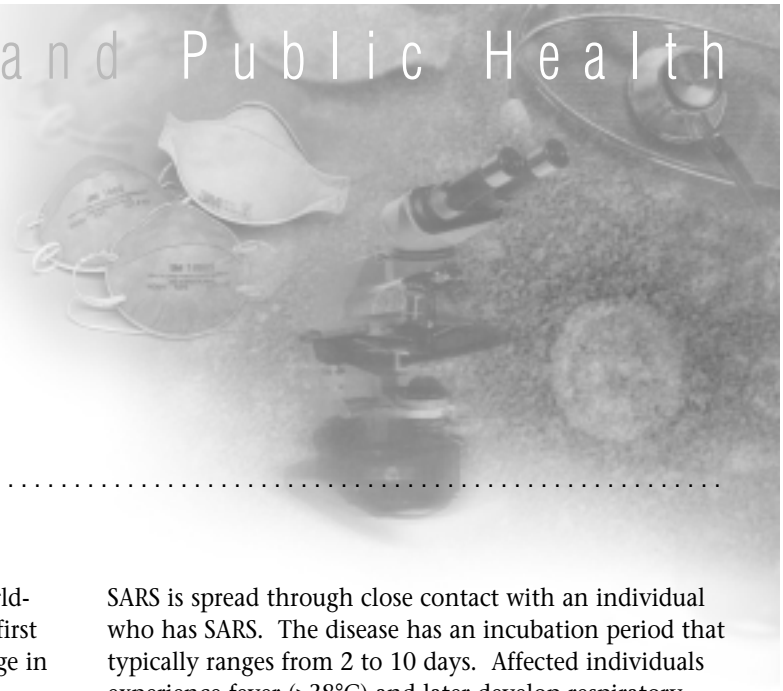
Chapter 1



INTRODUCTION

Severe Acute Respiratory Syndrome, now known worldwide by the acronym SARS, is considered to be the "first severe and readily transmissible new disease to emerge in the twenty-first century".[1]

In late February, several guests at the Metropole Hotel in Hong Kong had come in contact with an ill doctor who had been involved in treating patients with an atypical form of pneumonia in Guangdong, China. Those guests continued their travels in Hong Kong and on to Canada, Singapore, and Vietnam. They fell ill, and began spreading the disease to others. Many of them died. This illness was soon identified as severe acute respiratory syndrome or SARS. As of July 11, 2003 in its daily summary, the World Health Organization [WHO] reported 8,437 probable cases of SARS and 813 deaths worldwide, and the toll has since risen to about 900 as some previously-ill individuals have succumbed.

Canada, like other countries, faced an intense battle to control SARS. Public health and health care personnel worked tirelessly to contain the outbreak within systems that were often seriously inadequate to the task. Citizens were also impressively calm and cooperative, notwithstanding innumerable disruptions to their working lives and quarantine requirements that affected thousands.

SARS was and remains a challenge to diagnose and manage because its symptoms resemble those of many other respiratory infections. Thus far, extensive research by a WHO-coordinated international network of research centres has identified a novel coronavirus as the presumed cause of SARS. The diagnostic tests available to test for the SARS coronavirus have limitations with respect to their reliability and sensitivity, and more research is needed to enable the rapid identification and characterization of this new coronavirus.[2]

SARS is spread through close contact with an individual who has SARS. The disease has an incubation period that typically ranges from 2 to 10 days. Affected individuals experience fever (>38°C) and later develop respiratory symptoms such as cough, shortness of breath, or difficulty breathing. Overall, case fatality from progressive respiratory failure ranges from less than 1% of cases for persons under 24 years of age to 15% of cases for persons aged 45 to 64 years of age; in persons over the age of 65, the fatality rate can exceed 50%.[3] Diagnosis rests partly on the clinical syndrome, partly on a link to known cases of SARS, and partly on a process of exclusion. The virus can be isolated from respiratory secretions and stool; however, it is not always detected from these sources even in patients with probable SARS. Serological tests based on the body's immune response to SARS are also helpful, but these tests do not begin to yield useful information until a few weeks after the onset of symptoms. No vaccine or cure currently exists leaving clinicians to rely primarily on supportive measures and public health authorities to rely on isolation and quarantine as the predominant measures to control SARS.

