hand are often provided in specific settings (e.g., clinics, hospitals, long-term care homes) or in the homes of private citizens. (47)

With what supports is care provided

Support was sometimes referred to as capacity, which referred to human health resources and information technology. (86,100) The main sources of support in public health systems were identified as technology, to conduct public health activities, and human health resources. Not many articles discussed the use of technology, however it is used to deliver services and support essential functions such as health promotion and program implementation and delivery. Technology includes services such as eHealth (information and interventions delivered through the internet and other technologies), websites, web portals, mobile phone applications. Public health messaging is distributed through information and communication technology (e.g., programming such as mass media advertising, internet, and social media). (7)

Countries that outlined essential functions and purpose in their public health system used analytical tools to engage in quality assessment activities and performance management. (13,62) Quality improvement activities are conducted, but often within organizations and are targeted towards programs, and not the system itself. (47) Performance indicators for public health are tracked through public health agencies. Public health activities are supported through data gathered from monitoring and surveillance, through epidemiology and public health laboratories which provide clinical and environmental testing services. (3,47,66,89,102) For example, public health surveillance technology is used to track immunizations, vaccine inventories, and monitor communicable disease outbreaks. (47) The use of quality assessment tools as an instrument to measure performance is popular in public health and healthcare systems. (62,79) The development of functions and services in public health also led to the development of several quality assessment tools used within some public health systems. (13,27,59,62,96,98) Both Griffiths et al. (96) and Lenihan (20) suggest that the outcomes of these tools provide the evidence required for political and citizen interest. If programs and functions are shown to be effective and cost-efficient, governments and policymakers are more likely to invest in public health systems and programs.

Financial arrangements

Financing systems

Two articles outlined public health financing systems that illustrate the relationship between public health finance and delivery of services. Sutcliffe et al. (11) outlined a public and private quadrant of public health financing and delivery mechanisms, where financing impacts delivery of public health services. Public health services, much like healthcare services, can be publicly or privately financed, and publicly or privately delivered. Moulton et al. (22) provided their own typology of interactions within public health financing that outlined control over funding sources and control over use of those sources. For example, public health is largely publicly financed through general taxation, and use of those funds are controlled by public entities, namely federal, state/provincial and local governments. Public health activities can also be financed by the private sector, who may also control how those funds are used. For example, employers may provide benefits to employees that have an impact on health outcomes (e.g., smoking cessation programs). Private entities are often for-profit businesses and non-profit

organizations. The private sector may include individuals or households when they pay out-of-pocket service fees. Taxation streams included federal, state/provincial, and local taxes such as income taxes, property taxes, and sales taxes. (12,14,22,47,59,65,79,86,89,98) This includes taxes from dedicated funding streams targeted at consumer goods such as fuel and tobacco. (14,61,79,86) In developing countries, a significant part of public health funding is derived from external donors, especially for disease specific initiatives. (79) Third, user service fees were briefly mentioned as a source of revenue for public health services but the extent and services funded were not expanded on. (22,65,68,89) The true amount of spending within the public health system is unknown, however several documents have stated that on the national level, public health systems receive between 3 to 8 percent of total health spending in Canada and the US. (14,47,58,59,68,76,97,102)

Funding organizations

Funding organizations vary between countries. Most revenue is collected via taxation and funds are often transferred between governments and health ministries to state/provincial or local public health agencies. (58,61,65,79,89) Funds were rarely directly transferred between the federal government and local governments except to fund high priority programs such as malaria control. (79) Many federal and state/provincial governments allocated funds for specific public health activities, with funding being distributed to local health agencies who deliver the services. In many countries, these public health units were allowed to apply for funding, but funding was largely allocated by funding formulas. (58,61,65,89) A combination of funding mechanisms, such as activity- and standard-specific funding and reimbursements, per capita allocations, competitive and needs-based grants and performance-based funding with local agencies that ties local public health performance and outcomes to funding was also reported. (61,89,99)

Funding also originated from other public sector partners and collaborations between public and private sectors. (59,65,88,89) In some instances, partnerships between other government agencies and external donors have allocated funds to community-based organizations to target specific community health needs, or provided informal funding for non-essential public health programs. (4,28,59,65,87,88)

Remunerating providers

How service providers were paid for the provision of services was not identified within the literature.

Purchasing products and services

Funding organizations and purchasing products and services are strongly linked. Many federal and state/provincial governments allocated funds for specific public health activities which influenced the availability of services. (58,61,65,79,89) While funding oftentimes flowed through federal government, state/provincial and local governments had the majority of authority over funds. (82) Programs and services that were considered mandatory, either at the national or state/provincial level, were often cost-shared between governments depending on if citizens resided in specific coverage areas. (47,88) Generally, there was a trend towards a large portion of public health funding directed at individual public health services. (44) For example, Hyde and Shortell (68) reported that between 53 and 77% of public health funds were being spent on individual public health services in some states. In New Zealand, public health funds were diverted to curative services upon the integration of service delivery models. This diversion was

linked to poor health outcomes, monitoring activities, and planning and coordination. To combat this, legislation was enacted that ensured funds were protected and kept pace with total public spending on health. (79)

Incentivizing consumers

As the majority of public health systems are publicly funded and essential population and personal care services are provided free at the point of delivery, incentivizing consumers was not a widely-reported mechanism within the literature based on the potential to inflict financial burden. Privately funded public health services or activities, such as businesses offering health promotion or prevention activities to their employees, may encourage employees to take advantage of these services that they do not have to pay privately. While financed and delivered privately, these services impact public health outcomes (e.g., smoking cessation programs). (11,22)

Partnerships facilitated by ongoing communication

An argument around the differences between public health and healthcare systems is centred on the core synthetic construct of "partnerships and communication" as partnerships would not be possible without ongoing communication between partners, stakeholders (e.g., academia, health care, media), communities, and individual residents. Partnerships were defined as the social networks established among organizations and based on multi-sectoral collaborations and communication. (89,103) Partnerships and communication function as a synthetic construct because of the relationships identified as an essential role and function to carry out public health services, and because they are reflected within governance, delivery, and financial arrangements. (22,80,94)

Partnerships as an essential role and function of public health

In some countries, establishing intra-sectoral and inter-sectoral partnerships has become an essential function of public health systems, affecting governance, delivery, and financial arrangements (**Appendix H**). (59,71,94) Governmental public health agencies may be the loci of the public health system, but they are dependent on partners to deliver and contribute resources to varying degrees. (14,61,68,80,85,86,94) Potter and Fitzpatrick (89) and Zahner (94), among others, found that partnerships addressed 35 focus areas in public health systems. These were largely targeted towards health promotion, health assessment, health protection, linking and providing individuals with personal clinical services, and emergency planning and response functions of public health. (3,81,88,90,103) As health outcomes are influenced by a wide range of factors that lay outside the public health and health care sectors, public health cannot successfully fulfill its role without the help of others. (3,28,59,66,85) Partnerships were necessary for public health systems to be able to achieve its mission within changing societies, and were a useful and efficient way to extend the reach of programs, target population health issues, and share expertise, information, and resources. (7,27,28,59,61,66,103,104)

Partnerships within governance arrangements

Several sources have identified the goals of partnerships as community empowerment and capacity building. (11,28,71,84,91,94,101) Partnership engagement promotes and protects health within communities by increasing stakeholder involvement in policy and decision-making, as discovered within governance arrangements. Activities within communities are

therefore tailored to address local objectives. (84,91) As governance happens at four levels: international, national, regional, and local, both partnerships and leadership at these levels requires collaboration. The degree of these partnerships can be related to the degree of both centrality and integration of organizations within the public health system. This refers to the range of organizations participating in the system, how closely they are tied to public health activities, and how responsibilities are distributed among these organizations. The degree of centrality is related to both governance, delivery, and services available within a system. In systems that are highly decentralized, state/provincial or local public health organizations have authority in the organization and delivery of public health services and are responsible for engaging partners within and between sectors. (2,83)

Partnerships within delivery arrangements

Partnerships are described as bringing together the wide array of stakeholders involved across sectors and communities. (91) Public health is sometimes termed "community health" as its focus is largely extended to the outcomes of communities and groups. (69) The mission of public health is to assure good health at the population level and works in, and with, communities to achieve good health outcomes. Partnerships in public health systems appear to be naturally engrained in delivery arrangements and were highlighted as necessary for the delivery of services via organizations located in community settings. (90) Partnerships influence delivery, reach of public health services and programs, and may also impact organizational arrangements. (90) Partners either assist or are responsible for designing, providing, and supporting public health programs and services. Partnerships between the healthcare sector among others are common and necessary to carry out programs and deliver services as some programs that target positive health outcomes are not delivered through, nor directly involve, local public health agencies (e.g., cancer screening, sexual education delivered as part of school curriculum, immunizations which are often delivered in physician offices, and dietary programs). (3,6,14,21,59,100) Governmental health organizations are often given responsibility for forming these partnerships. (6,62,80) However the level of engagement is difficult to determine as not all actors may necessarily be active participants, but have policies that impact health outcomes. They include other government agencies, both national and international, the healthcare system, academic centres, private sector businesses, religious groups, foundations, service organizations, and communities. (2,8,14,22,54,61,62,66,71,80,84–87,94,96,97)