Emerging and Re-emerging Infectious Diseases

Emerging infectious diseases are diseases that are newly identified, or that have existed previously but are increasing in incidence or geographic range.[4] SARS is the most recent example of a new or otherwise unknown disease. Variant Creutzfeldt-Jakob disease, discovered in 1996 and considered to be the same agent as that causing bovine spongiform encephalitis in cattle, is another example. Since 1973, more than 30 previously unknown diseases associated with viruses and bacteria have emerged. Examples include: Ebola virus (1977); Legionnaire's disease (1977);

E. coli 0157:H7-associated hemolytic uremic syndrome (1982); HIV/AIDS (1983); Hepatitis C (1989); and H5N1 Influenza A or avian flu (1997).[5]

West Nile virus infection is an example of a previously known disease that has increased its geographic range. The discovery of West Nile virus in the USA in 1999 marked the first introduction in recent history of an Old World flavivirus into the New World.[6] West Nile virus was discovered in the West Nile district of Uganda in 1937. In the last decade, human outbreaks of West Nile have increased in the Middle East and Europe, suggesting the evolution of a new West Nile virus variant.[7] West Nile virus arrived in Canada in 2001, found in dead birds and mosquito pools in Ontario. The first human cases of infection occurred in 2002. In 2002, West Nile virus was found in five provinces: Nova Scotia, Quebec, Ontario, Manitoba, and Saskatchewan, with Quebec and Ontario having confirmed cases of human infection.[8] On August 12, 2003, Alberta reported its first case of West Nile virus, a young woman who likely contracted the disease while camping in Southern Alberta.[9] Federal and provincial governments all have action plans to reduce the spread of the virus.

Re-emerging infectious diseases are known diseases previously considered under control and no longer considered a public health problem, but that have reappeared or are causing an increased number of infections.[10] Some examples include: the reappearance of epidemic cholera in the Americas in 1991; dengue fever in the Americas in the 1990s; diphtheria in the Russian Federation and other republics of the former Soviet Union in 1994; the increase in the occurrence of meningococcal meningitis in Sub-Saharan Africa since the mid-1990s; and Yellow fever in Africa and South America since the mid-1980s. Tuberculosis may be considered in this category in some respects. Tuberculosis has remained a public health problem for vulnerable populations. Its toll has increased with urban crowding and poverty in developing and developed nations, with the advent of the HIV pandemic, and with the emergence of strains of drug-resistant tuberculosis bacteria.

Many of the pathogens believed to cause infectious diseases are already present in the environment. Activities that increase microbial traffic between people and their environments promote emergence and epidemics.[11] Among the factors precipitating the emergence and re-emergence of infectious diseases are: ecological changes (including those due to economic development and land use); human demographics and behaviour; technology and industry; and microbial adaptation and change.

HIV provides a good example of how such factors have led to the emergence of infectious diseases. HIV is believed to have had a zoonotic origin. Ecological factors such as deforestation and land development would have increased human exposure to the animal host. Social events such as population growth and migration played a role in increasing the opportunity for HIV transmission to other humans. Sexual behaviour, use of illicit drugs by injection, and iatrogenic causes (e.g., the early spread of HIV through blood transfusions and blood products) provided added advantages for the continued and accelerated transmission of HIV.[12] Bovine spongiform encephalopathy and hemolytic uremic syndrome caused by *E. coli* 0157:H7 (commonly known as hamburger sickness) are examples of diseases that emerged as a result of changes in food production.[13]

Factors that exacerbate the emergence and re-emergence of infectious diseases, and that present challenges in dealing with outbreaks, are globalization and deficiencies in public health infrastructure.

Globalization and Communicable Disease

Globalization has made our world smaller as people and goods move more freely and more frequently around the globe. As the world becomes more interconnected, the opportunities for rapid and effective disease spread increase. And as was seen with SARS, travel plays a pivotal role in the rapid dissemination of disease. According to World Tourism Organization data[14], approximately 715 million international tourist arrivals were registered at borders in 2002 (preliminary data). Human migration has been a key means for infectious disease transmission throughout recorded history. However, the volume, speed, and reach of travel today have accelerated the spread of infectious diseases.[15] The rapidity of movement from one country to another or one continent to another falls well within the incubation period of virtually all infectious diseases. Disease emergence is nonetheless complex, and the conditions for a disease-causing organism must be right in order for it to survive, proliferate, and find a way to enter a susceptible host.[16] SARS, thought to be spread through droplet nuclei and close physical contact, proved to be a disease easily carried to any part of the world.