Communication is highlighted for three reasons. First public health is information-dependent and information supports public health functions and policy development. (3,79) Historically, many countries have struggled with fragmented and underdeveloped information systems. (3,6,14,85,97) Disease outbreaks, such as SARS and West Nile, highlighted the risks associated with dysfunctional systems. Communication between all actors within the system is required in order to deliver and improve health promotion and protection activities, and engage in emergency planning and response. (6,76,81) Second, communication improves surveillance and response systems between all levels of government and internationally. Collaboration requires organizations to share administrative data, resources and decision-making with other groups through on-going and effective communication. (76,91,92) Technology such as health information systems strengthen links between agencies and partners responsible for surveillance, and epidemiologic efforts. (57,69,76) Third, communication is essential for delivering messages to the public, preventing mixed messages, and encouraging public engagement. Communication supports the delivery of programs and interventions using technology, and the delivery of

messages to the public in a timely manner supports public health activities, such as surveillance, health promotion, and health protection, and influences individuals to engage in activities that protect their health. (7,69) Current technology, such as the internet and other mass media, are tools that support this effort by improving health literacy and outreach. (7)

Partnerships within financial arrangements

As previously mentioned, several sectors contribute to funding activities that impact public health, however this has been difficult to establish due to the lack of transparency and available literature. Multiple sectors fund related activities, but currently there is no data that details this. (59) Partnerships may contribute to funding resources for public health services and programs, and public health is often seen as a shared responsibility between various sectors however funding estimates for public health may be underreported due to financial contributions from multiple ministries or from the private sector. Financial contributions that come from the budgets of other sectors are therefore difficult to determine.

4. Influence of political systems and societal contexts on public health systems

Institutions

Public health systems are heavily influenced by their macro environments, the political systems and social contexts, which explains variety observed between public health systems. Public health system renewal and development is dependent on deep engagement with the political process at all levels. As institutions are the ingrained societal structures that determine government structures, policy networks, and policy legacies (e.g., past laws or policies), these naturally varied within different contexts. What remained consistent however were the interests, ideas, and external factors that tended to influence public health and public health systems.

Interests

Interests included the advocacy groups, stakeholders, and civil society that can have positive or negative effects on policy development and choice, depending on their interests. (59) Interest groups in public health systems influence governance, delivery, and financing of public health services. These groups are often composed of professional interest groups and labour unions that use their influence mainly at the community and local levels (e.g., public health associations, medical associations, dental associations, labour unions, donor agencies such as The Bill and Melinda Gates Foundation). These groups have played a role in establishing the functions and services provided by public health. (86,102) State/provincial and local public health agencies also act as interest groups who trigger, champion, and support change. (20) Political stakeholders provide support to organize and restructure public health systems. These stakeholders also provide the support needed to call attention to public health systems. (91,105) However, while advocacy groups, stakeholders, and civil society may influence interest in public health, lack of political will may also obstruct system change and investment. (11,96)

Ideas

The ideas, values, experiences, and research evidence within public health systems are also significant factors that are influenced by political decision making. First, health systems are still generally understood to mean “health care” and healthcare systems, but public health is seen as an essential part of the health system by those who work within the public health system. (11)

The ideas about what public health should be responsible for influences all system arrangements. Political and public values influence which programs and services are funded, where and how services are delivered, and who is responsible for them. For example, public health provides specialized services to targeted groups to improve equity and access, particularly for individuals who cannot afford to access private healthcare systems. (8,66,99) These ideas are reinforced through policy documents from national, state/provincial, and local public health agencies who identify core competency areas and functions of public health. For example, Canada's federal public health agency, the Public Health Agency of Canada (PHAC), has established a set of seven core competencies that describe the knowledge and skills required to support public health practice and functions. (106) Patient interaction with individual-targeted public health programs are often not attributed to public health, but to the healthcare system, and health is often credited to health care. This lack of understanding by policymakers and the public ensures that beliefs about the health system remains unchanged, as the idea of public health systems is unable to make its way onto the political agenda except during times of crisis. Third, evidence-based knowledge based on health outcomes, such as determinants and differences in health outcomes in minority populations, support public health activities and policies. (95) Delineating public health functions provided guidance for national and state/provincial public health systems. (62) This further resulted in quality improvement activities that increased evidence-based knowledge. (96)

External factors

External factors, such as cultural, political, economic and technological changes, major reports, and media coverage, are some of the biggest factors that influence policy development. Critical events and the release of major reports, such as the 1988 and 2003 Institute of Medicine (IOM) reports, contributed to the rise and fall of interest in both public health and investment in the public health system in national and global settings. Major national governmental and international development centres, namely WHO and PAHO, have also provided guidance for public health development in national settings. Elections, global, national, or local economic crisis, and advancement in technology introduce new levels of support for public health systems. High-profile reports have highlighted inequities in health outcomes which have large political and social impacts. (95) For example, the 1974 Lalonde Report introduced what is now well-known as the social determinants of health. This report highlighted the need to shift from the medical perspective to recognize broader influences on the health of the population and individual health. Healthy public policies, healthy lifestyles, and funding for public health were highlighted in the report, gaining international attention and established Canada as a leader in public health. (87) Emerging health threats, the increase in globalization, and the epidemiological transition to chronic illnesses and disease, like obesity, HIV/AIDS, hepatitis, and tuberculosis, increased emphasis on lifestyle factors and population health outcomes. (92,96) The rise of natural and man-made disasters and epidemic outbreaks has focused new attention to public health systems by raising concerns about public health agency capacity to respond to threats to the health of the public. The Severe acute respiratory syndrome (SARS) outbreak, and others that followed shortly after in Canada, drove public health research and strengthening as it highlighted the dangers and damage caused by an inadequate system. International, national, and local events were catalysts to emergency planning becoming a public health activity, and governmental discourse on the need to strengthen weak public health and emergency response systems. Examples of events include climate-related weather patterns such as Hurricane Katrina, droughts, and the Calgary floods, influenza, malaria, bioterrorism, SARS, West Nile Virus,

Ebola, and Zika Virus. (2,14,28,81,95,96) Finally, further interest is propagated through media interest in public health events. In addition to being the primary source for disseminating information to the public, the mass media engages the public, policymakers, and professionals in discussions of system failures and reforms. (96)

5. Integrated health systems

Sofaer (71) states that the best way to judge how effective a health system is, is by how well it can improve the health of individuals and populations. Globally, there seems to be a shift towards moving from the idea that public health and health care work separately, to developing health systems that are holistic and have equal importance. Public health and health care are often accepted as complementary but separate systems in many countries as traditionally they have worked with little interaction with each other. (14,60) Public health systems have been proven to be conceptually distinct from healthcare systems. The differences also relate to the intended targets, and the strategies used to deliver programs. Identifying the similarities and differences between the components of each system allows gaps to be remedied. Health care targets users in specific settings, whereas public health targets the community at the societal level, largely through population-based services and programs. Individuals often do not have daily interaction with their health care services or system unless medically necessary, whereas the interactions with the public health system occur daily, whether it is a conscious decision or not. While public health and health care may sometimes overlap, generally these two systems have distinct governance, delivery, and financial arrangements, policies, roles, and functions. The challenge with integration to create a broader health system is determining how to best align and arrange financial, governance, and delivery arrangements within systems so that they are complimentary and improve health outcomes, and determine which functions and services make the most sense to be delivered by each system.

Interest in integrating public health and healthcare systems is not new. (54,62,98) It has been proposed and implemented in various localities, with differing models and outcomes, for quite some time. While definitions of integration vary, integration in this report is the relationship between public health and primary health care, and the extent to which services are provided to promote and achieve health. Integration is believed to bring the two systems closer together to provide a seamless service delivery within the larger health system and better respond to the needs of both individuals and communities. (8,88) A question that should be asked is at what government level – local, regional, or federal – integration works best. Integration at the federal or regional levels may increase political will, and at any level of integration, how public health systems are governed and funded, and how services are delivered will be affected. This will therefore require establishing boundaries between systems and a shared vision between sectors. For integration to occur, definitions, responsibilities, organizational structures and capacity need to be strengthened. In Canada, all provinces except Ontario, have vertically integrated public health into their provincial healthcare systems. (5,11) Public health in other provinces lay within a Regional Health Authority, where funding and governance for public health is the same funding and governance that applies to primary care, long-term care, hospitals, and other parts of the healthcare system. Ontario's Ministry of Health and Long-Term Care (MOHLTC) has recently proposed bringing Ontario's public health system closer to the healthcare system to improve efficiency and consistency across the province. While public health should have strong partnerships with the healthcare system, it rarely does, instead building partnerships with other sectors such as education, transportation, and housing. Public health in Ontario is described as

being disconnected from health care and its systems, as it involves shared authority with municipalities and the province. (88,104) Potential benefits of integration include bringing a population health perspective to the healthcare system, increased access to care, and the reduction of direct and indirect healthcare costs. (28) However, several interest groups and public health professionals have highlighted various challenges regarding integration and what it might mean for the future of the public health system. This included the loss of public health authority and expertise, capacity, and managing competing priorities, which were subsequently linked to adverse health outcomes. (79) Over time public health resources were diverted to primary care, and positions in public health units were lost, as were linkages to community partners and communities. (21,25,79) A loss of these linkages would hinder public health from being able to extend the reach of its activities and lead to fragmentation in program delivery and services necessary to protect the health of the population, such as community health assessments, program planning, and disease control and surveillance.

The exercise of defining public health systems led to the development of a potential model of a population health system driven by the "population health approach" and influenced by political system contexts (**Appendix K**). The population health approach is the driving force behind public health. Its upstream focus is concerned with how individual factors, social, and ecological determinants influence health outcomes. (13,99) In this model, population health is conceptualized as extending far beyond the health system to include the political and societal contexts that it influences and is supported by. Several examples of individuals and societal influencers are provided. A strength of the population health approach is that it recognizes that people are not passive, but often active participants in their own health outcomes. Individual health is supported by both public health and health care activities, and by how individuals interact with these systems and their larger social environments. Individuals can influence healthcare and public health systems via factors such as personal lifestyle habits, education, and other socio-economic factors that determine use, programs and services, delivery, and financial arrangements. There is a constant exchange between individuals, health care, and public health. More resources, programs and services are targeted towards those identified as vulnerable to try and establish a level of equity in health outcomes. It could be argued that, while activities in public health are population-based, the ultimate target of public health is still to support individual health within the larger community. For example, although health promotion messages and activities are delivered to the population, the goal of these activities are to encourage individuals within communities towards healthier lifestyles (e.g., tobacco cessation, obesity, vaccinations), whose health statistics are then tracked (e.g., surveillance) for the benefit of public health activities. Public and private sector policies also influence health. As broader determinants of health are becoming increasingly recognized as influential, there is movement towards the idea of "healthy public policies". (25) While policies outside of the public health system may not be implemented to directly impact population health, they often do. Similarly, public health systems affect, and are affected by, many sectors. This reinforces the idea that changes in policies, sectors, and systems do not work in a vacuum, but rather there is a reliance on each actor to ensure healthy populations. For example, taxes on carbon emissions have short- and long-term effects on population health outcomes.

The influence of political systems on health and public health systems has been previously demonstrated in detail. In this model, the health system includes both healthcare and public health systems, and the intersection between them may be what is meant by an integrated health system. It was found that the public health system is as an essential part of the broader health

system for three reasons: first, public health actively supports the population health approach that targets the broader determinants of health. Public health is population-targeted and therefore takes on a population health approach on many national and local agendas. There is greater interest in targeting societal and economic contributors to disease, rather than just treating the disease itself. For example, in many communities, trends such as obesity, immunizations, injury, and HIV/AIDS testing are viewed as societal, public health, and political issues. (92,104,107) Therefore it may be better able to proactively address the needs of a community and address issues of equity and disparities in health and the larger society. Second, constant ongoing communication and exchange of information between public health and health care are essential to prevent and respond to health threats. Public health functions and services rely on these activities to support the goals of public health, placing public health systems in a unique position to effectively and efficiently conduct activities. Third, public health actively engages in partnerships with individuals, communities, and other public and private sectors, and is in a well-established position to expand these partnerships. Public health systems rely on using available resources within the community and forming partnerships to address health issues. These partnerships help to relieve pressure from the significant underfunding for public health, compared to national healthcare systems. With the help of the healthcare system, the resources shared through partnerships may help to decrease the rising cost and resources consumed by health care by investing in preventative measures. The degree of integration must be negotiated based on the needs of the population. Governance, financial, delivery arrangements must align, but integration would benefit from a clear articulation of roles and a recognition of the strengths of each system.

Discussion

Main findings

Sixty-seven documents were reviewed for this study, including documents based on global, regional, national, state/provincial, and local contexts. The majority of the documents were peer-reviewed papers, with about half being conceptual, and half empirical, and the remaining were gray literature.

To define public health systems, public health must also be understood. Critical interpretation of this literature has highlighted the significant diversity in how public health and public health systems have been defined. For example, public health was defined as being proactive, political, and responsible for protecting and improving the quality of life, reducing health inequalities, ensuring healthy environments, and addressing the needs of the population through organized activities. Many definitions of public health systems emphasized the role of government agencies at all levels (e.g. local, state/provincial, and national), and other public and private sector organizations that partnered to deliver public health services. It was also noted throughout the literature that the term public health system was often used to refer to publicly-funded healthcare systems. This resulted in the further exclusion of several papers during analysis. Similarly, the term healthcare system was often used to refer to health systems. A good example of this is the term "health policy" or "health systems research" which is very often used to refer to "health care" policies, with public health nowhere to be found. The focus of the policies or research are mainly on clinical care services and not on public health. This causes confusion about what a public health system is, and by extension public health, and may explain why research, policy, and funding are often skewed in the direction of health care services and organization. Referring to the healthcare system as the health system minimizes, and oftentimes, erases public health from truly being part of the broader health system. This significantly undervalues the role and contributions of public health, resulting in the pervasive patterns of underfunding that are commonplace today.

While there were no comprehensive public health system frameworks, there is significant emphasis on defining roles and functions in public health systems, and most documents included "essential public health functions" as components of public health systems. Functions and services in public health are broad, and consensus on essential functions is often absent within and between countries as evidenced by the large variations. Functions and services had to be "translated" because there were different terms being used to represent the same activities within and between countries. This made comparisons within and between countries challenging due to the lack of standardization of even basic terminology. For example, health protection and environmental health were both used to describe the responsibility for testing and monitoring the quality of air, food, and water. Population health assessment was used to describe monitoring, surveillance, or epidemiological activities. This may result in an overlap or gap in activities. As community needs vary, public health services often adapt to reflect those needs. A major problem with public health systems seems to be that services not provided by the healthcare system are taken up by public health, for example, mental health. This presents challenges for system arrangements as financial, delivery, and governance resources must be rearranged and/or diverted to new services that are increasingly more clinical in nature, when public health receives a small fraction of the overall health budget. Thus, defining public health and responsibilities could prove to be an important step in defining the boundaries of public health systems and prevent systems from becoming too complex or overburdened. (62,80) This may also help to

develop better indicators to measure system performance and health outcomes, as well as protect itself from the challenges of integration.

Many public health system components could be identified using the basic healthcare systems arrangements of governance (e.g., boards of health at the state/provincial and municipal levels of government), delivery (such as where, by whom, and how care was arranged), and financial (e.g., funding from grants, taxes, non-profits or private partnerships, and state/provincial health department budgets), and many countries had similar public health system components. Governance and financial arrangements had the largest influence on delivery arrangements, organization, and partnerships within public health systems. (89,105) While components of public health systems can generally be aligned within the healthcare systems arrangements framework, significant differences between arrangements in the public health and healthcare systems exist. Governance was the most commonly identified system arrangement and was found to be unique for two reasons. First are the relationships and the idea that public health is a shared responsibility between all levels of government, particularly at the international and local governance levels. In public health systems, authority also occurs at the international level. In national public health emergencies, the federal government leads and communicates with foreign governments, and other health agencies. (28,59) This is distinct in public health due to the need to develop and enforce policies that aim to control the spread of illness and disease across borders. In public health systems, governance arrangements are strong at local levels, and guided by their own and state/provincial legislation. Local boards of health are given authority to establish policies and programs. Second, governmental public health agencies are often mandated to establish partnerships in order to carry out public health's functions and services. As arrangements in public health systems were influenced by communities and local governments, response to health needs at the community level were found to impact system arrangements at all levels.

Financial arrangements in public health systems was the most challenging arrangement to align within the framework because of the limited amount of research in this field. Financing systems and funding organizations were easiest to identify within the available literature. It is difficult to understand financial arrangements and resource allocation because of the various activities and partners that contribute to public health from the international level down to the individual level. Most governments have an idea of what they are spending on health care however in public health this is rarely defined. (7,47,88,99,102) The consequence of this is the lack of a foundation for best practice and informed decision-making for practitioners and policy-makers. This is troubling as the flow of funds through the system impact system functions and services. (22,47,61,79) Due to the lack of research in the area of public health economics and financial arrangements, Moulton et al. (22) and Sutcliffe et al. (11) provide researchers with a good starting point to continue work in this area, particularly in the area of provider remuneration, and level of funding provided by inter-sectoral and private sector partners.