The globalization of the food (and feed) trade, while offering many benefits and opportunities, also presents new risks. Because food production, manufacturing, and marketing are now global, infectious agents can be disseminated from the original point of processing and packaging to locations thousands of miles away.[17]

Emerging and re-emerging infectious diseases are a permanent fixture on the public health landscape at the local, regional, national, and international levels. People will continue to travel and migrate; goods will continue to be traded. In order to mitigate the incidence and effects of infectious diseases, therefore, communication at all levels and local responses to infectious diseases must be enhanced.

Compounding the challenges of dealing with emerging and re-emerging infectious diseases is the threat of the accidental or intentional release of biological agents. The events of September 11, 2001 and the intentional release of anthrax spores that immediately followed in the USA, make the possibility of the accidental or intentional release of a biological agent a disturbing reality and a threat to global security. International cooperation has been required to prepare for such events.

Working collaboratively with international bodies is also a key component to dealing effectively with infectious diseases. Canada is in regular contact with the World Health Organization [WHO] and the US Centers for Disease Control and Prevention [CDC] in its day-to-day business of conducting disease surveillance.

The World Health Organization [WHO]

WHO is the United Nations' specialized agency for health whose objective is the "attainment by all peoples of the highest possible level of health." In 2001, the World Health Assembly, made up of 192 member states, adopted a resolution on "Global health security: Epidemic alert and response," in recognition of the threats to public health posed by epidemic-prone and emerging infections, and bioterrorism. That resolution expressed support for ongoing work on the revision of the International Health Regulations, the development of a global strategy for infectious disease containment and the prevention of antimicrobial resistance, and collaboration between WHO and technical partners in the area of epidemic alert and response. It also urged members to participate actively in surveillance activities related to health emergencies of international concern, to develop and update national preparation and response plans, to develop training for involved staff, and to ensure availability of contemporary information on surveillance and control of infectious diseases.

Within WHO, the Department of Communicable Disease Surveillance and Response [CSR] is responsible for realizing this mandate. It envisages that "every country should be able to detect, verify rapidly and respond appropriately to epidemic-prone and emerging disease threats when they arise to minimize their impact on the health and economy of the world's population."

The CSR's three strategic directions are to contain known risks, respond to the unexpected, and improve preparedness. Activities include tracking emerging infectious diseases, sounding an alarm when necessary, sharing information on emerging diseases and disease outbreaks, and providing assistance to affected states in the form of technical assistance, supplies, and in some cases, international investigations/responses.

WHO emphasizes that global surveillance and strong public health systems are needed to respond to emerging and re-emerging infectious diseases, and possible bioterrorism events. As mentioned earlier, WHO is currently revising its International Health Regulations which set out to "ensure the maximum security against the international spread of diseases with minimum interference with world traffic." From WHO's perspective, the worldwide SARS outbreak has underscored the need for these revised regulations.[18]

US Centers for Disease Control and Prevention [CDC]

The CDC is the lead federal agency in the USA for protecting the health and safety of its citizens, and is part of the Department of Health and Human Services. It serves as the national focus for developing and applying disease prevention and control, environmental health, and health promotion and education activities with respect to health. CDC was originally established as the US 'Communicable Diseases Center' after the Second World War. The continuation of the acronym CDC (minus the P for prevention) and public image of the agency as an outbreak-fighting organization both tend to mask the extent to which CDC now serves broad public health functions in the USA. The agency employs approximately 8,500 employees working in 170 occupations in various locations, including in CDC facilities around the USA, in other countries, in quarantine offices, and in state and local health agencies. It is made up of 12 centres, institutes and offices, one of which is the National Center for Infectious Diseases [NCID].

The NCID's mandate is "to prevent illness, disability, and death caused by infectious diseases in the United States and around the world." It accomplishes this by conducting surveillance, epidemic investigations, epidemiologic and laboratory research, training, and public education programs to develop, evaluate, and promote prevention and control strategies for infectious diseases. NCID staff work in partnership with local and state public health officials, other federal agencies, medical and public health professional associations, infectious disease experts from academic and clinical practice, and international and public service organizations. The NCID also works closely with other Centers within the CDC such as the Public Health Practice Program Office, the Office of Global Health, and the Epidemiology Program Office among others.

Like many other countries, the USA is in the process of improving its national capacities for disease surveillance, prevention, and control. It has developed a strategic plan for preventing emerging infectious diseases, the pillars of which are surveillance and response, applied research, infrastructure and training, and prevention and control. The CDC seeks to improve epidemiologic capacity, surge capacity, communications, and the supply of appropriate and adequate equipment and training.[19]

A "CDC North"?

The experience of the SARS outbreak has renewed calls for a Canadian version of the US Centers for Disease Control and Prevention to improve coordination of public health across Canada, champion public health initiatives nationally, and direct the operations of a national disease control body. These calls are based on the premise that public health threats such as SARS are national issues that need a coordinated response from both public health and emergency response systems, with appropriate support at the federal level. They are also based on the limitations in response capacity as well as issues with coordination and communication that were highlighted during the battle to control SARS in Canada. The National Advisory Committee on SARS and Public Health has taken a key part of its mandate to be the assessment of options for enhancing our response capacity to health crises, particularly outbreaks of emerging infectious diseases such as SARS.

Emergency Preparedness

The terrorist attacks of September 11, 2001 in the USA underscored the necessity of local, regional, and national preparedness for any emergency. New York City [NYC] saw the benefits of forward planning when a case of exposure to anthrax, found on October 9, 2001, was successfully handled. NYC was in the process of developing protocols for mass antibiotic prophylaxis against anthrax in 1999, and had also established an incident command structure of which NYC government agencies are part. This command structure includes the following components: clinical response, sheltering, surveillance, environmental health, laboratory, communications, management information systems, and physical plant operations. Each component is operated by staff from a variety of the city's Department of Health programs. NYC's command system swung into high gear the moment the anthrax exposure case was identified. An antibiotic distribution site was established, and work began on administering antibiotics and determining the source of the anthrax and who might have been exposed.

The success of this operation was attributed to four "C's", i.e., *clarity* of mission, lines of authority, and responsibilities; *communication; collaboration* among federal, state and local public health officials, and law enforcement officials; and *coordination* of staffing and supplies.[20]

Federal/provincial/territorial Ministries of Health have made progress in their emergency preparedness and responses plans since September 11, 2001, and are working collaboratively towards a seamless pan-Canadian health emergency management system. However, the SARS outbreak demonstrated that more needs to be done to integrate the public health and emergency response systems in times of crisis. We cannot say, with confidence, that the factors that contributed to NYC's successful handling of its anthrax incident were in place to handle Canada's SARS outbreak.

The State of Canada's Public Health System

The public health system, unlike the clinical or personal health services system, tends to operate in the background, little known to most Canadians unless there is an unexpected outbreak of disease. However, the public health system has many essential roles. These include health protection, disease and injury prevention, and health promotion, along with time-honoured fundamentals such as access to safe foods, safe drinking water, and proper sanitation systems. An effective public health system is essential to preserve and enhance the health status of Canadians, to reduce health disparities, and to reduce the costs of curative health services. While public health activities may evolve as a result of changing technology and needs, the goals remain the same: to reduce the amount of disease, premature death, and pain and suffering in the population.

Public health has the health of populations as its priority. The population approach recognizes that the health of populations and individuals is shaped by a wide range of factors in the social, economic, natural, built, and political environments. In turn, these factors interact in complex ways with each other and with innate individual traits such as sex and genetics. Such a broad perspective on health takes into account the potential effects of social connectedness, economic inequality, social norms, and public policies on health-related behaviours and on health status.

The Walkerton, Ontario *E. coli* outbreak in May 2000 and the North Battleford, Saskatchewan outbreak of *Cryptosporidium parvum* in April 2001 demonstrate how breakdowns in infrastructure lead to public health crises. A recent comparative study of the Walkerton and North Battleford outbreaks conducted by Woo and Vicente concludes that both accidents resulted from a complex interaction among factors at multiple levels ranging from inadequate supervision, compliancy failure, and complacency on the part of regulatory bodies, to provincial budget cutbacks.[21]

A more cohesive, comprehensive approach to public health must form the basis for a sustainable public health system. This means cooperation not only across governments but also within governments, and involves the private sector, non-governmental organizations, and the public. This is no easy task.

Federal/Provincial/Territorial Structures and Linkages

Canada's Constitution provides both the federal and provincial/territorial governments with elements of legislative authority over health. The primary federal acts governing public health and infectious diseases are the *Department of Health Act* which provides powers related to disease surveillance and the "protection of the people of Canada against the risks to health and the spreading of diseases" and the *Quarantine Act*. Provincial and territorial governments have regulations with respect to reportable diseases requiring special attention and measures. All jurisdictions have legislation governing emergencies which generally cover infectious disease epidemics and other situations that would present a serious public health threat.