Another difference between public health and health care is that public health recognizes the role of other sectors and agencies as being essential to its mission. Partnerships were not only highlighted in how public health systems have been defined, but were highly visible within governance, delivery, and financial arrangements throughout the current evidence. Partnerships are often necessary due to the nature of public health. Partnerships and collaboration across sectors, organizations and administrative levels requires coordination and a shared vision between different actors. This was reinforced by the identification of "establishing partnerships and advocacy" as an essential function of public health in some public health systems, and

resulted in the proposal of a public health system framework to reflect how partnerships and communication intersect all system arrangements. Public health's ability to respond to threats to health are dependent on available resources and infrastructure. (1) Partnerships provide the structure for multi-sectoral collaboration and facilitate communication and information exchange to accomplish the core functions. (6,103) Public health systems appear to be constantly engaged in a mutual exchange of information and engagement within communities as public health relies on a wide range of information sources to prioritize issues, assess health, and plan programs, services, and interventions to support decision making. (3) It is due to this that they are able to proactively anticipate the needs of the community. Information needs to flow rapidly through the public health system to manage outbreaks and detect threats to health, and coordinate between public health, health care, and other sectors through surveillance systems, and to the media and public. In response to public health emergencies, all levels of government play a role in organizing and sharing in the responsibility of protecting the health of the public. When emergencies grow outside of municipal or regional jurisdictions, federal governments often get involved and play a coordinating role within the country and between countries. (59) Response to health emergencies largely falls to public health possibly because of its ability to mobilize with other groups, while the healthcare system, whose focus remains on individual health, lacks the capacity and expertise to organize and respond to large-scale events or threats to public health. The proposed refined framework may be a starting point to reaffirming the key components of public health systems.

Contextual factors that influenced public health systems were political systems. Changes in the macro context, in this case health systems and political environments, affected how public health systems are defined, its role within the larger health system, the relationship between system arrangements, and outcomes. If integration is to be successful, public health and health care must be viewed as two supportive systems that can achieve their goals through different perspectives and approaches. Partnerships with primary health care are more likely if issues address both primary health care and public health interventions, therefore a shared or compatible vision is required to prevent the duplication of work that has already been done. This also requires that resources in public health are protected and not diverted to primary health care.

Implications for practice and policy

Five main implications for practice and policy were found. First, this study highlights the differences and similarities between public health and healthcare system arrangements, and defines public health systems. Public health systems have previously not been strongly defined within the literature. Defining public health systems solidifies public health's role in the health system and encourages political interest and resources.

Second, this study adds to the discourse around establishing essential functions of public health systems, and whether public health should assume responsibility for providing services health care does not at the cost of system capacity. Recent changes to the healthcare system in the US for example, particularly with the Patient Protection and Affordable Care Act, 2012, and the current administration's promise to repeal it, suggests more citizens who are unable to afford the cost of private health insurance will be forced to rely on an already under-resourced public health system. Less money will then be directed towards performing traditional public health functions or reducing health risks from emerging threats. India is another country that is experiencing significant burden on its public health system due to the heavy reliance on public health to supplement the private health care sector. (85)

The third implication relates to strengthening public health systems. Defining public health systems serves as a building block for non-existent or poorly constructed public health systems and services. Determining roles and functions of public health systems allows practitioners to identify areas that need to be strengthened to prevent individuals and vulnerable communities from being underserviced and contributing to negative health outcomes.

Fourth, this study presents important implications regarding partnerships. The establishment of the United Nations Millennium Development Goals (MDGs), a result of international and inter-sectoral collaboration, shed light on the condition of health systems in many developing countries and highlighted the need for systems strengthening. (15,73) As these goals sought to target global challenges influencing health, the state of health systems revealed barriers to reaching specific targets and delivering services to the most vulnerable. (15,73) Following the conclusion of the MDGs era, 17 Sustainable Development Goals (SDGs) were launched, whose agenda is broader and more ambitious, to tackle current challenges. (108) This study reinforces the importance and benefits of mobilizing collaborative partnerships to improve the health of the public.

Fifth, this synthesis has led the suggestion that the differences between public health and healthcare systems need to be acknowledged and negotiated for integration to be successful. With the recent emphasis on creating stronger, patient-centred and integrated health systems, the lack of clear definitions and understanding of responsibilities hinders the ability to integrate public health and healthcare systems. Highlighting the differences between systems allows policymakers and practitioners to identify the best way to align public health and health care for some form of integration, and the best ways to ensure that arrangements are complimentary and not competing for resources. What then constitutes a health system? Is it a system that only integrates primary health care and public health, or is it a system that is reflective of population health? Many definitions of public health include concepts of population health, but there is an important distinction that needs to be made. Although public health is driven by the population health approach, it is not the same as population health, as public health is interested in the health of populations while population health is an approach to understanding social and environmental factors that influence health. The question then needs to be asked: is public health the steward of population health? This author argues that it is not, and that it cannot be responsible for population health. Public health may have a better understanding, and is probably in the best place to advocate for population health, but it cannot take on its scope. There may be those who would want it to be so and see population health as falling under public health's jurisdiction, but it does not have the resources, nor the power, to influence the various determinants of health. Population health is much bigger than public health, and as such public health should maintain its focus on public health by defining its boundaries. Traditionally, public health has been given, or assumed, responsibility for many services because of its position to carry them out and its connections between sectors. If it is required to be the steward of population health, public health requires more resources and a bigger seat at the policymaking and decision table.

Implications for research

Four implications for this research were found. First, is that the study design provides a new way of thinking about and conducting research in health systems, for example by combining two qualitative systematic review methods, CIS and BFF, to bring data together faster using reliable and well-known frameworks while constructing an adapted conceptual framework.

Second, is that research in public health systems and services is not as supported as health care and systems research by government or academic institutions. Health systems research was identified by a large number of government, international, and development agencies as essential in order to support development goals, however how they have been defined has obscured public health. (15,73) Health services research tends to focus on issues related to the organization, financing, and delivery of primary health care and medical services rather than public health. A lack of research in public health and public health systems hampers investments in public health, and limits the ability to address health disparities or develop recommendations for evidence-based practice.

Third, is that the variations in terminology used makes it difficult to perform comparative analysis of public health systems across jurisdictions. Similarly, the differences in defined functions, or lack thereof, makes comparisons difficult for monitoring quality indicators and knowledge exchange between jurisdictions, and impacts the generalizability of results.

Lastly, this study is a first attempt at trying to understand how public health systems have been conceptualized. An adapted framework and conceptual model have been proposed that can be applied and tested in real life settings, and can be used to guide further research and practice in public health and health systems. Several areas for further research were identified:

- Identifying how public health systems are defined and classified in low- and middle-income countries through surveys or semi-structured interviews
- A survey of public health functions and services within countries
- Filling in existing conceptual gaps that reside within each system arrangement (e.g., commercial and professional authority, remunerating providers, purchasing products and services, and incentivising consumers)
- Measuring the performance of public health systems and the impacts of contexts and organization on system performance has not been well-studied. To move forward, practitioners and public health professionals must be able to establish a clear link between contextual factors, organization, and performance (63,64,68,109)
- Delivery system typologies have been applied to local public health delivery systems in the US (2), therefore these typologies could be tested against public health systems in other contexts. Descriptive typologies of public health systems could illustrate the infrastructure and capacity within public health systems, and examine how health status is impacted by various public health system characteristics (62)
- Exploring optimal organizations of public health systems, of both delivery and governance arrangements that influence health outcomes and developing appropriate indicators (e.g., how the composition of local boards of health impacts decision-making, health outcomes, and performance is an area for future research) (4,64)
- Comparative studies on the functions and governance structures of boards of health around efficiency, quality of public health services, and broader health initiatives

Strengths and limitations of this study

This study has several methodological strengths. CIS is the most appropriate methodology for theory development, and is used in health systems research. Second, the study included the use of both empirical and gray literature to capture a variety of evidence. This is important as public health and health systems research is interdisciplinary, and often produces gray literature such as policy documents. Third, diligent pilot testing was conducted at all stages of document selection and extraction by two researchers, including the development of the

search string and data extraction tool. The study was informed by a diverse team of experts in public health, health systems research, and qualitative research methodology.

A limitation of this study is the diversity of search terms in health systems research. It is acknowledged that search terms in health systems research are diverse and sometimes vague, therefore the search strategy may not have captured all terms and concepts regarding public health systems. To try and mitigate this, a search string was developed with broad search terms to identify as much relevant literature as possible. A second limitation is the reproducibility of results due to the methodological approach undertaken. As CIS requires constant reflective analysis during each stage of the review process the results are likely to vary, however the use of *a priori* codes may help to increase transparency. A third limitation, is that although public health systems from various countries were reviewed, almost all documents were from high-income countries. This limits our ability to generalize these results to low- or middle-income countries, however this presents an opportunity for future research.

Conclusion

This study provides more detail on the complex issue of defining and understanding public health systems. This paper illustrates the value in defining public health systems, and specifically addresses a priority research theme by Canadian and U.S. federal agencies, the Canadian Institutes of Health Research (CIHR) Institute of Population and Public Health, the CDC, and other stakeholders to describe dimensions of public health systems and "conceptualize a framework of high-performing public health systems that includes key elements" [p. 412] as well as initiate a research agenda for this field. (17–19) In order to develop a framework for public health systems however, we must be able to define both the public health system itself and components within it.

Although health systems research has been of interest to researchers and policymakers for quite some time, there is little research on public health systems. No clear or consistent definition of public health systems exist because public health itself has not been clearly defined. This paper has highlighted the significant diversity in how public health and public health systems are understood, and puts forth definitions that may contribute to this field. No comprehensive public health system frameworks were identified within the literature although there is significant emphasis on defining the essential roles and functions of public health. While the healthcare systems arrangements framework could be used to identify many components within public health systems significant differences were highlighted. Partnerships are an important component of public health and highlighted in how public health systems have been defined. Partnerships provided the structure for multi-sectoral collaboration and facilitated communication and information exchange to accomplish the core functions of public health. A refined framework for public health systems has been proposed and serves as an important starting point to reaffirming the key components of public health systems.

It is often assumed that health is a result of health care, however public health is as equally influential. The evolution of public health and public health systems has been shaped by political and social environments and current economic challenges may push nations to consider ways to protect health in a way that is affordable, effective, and efficient. Understanding these factors will assist in identifying and repairing gaps in services to improve and achieve optimum health. Defining the boundaries of public health systems can not only help solidify public health's role in the health system, but identifying areas of compatibility between primary health care and public health can make possible integration smoother. This paper has also highlighted two additional questions that must now be considered: what constitutes a health system, and is public health the steward of population health?

The success of public health systems cannot be measured if there is no understanding of public health, its functions, or its system components and arrangements. Developing common classifications of public health systems serves as a building block for future research. Research on public health systems is important for researchers, policy makers, and local and national public health organizations to help determine the effectiveness of public health systems as well as to assist in the popular discussion of health system reform. As most health systems research is conducted on healthcare systems, this study addresses an important gap in understanding public health systems and provides a stepping stone for future research. Closing gaps in the availability and quality of public health services, and improving performance and investments in public health systems, requires evidence on how to best finance, organize, and deliver services in order to continue to protect and improve the health of the population.

Appendix

Appendix A: Database Search Table

Database	Database name	Description of database	Search string used	Number found and comments
EBSCOHost	AgeLine	Covers issues of aging over 50+ from health sciences, policy and economics perspectives, among other	**Title**: Public health; **All Text**: system*; **All Text**: (deliver* OR governance OR organization OR classif* OR structure* OR manag* OR fund* OR function* financ* OR role OR purpose OR typology OR framework* OR model* OR component* OR definition*)	2, 003
	CINAHL	Includes allied health		
	Social Sciences Abstracts	Applied and theoretical aspects of social sciences		
Scholars Portal			**Article Title**: Public health; **Article Title**: system*; **Anywhere**: (deliver* OR governance OR organization OR classif* OR structure* OR manag* OR fund* OR function* financ* OR role OR purpose OR typology OR framework* OR model* OR component* OR definition*)	414
OVID	Global health	Includes public health topics in an international forum	**Title**: Public health; **Heading words**: system*; **All fields**: (deliver* OR governance OR organization OR classif* OR structure* OR manag* OR fund* OR function* financ* OR role OR purpose OR typology OR framework* OR model* OR component* OR definition*)	960
	Ovid Healthstar	Clinical and non-clinical aspects of healthcare delivery		

Web of Science	Core collection	Sciences, social sciences, arts, humanities and includes gray literature	**Title**: Public health; **Topic**: system*; **Topic**: (deliver* OR governance OR organization OR classif* OR structure* OR manag* OR fund* OR function* financ* OR role OR purpose OR typology OR framework* OR model* OR component* OR definition*)	3, 356
Cochrane Library	Cochrane Library	Includes systematic reviews, methodology reviews, clinical trials and others relating mostly to healthcare	**Title, abstract, keywords:** Public health; **Keywords:** system*; **Search All Text:** (deliver* OR governance OR organization OR classif* OR structure* OR manag* OR fund* OR function* financ* OR role OR purpose OR typology OR framework* OR model* OR component* OR definition*)	305 – 297 downloaded correctly
Health Systems Evidence	Health Systems Evidence	Health systems database	Public health; system*; (deliver* OR governance OR organization OR classif* OR structure* OR manag* OR fund* OR function* financ* OR role OR purpose OR typology OR framework* OR model* OR component* OR definition*); Filtered by: Sectors: Public Health; Any system arrangement; Document Features: Health reform descriptions; Health system descriptions; Intergovernmental organizations' health systems documents; Canada's health systems documents; Ontario's health system documents; Target: Health System	529 – saved in Excel, could not save into Zotero or Refworks. Manually reviewed for duplicates and inclusion/exclusion separately.
TOTAL				7, 559

Appendix B: Data extraction

1. Title
2. Authors
3. Source (journal, organization, publisher)
4. Year
5. Peer-reviewed or gray literature
6. Empirical vs. conceptual
    a. Type of conceptual literature (non-systematic review, theory/discussion/policy or position paper, commentary/editorial, website content)
    b. Type of empirical research (systematic review, randomized control trial (RCT), cross-sectional, cohort study, interrupted time series, before-after study, qualitative study, case study, mixed methods, other (specify))
7. Context of Study (Country/Region)
8. Key topic areas
9. Relevant findings
10. Code(s) applied
11. Themes
12. Further relevant references from paper