The federal government supports health care through the Canada Health and Social Transfer [CHST] which provides provinces and territories with cash payments and tax transfers to apply as they see fit to their health and social programs. From time to time, the federal government also provides funding for specific health initiatives, most recently primary or home care. Provincial and territorial governments provide funding to their respective health authorities predominantly through grants. In Ontario, municipalities share a 50% responsibility for the funding of most local public health programs. In 2002, approximately $79.354 billion was spent on health by the federal, provincial, territorial, and municipal governments. There is no standardized definition of public health, and it is therefore difficult to obtain a precise estimate of what is spent on public health. However, in rough terms, spending on personal health services is about thirty-fold greater than public health spending.

Only weak mechanisms exist in public health for collaborative decision making or systematic data sharing across governments. Furthermore, governments have not adequately sorted out their roles and responsibilities during a national health crisis. Each level of government, from local to federal must collaborate if Canada is to achieve a seamless, integrated approach to public health and to managing health crises. The SARS outbreak has highlighted many areas where inter-jurisdictional collaboration is suboptimal; so far from being seamless, the public health system showed a number of serious gaps.

Canada's SARS Experience

After China and Hong Kong, Toronto was the region hardest hit by SARS. As of August 12, 2003, there had been 438 probable and suspect SARS cases in Canada, including 44 deaths. The majority of SARS cases have been concentrated in Ontario and all deaths have occurred in Toronto. The toll on health care workers has been especially high: more than 100 fell ill with probable SARS and three succumbed.

SARS placed heavy pressures on Toronto's public health and health care system. The region's health care professionals, as front-line workers vital to controlling the disease, were at heightened risk for contracting the disease, and under considerable physical and psychological stress. Many patients required intensive care, hospitals had to close, elective procedures were cancelled, and procuring adequate types and quantities of supplies to combat the disease was difficult. SARS also placed unprecedented demands on the public health system, challenging regional capacity for outbreak containment, surveillance, information management, and infection control.

While the public health and health care workers involved did an admirable job of containing SARS and keeping it from spreading to the larger community, the SARS experience highlighted weaknesses in Canada's public health system. Many issues to do with the clinical system and clinical/public health interface were also thrown into high relief. Aside from the lack of surge capacity to deal with this crisis situation, problems emerged with respect to timely access to laboratory results, information sharing, data ownership, and epidemiologic investigation of the outbreak. Communication to the public was sometimes inconsistent, and it was not always clear who was in charge of the outbreak response.

The SARS experience illustrated that Canada is not adequately prepared to deal with a true pandemic. The Ontario government has similarly emphasized that Ontario's public health system could not have withstood two simultaneous large-scale outbreaks or crises such as SARS.[22] It is unlikely that most other provinces are in a better position, and the federal capacity to support one or more provinces facing simultaneous health crises is limited.

Having the SARS outbreaks occur in Canada's largest city presented many challenges. However, it may have been fortuitous that SARS struck Toronto and not a less-advantaged region of the country. Few rural and small urban hospitals have resident specialists in infectious disease; infection control officers/nurses are often part-time, and include infection control among a number of somewhat unrelated functions such as nursing supervision or occupational health. In smaller jurisdictions, communicable disease investigation and control falls to public health nurses and inspectors with at most one physician, who may or may not be fully trained in public health, to provide back-up and oversight. Multi-tasking across a wide range of activities from well baby and immunization to community development is the rule in rural public health units, with very limited specialization of functions. How can we strengthen the public health system to ensure that it can meet the unique challenges of both major metropolitan areas and smaller or rural communities?

Learning from SARS

The lessons learned from SARS are critical pieces of information for determining the improvements needed in Canada's public health system. Enhancement of surveillance mechanisms, better coordination among the various levels of government and institutions for outbreak containment, improved public communications strategies, and major increases in expert human resources are just some of the changes needed if Canada is to be better prepared for future health crises.

SARS resulted in a tragic loss of life, grieving families and friends, tremendous dislocation to the health system, and economic turmoil. Fortunately, SARS was only moderately contagious and did not turn into a full-blown pandemic. In Canada, the outbreak was primarily centred in a major urban area with unparalleled health care resources. Nonetheless, it severely tested local, federal, and provincial capacity to deal with the outbreak, illuminating the strengths and deficiencies of the existing public health and health care systems. The knowledge gained from battling SARS should help Canada put in place a public health system that will be capable of not only dealing with the next outbreak, but the next pandemic.

There is no time for complacency. SARS has been subdued, perhaps only temporarily, and the fall season of respiratory illnesses will soon be upon Canada. The work to improve the public health system and prepare the clinical services system must begin apace.

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