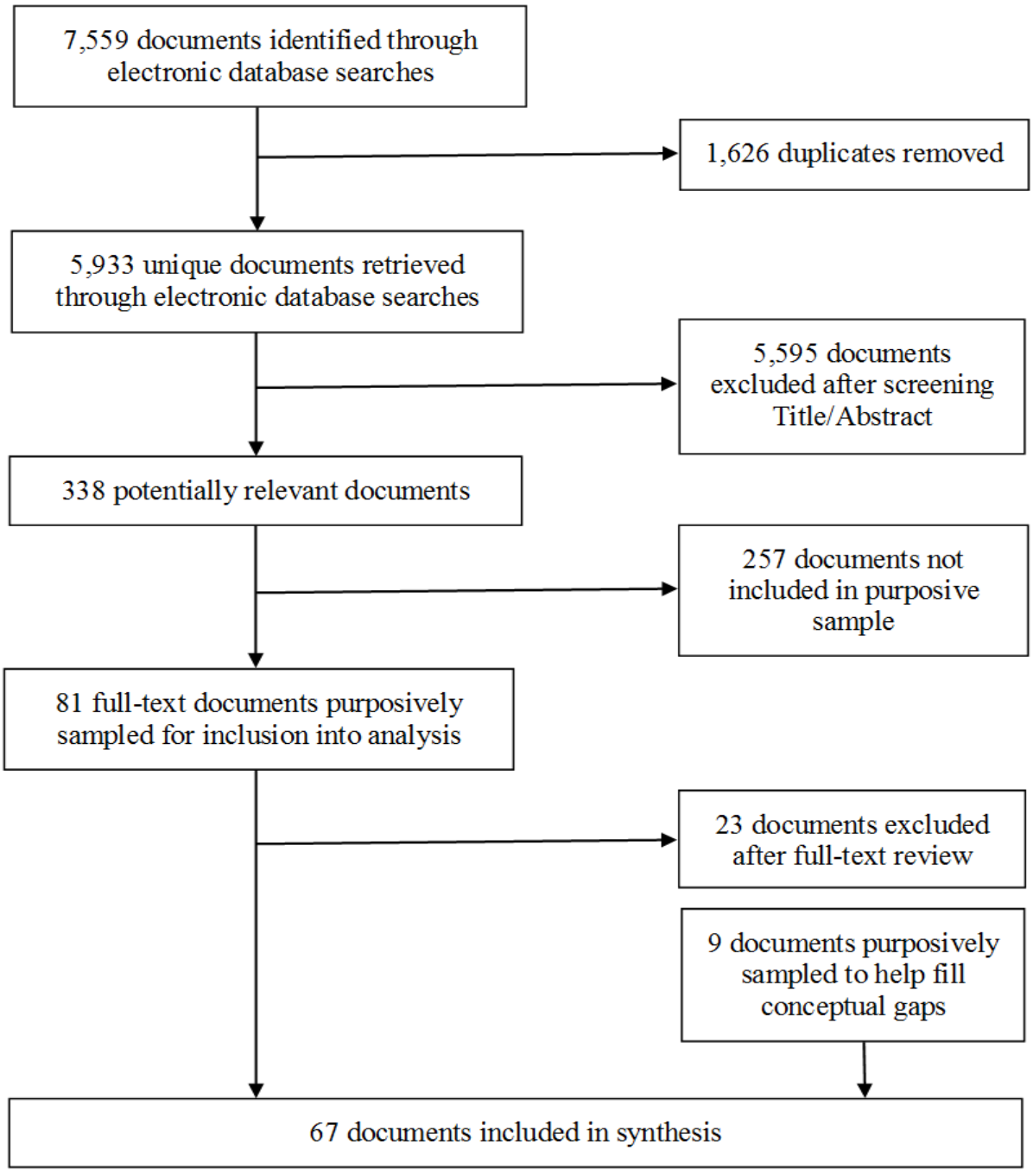
Appendix C: Health system arrangements

Key Features		**Examples**
Governance arrangements		
	Policy authority	National ministry sets policy directions but a sub-national ministry can accept, reject, or adapt them (45)
	Organizational authority	Who has the authority to organize health agencies and services (47)
	Commercial authority	Who has the authority to regulate patents, prices, and marketing of services (45)
	Professional authority	Who has professional authority over health service providers (47)
	Consumer and stakeholder involvement	Under what conditions are other stakeholders involved in policy and organizational decisions (47)
Financial arrangements		
	Financing systems	How funds are raised and sources of revenue (e.g., reliance on donor contributions) (47)
	Funding organizations	How revenues raised are used and allocated to the organizations responsible for providing programs and services to citizens (47)
	Remunerating providers	How revenue raised is used to pay individuals providing the programs (47)
	Purchasing products and services	How are decisions made about the types of care paid for with public dollars, and how is this translated into programs, services, and drugs? (47)
	Incentivizing consumers	How consequences of system financing influence consumer use (47)
Delivery arrangements		
	How care is designed to meet consumers' needs	Are there local cultural beliefs that limit the demand for certain types of programs and services? (45)
	By whom care is provided	Community health workers, Nurses, Dentists (47)
	Where care is provided	Are hospitals located in urban areas have high-quality infrastructure or in rural areas? (45)
	With what supports is care provided	Are quality monitoring and improvement systems in place and functioning well? (45)

Appendix D: 3I+E framework for health policy formulation

Key Features		**Examples**
Institutions		
	Government structures	Constitutionally, health care is a sub-national responsibility, so provincial ministries make most key decisions (45)
	Policy legacies	Health care insurance policies influence the country's medical association (45)
	Policy networks	A committee stakeholder representatives make many recommendations that later become law (45)
Interests		
	Interest groups	Nursing associations have the appropriate staff needed to influence the policy-making process (45)
	Civil society	Lack of independent media hampers dialogue and debate (45)
Ideas		
	Values	Widely held values support a focus on equity in the health systems (45)
	Personal experiences	Personal experiences of the minister influence much of her decision-making (45)
	Research evidence	A systematic review suggests that one option is more effective and cost-effective than others (45)
External Factors		
	Political change	Cabinet shuffle introduces a new minister to the health portfolio (45)
	Economic change	Global economic crisis reduces donors' capacity to support national programs (45)
	Release of major reports	A report by a prominent international organization endorses one option over others (45)
	Technological change	Mobile phone technology introduces new possibilities for performance management (45)
	New diseases	An influenza outbreak spreads rapidly to other countries (45)
	Media coverage	A series of investigative news articles in the national newspaper reveals the weak enforcement of contracts in the health system (45)

Appendix E: PRISMA flow chart for inclusion/exclusion of documents in a systematic review



Appendix F: Characteristics of documents reviewed for this study

Characteristics		Number n=67	Percent (%)
Peer-reviewed vs. gray literature	Peer-reviewed	51	76
	Gray literature	16	24
Peer-reviewed	Conceptual	26	51
	Empirical	25	49
Design (for conceptual papers)	Discussion paper	11	42
	Non-systematic review	7	27
	Commentary	5	19
	Theory paper	2	8
	Editorial	1	4
Design (for empirical papers)	Cross-sectional	9	36
	Qualitative	9	36
	Case study	3	12
	Systematic review	2	8
	Cohort	1	4
	Mixed methods	1	4
Context	Global	7	10
	Regional	3	5
	National	43	64
	State/Provincial	12	18
	Local	2	3
Year of publication	2017	1	1
	2016	4	6
	2011-2015	14	21
	2006-2010	20	30
	2001-2005	22	33
	before 2001	6	9

Appendix G: Definitions of entities and systems

Entity	Definitions/Descriptions	Citation	Suggested definition
Public Health	The art and science of health promotion and protection, disease prevention, and the improvement and prolonging of quality of life through the organized efforts of society.	(8,14,54–59)	Public health is an art and science, based on objective findings but responsive to the needs and contexts of populations, concerned with addressing the health needs of a community. It is a diverse set of organized activities aimed at improving quality of life and reducing health disparities to enable people to thrive.
	The organized efforts of society to prevent morbidity and premature mortality, keep people healthy, improve health and well-being, and reduce health inequalities.	(7)	
	The proactive approach to protecting the health of a community.	(69)	
	Public health fulfills society's collective interest in assuring environments that allow people to thrive.	(97)	
	The political art of applying science with the aim of reducing health inequalities while ensuring the overall health of the population.	(79)	
	Social medicine is the impact of decisions or policies made by other sectors that impact health, i.e. welfare, education	(71)	
	The diverse set of activities that focus on the promotion and protection of the health of the population and address health needs.	(104)	
Public Health System	Includes all levels of governmental and non-governmental entities that share in the responsibility for ensuring healthy environments. It is a complex network of organizations that contribute to the core functions of public health to protect and promote health within the community.	(2,4,60–68)	A public health system is the collective capacity of governmental, private, and other public sector entities that support the mission and core functions of public health. It is the cumulative arrangement of resources, infrastructure, and policies impacting health that exist to support public health within communities.
	The public health system consists of national, state/provincial, and local agencies.	(58)	
	Governmental public health agencies that partner and interact with other public and private entities to engage in a variety of public health activities within communities.	(80)	

	Governmental, private, and public sector agencies and organizations whose actions impact the health of the population, as well as infrastructure and laws that support public health activities.	(22)	
	Governmental, non-governmental and community organizations that operate at all levels of government and are responsible for program delivery, policy setting, funding and the coordination of public health initiatives.	(54)	
	Public health systems provide services to the population with the primary goal of reducing exposure to disease through regulations and education.	(85)	
	Individuals and organizations that work towards the health of a community or population, usually revolving around a government agency that directs the actions of partners to accomplish system goals.	(110)	
	Public health systems work at the local, regional, national and international levels to deliver comprehensive programs through partnerships and multidisciplinary teams of practitioners, specialists, and advocates to improve and protect health in communities.	(96)	
	The public health system is separate and complimentary to the healthcare system. Due to the nature of the public health, public health systems consist of essential partnerships between formal and informal public health organizations and societal groups to influence determinants of health.	(3)	
	The essential building block of public health that brings together community and organizations through partnerships to perform essential public health functions, standardizing public health practice and performance.	(20)	
Health Care	Provides individual services to treat acute and chronic illnesses and disease within individuals in specific settings, such as clinics and hospitals.	(58,69)	

	Medical care provided by a health professional to individuals seeking treatment or advice to restore personal health.	(8)	
Healthcare System	The diagnosing, treatment and rehabilitation of injury and illness.	(3)	
	Healthcare systems are focused on treating disease, and is a responsibility of the provincial government, planned and funded by regional bodies, while the federal government finances and is responsible for health care of targeted groups.	(47)	
	The healthcare system is responsible for responding to the medical needs of individuals.	(70)	
Health System	A system that encompasses all formally and informally organized health care organizations and institutions who seek to understand, improve, and tend to the health of individuals within the population. Formally organized health systems are supported by political and economic systems, and informal health care may include services provided by families and communities and traditional practitioners.	(8)	Health systems are the formal and informal actors, services, and institutions, whose activities and policies aim to promote, protect, and restore the health of individuals and populations.
	Two sectors within one larger overarching system – personal and palliative care services, and collective services, whose aim is to promote, preserve or restore health through a combination of organizations and activities.	(9,21)	
	The health system includes medicine and public health to improve the health of individuals and populations.	(71,72)	
	The delivery of services to promote, restore or maintain health in a population through the combination of organizations, management, financing, and resources.	(16,73)	
	Health systems are responsible for the promotion of health, and the prevention and treatment of disease.	(47)	

Appendix H: Public Health Functions and Purpose

Region			Source	Framework										Established Essential Services								
	Country	State/ Local		I.O.M. Three Core Functions of Public Health (U.S.A.)																		
			(4,58,62,63,65,72)	Assessment		Policy Development			Assurance													
			(13,22,62,63,66,68,80,94,99,102)	10 Essential Public Health Services (U.S.A.)																		
				Health Assessment and Monitoring	Investigation/Surveillance	Inform/educate/Health Promotion	Partner Engagement & Advocacy	Policy Development & Planning	Regulation/ Enforcement	Link & provide health services	Workforce strengthening	Evaluation of health services	Research	Communicable Disease Control	Chronic Disease & Injury Prevention	Health Protection	Emergency Planning & Response	Laboratory Services	Licensing	Program Implementation	Resource & Organization Mgmt.	Vital Statistics
North America																						
	U.S.A		(13,22,62,63,66,68,80,94,99,102)	x	x	x	x	x	x	x	x	x	x									
			(2)		x	x									x	x	x					
			(69)		x			x		x								x				
			(82)							x							x					
			(4)						x	x		x		x	x	x	x	x	x			x
			(65)	x	x	x	x	x				x								x	x	
			(77)	x	x					x				x		x			x			
			(97)	x						x					x							
			(62)			x				x				x		x						x
	Canada		(7)	x	x	x							x				x					

Region			Source	Framework									Established Essential Services								
	Country	State/ Local		I.O.M. Three Core Functions of Public Health (U.S.A.)																	
			(4,58,62,63,65,72)	Assessment		Policy Development			Assurance												
			(13,22,62,63,66,68,80,94,99,102)	10 Essential Public Health Services (U.S.A.)																	
				Health Assessment and Monitoring	Investigation/Surveillance	Inform/educate/Health Promotion	Partner Engagement & Advocacy	Policy Development & Planning	Regulation/ Enforcement	Link & provide health services	Workforce strengthening	Evaluation of health services	Research	Communicable Disease Control	Chronic Disease & Injury Prevention	Health Protection	Emergency Planning & Response	Laboratory Services	Licensing	Program Implementation	Resource & Organization Mgmt.	Vital Statistics
North America																					
	Canada		(3,5,14,28,87)	x	x	x									x	x					
			(6)	x		x				x			x	x	x	x	x				
			(111)	x	x				x					x	x	x	x				
			(100)		x	x									x	x					
			(95)			x								x	x	x	x				
		Ontario	(11)	x	x	x			x	x			x	x	x	x	x				x	
			(54)			x				x				x	x	x	x					
			(104)	x	x	x		x		x					x	x	x					
		British Colombia	(13)	x	x	x						x			x	x	x					
		Alberta	(11)				x		x	x				x			x				x	

Region			Source	Framework										Established Essential Services								
	Country	State/ Local		I.O.M. Three Core Functions of Public Health (U.S.A.)																		
			(4,58,62,63,65,72)	Assessment		Policy Development			Assurance													
			(13,22,62,63,66,68,80,94,99,102)	10 Essential Public Health Services (U.S.A.)																		
				Health Assessment and Monitoring	Investigation/Surveillance	Inform/educate/Health Promotion	Partner Engagement & Advocacy	Policy Development & Planning	Regulation/ Enforcement	Link & provide health services	Workforce strengthening	Evaluation of health services	Research	Communicable Disease Control	Chronic Disease & Injury Prevention	Health Protection	Emergency Planning & Response	Laboratory Services	Licensing	Program Implementation	Resource & Organization Mgmt.	Vital Statistics
North America																						
	Canada	Newfoundland and Labrador	(11)		x	x			x	x			x	x	x		x				x	
		New Brunswick	(11)		x				x	x				x		x	x				x	
		Manitoba	(11)		x	x	x		x	x			x	x	x	x	x				x	
		Saskatchewan	(11)	x	x	x	x		x	x			x	x	x	x	x				x	
South America																						
	Latin American Region		(13)	x	x	x	x	x	x		x	x	x				x				x	

Region			Source	Framework										Established Essential Services								
	Country	State/ Local		I.O.M. Three Core Functions of Public Health (U.S.A.)																		
			(4,58,62,63,65,72)	Assessment		Policy Development		Assurance														
			(13,22,62,63,66,68,80,94,99,102)	10 Essential Public Health Services (U.S.A.)																		
				Health Assessment and Monitoring	Investigation/Surveillance	Inform/educate/Health Promotion	Partner Engagement & Advocacy	Policy Development & Planning	Regulation/ Enforcement	Link & provide health services	Workforce strengthening	Evaluation of health services	Research	Communicable Disease Control	Chronic Disease & Injury Prevention	Health Protection	Emergency Planning & Response	Laboratory Services	Licensing	Program Implementation	Resource & Organization Mgmt.	Vital Statistics
Asia																						
	India		(13,85)	x	x	x		x	x	x	x	x	x	x			x				x	
Middle East																						
	Israel		(13,62)	x			x	x	x		x	x	x		x	x	x					
Pacific																						
	Fiji, Malaysia, Viet Nam		(13,79)	x		x		x	x		x	x	x		x						x	
	Australia		(13)	x	x	x	x	x		x				x	x	x					x	
	New Zealand		(13)	x	x	x				x		x				x						
Europe																						
	European Region		(13)	x		x	x	x		x			x	x		x	x	x				

Region			Source	Framework									Established Essential Services								
	Country	State/ Local		I.O.M. Three Core Functions of Public Health (U.S.A.)																	
			(4,58,62,63,65,72)	Assessment		Policy Development			Assurance												
			(13,22,62,63,66,68,80,94,99,102)	10 Essential Public Health Services (U.S.A.)																	
				Health Assessment and Monitoring	Investigation/Surveillance	Inform/educate/Health Promotion	Partner Engagement & Advocacy	Policy Development & Planning	Regulation/ Enforcement	Link & provide health services	Workforce strengthening	Evaluation of health services	Research	Communicable Disease Control	Chronic Disease & Injury Prevention	Health Protection	Emergency Planning & Response	Laboratory Services	Licensing	Program Implementation	Resource & Organization Mgmt.	Vital Statistics
Europe	European Region		(13)	x		x	x				x		x		x	x	x				x	
	European Region		(13)			x	x				x										x	
	Eastern Europe		(55)	x		x				x				x	x	x						
	Eastern Mediterranean		(56)		x	x									x	x	x					
	Eastern Mediterranean		(13)		x	x	x	x			x		x			x	x			x	x	
	U.K.		(96)	x	x	x			x	x		x	x	x	x		x					
			(13)	x	x		x		x		x	x	x							x		
Global			(57)		x	x			x							x	x					
			(8)	x		x									x	x				x		
Total			**39**	**24**	**25**	**30**	**13**	**11**	**15**	**22**	**9**	**11**	**16**	**18**	**22**	**26**	**25**	**3**	**2**	**4**	**14**	**2**

Appendix I: Aligning public health systems into the health system arrangements framework

Public health system arrangements		
A. Governance Arrangements		
	Public Health Systems	**Sources discussing these arrangements**
Policy Authority	• Four levels of policy authority in public health (e.g., international, national, regional, and local.)	(28,59,68,87)
	• Federal governments involved in regulatory functions	(11,14,28,47,59,62, 80,85–87)
	• Policy authority de-centralized (e.g., state/provincial/territory/municipality level)	(4,14,28,47,54,57,6 1,64,68,77,79,89)
	• Legislation mandates performance and other procedures	(64,68,77,79,82–84)
	• Defined powers of governmental public health agencies vary.	(109)
	• Leadership, expertise and guidance, advocacy (e.g., governmental public health agencies) (e.g., chief public health officer assumes authority over minister of health on issues of public health) (e.g., senior public health managers) • Resource stewardship and oversight (28,84,95)	(5,28,54,79,80,82,8 5,97)
	• Political and financial influence and support can persuade agencies to target specific public health objectives	(85)
	• In national public health emergencies, the federal government leads and communicates with foreign governments, and health agencies	(28,59)
Organizational authority	• Boards of health (e.g., state, local) (e.g., independent, elected, appointed) (e.g., public health professionals, citizens, consumers, educators, and business professionals)	(11,27,47,54,68,77, 84,87,88,90)
	• Who can approve health department budgets, adopt regulations, set and impose fees	(11,14,27,28,47,68, 77,83,86,87)
Commercial authority	N/A	N/A
Professional authority	• Professionals are represented and regulated by their associated regulatory colleges	(47)
Consumer and stakeholder involvement	• citizens provide informed consent when participating in public health clinical services	(47)
	• Stakeholder organizations are given a voice in policy and organizational decisions (e.g., private citizens and consumers)	(27,47,68,79,87,90)

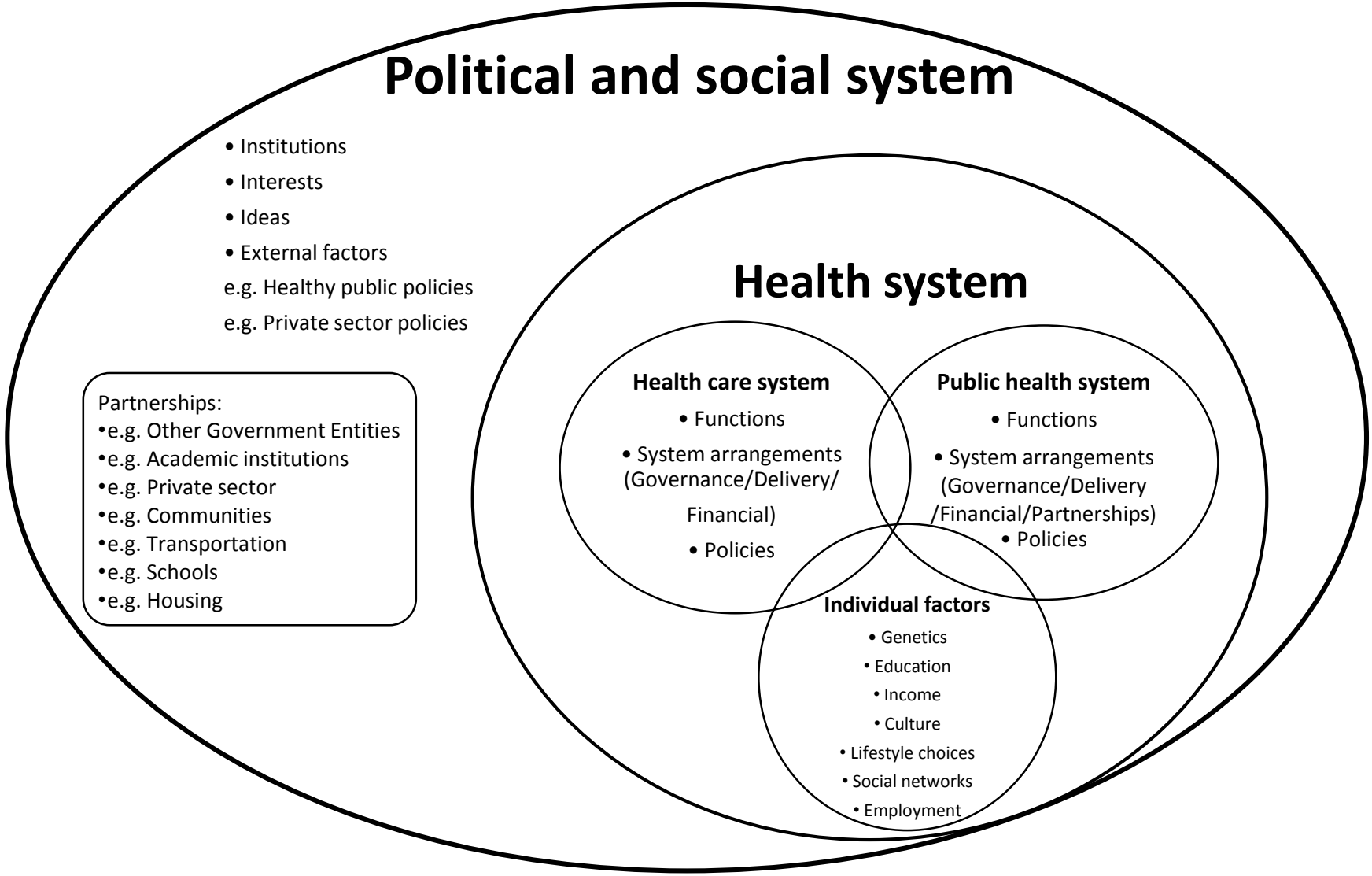
	(e.g., communities, boards of health) • Advocacy groups influence policy	
Partnership Engagement	• Partnerships and collaboration occurs at all levels of government, and to varying degrees of collaboration between other public, private and community organizations • Building and maintenance of services through coordination is often mandated • Dependency on partners to deliver and contribute to programs.	(14,47,59,61,68,80, 83,85,86,94)
B. Delivery Arrangements		
	Public Health Systems	**Sources discussing these arrangements**
How care is designed to meet consumers' need	• Public health functions carried out by all levels of government, federal, state/provincial, local, but most activities are carried out at state/provincial level or locally (e.g., protection or promotion marketing is more effective from the federal level) (e.g., programs designed at state/provincial and local levels) (e.g., immunizations delivered at the local level)	(3,5,12,23,27,47,54 ,58,59,61,62,66,79, 83,86,86–89)
	• Size of jurisdictions influence support, human resources	(11,14,47,58,61,89, 98,99)
	• Organizational structures	(2,68)
	• Funding to target specific programs and groups	(47,58,97)
Who care is provided by	• Care is provided at all levels of government (47) • Care delivered by multiple organizations outside of government (61) • Multidisciplinary nature of public health system means wide range of professionals participate in public health system (e.g., by both regulated and unregulated professionals)	(47,76,87,95,100)
Where care is provided	• Delivery of public health services occurs in multiple public and private settings (e.g., schools, homes, offices, clinics, community)	(11,47)
With what supports care is provided	• Public health relies on data e.g., public health laboratories, surveillance • Technology (7) (e.g., eHealth, internet, media)	(3,47,66,89,102)
Partnership	• Partnerships with other governmental, non-governmental, and community organizations (e.g., emergency response, reporting, surveillances)	(57,64,66,80,83,86, 90,95,101)

C. Financial Arrangements		
	Public Health Systems	**Sources discussing these arrangements**
Financing systems	• General taxation	(12,14,22,47,59,65, 79,86,89,98)
	• Dedicated funding streams/"ear-marked/targeted funding" from taxes charged on consumer goods, such as fuel or tobacco	(14,61,86,89)
	• Service fees	(22,65,68,89)
	• Private sector funding from non-government organizations, such as non-profit and for-profits and development agencies	(11,22,79)
	• Partnerships/public sector collaborations between different Ministries and other partners	(65,88,89)
	• Intersectoral collaboration between public and private sectors	(59)
	• Public health underfunded • All level of government in the United States funded public health, although spending accounts for 1-3 percent	(14,47,58,59,68,76) (102)
	• Public health received 13.5% of fiscal Department of Health budget to conduct broad range of services (1997)	(97)
Funding Organizations	• Cost-shared between governments • Informal funding for non-mandatory programs (4)	(12,22,28,47,86–88,99)
	• Allocate funds for specific public health activities • Allocated by funding formulas • High priority programs receive support from external factors • Pay-for-performance arrangements	(58,59,61,65,79,89)
	• Sources of funding vary	(14,58,68,99)
Remunerating providers	• Not defined	N/A
Purchasing products and services	• Mandatory programs and services are funded	(47,79,88)
	• Funding individual public health services.	(68)
Incentivizing consumers	• N/A	N/A

Appendix J: Public health system arrangements

Key Features		
Partnerships and Communication	**Governance arrangements**	**Examples**
	Policy authority	National ministry sets policy directions but a sub-national ministry can accept, reject, or adapt them (45)
	Organizational authority	Who has the authority to organize health agencies and services (47)
	Commercial authority	Who has the authority to regulate patents, prices, and marketing of services (45)
	Professional authority	Who has professional authority over health service providers (47)
	Consumer and stakeholder involvement	Under what conditions are other stakeholders involved in policy and organizational decisions (47)
	Financial arrangements	
	Financing systems	How funds are raised and sources of revenue (e.g., reliance on donor contributions) (47)
	Funding organizations	How revenues raised are used and allocated to the organizations responsible for providing programs and services to citizens (47)
	Remunerating providers	How revenue raised is used to pay individuals providing the programs (47)
	Purchasing products and services	How are decisions made about the types of care paid for with public dollars, and how is this translated into programs, services, and drugs? (47)
	Incentivizing consumers	How consequences of system financing influence consumer use (47)
	Delivery arrangements	
	How care is designed to meet consumers' needs	Are there local cultural beliefs that limit the demand for certain types of programs and services? (45)
	By whom care is provided	i.e. Community health workers, Nurses, Dentists (47)
	Where care is provided	Are hospitals located in urban areas have high-quality infrastructure or in rural areas? (45)
	With what supports is care provided	Are quality monitoring and improvement systems in place and functioning well? (45)

Appendix K: Conceptual model of a population health system



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