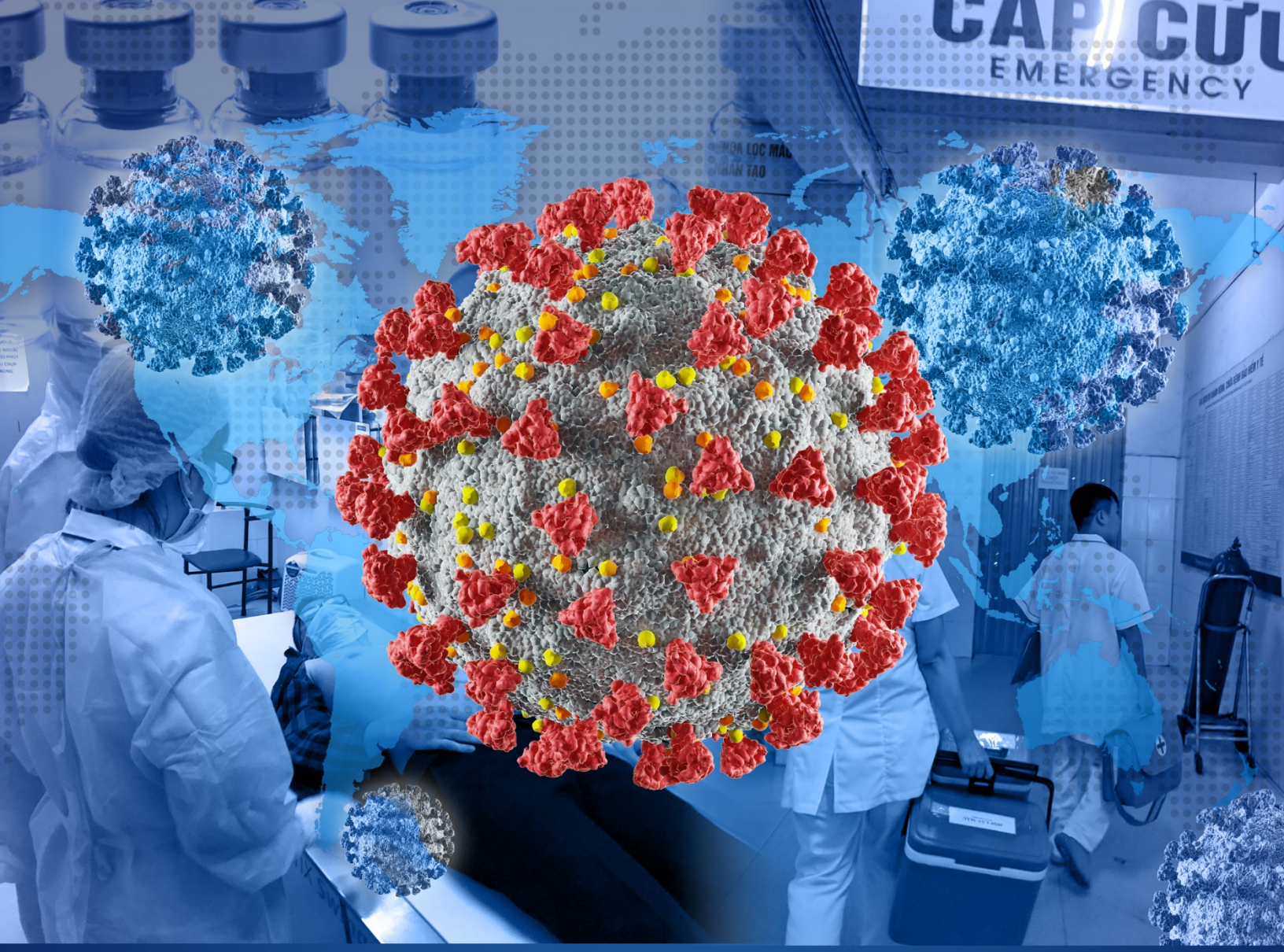

Did Lessons Learned from SARS Save Us from COVID-19?

A Systems Thinking Perspective on International Case Studies

Dr. Maki Fukami and Frances Veasey

Published by IIGR and ANSER

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Published by International Institute of Global Resilience and ANSER in 2022.

Funded by:

- Global Social Entrepreneurship Endowed Chairs, Graduate School of Management, Kyoto University
- Sachiko Kuno Foundation
- ANSER

Library of Congress Cataloguing-in-Publication Data

ISBN 978-0-578-25712-9

Credit

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Preface

The International Institute of Global Resilience (IIGR) has undertaken multiple international projects to help strengthen the readiness and professionalism of the emergency management community worldwide through training, education, and research since 2012. As the founder, president, and CEO, I'm fortunate to have so many opportunities to work with the world-class emergency managers from various countries and communities through those projects.

Since 2019, I have been teaching Emergency Management at the Graduate School of Management, Kyoto University, and I always enjoy having emergency management professionals from all over the world as the guest lecturers, sharing their diverse perspectives and multicultural experiences with the students in my class. Therefore, I immediately believed the 2020 class would be a great opportunity to learn about the ongoing real international comparative response when COVID-19 happened. I asked my long-time friends to talk about what's going on in their countries. Victor Bai, Certified Emergency Manager (CEM) from China, Lip-Heng Chew from Singapore, and Tswen-Juh Gu, CEM from Taiwan, jumped in right away. I also asked Frances Veasey of ANSER to speak about the Vietnam case. I knew she had been working with health emergency managers in the country and I was very interested in the Vietnam case because so many media repeatedly reported that the country was doing great in their response to COVID-19.

Beyond my expectation, these friends brought a lot of excitement, detailed reality on the field and politics, reliable data, and insightful observations. They really made the 2020 class successful.

It is not easy to collect ongoing, real-time information from multiple countries at once; therefore, I thought we should share this great opportunity with more people. I suggested publishing the outcome to the public, and Professor Yoshinori Hara, the head of Global Social Entrepreneurship Endowed Chairs, Graduate School of Management, Kyoto University, generously agreed with me, and the Endowed Chairs committee and Sachiko Kuno Foundation supported this publication financially.

Through the class, I've learned each country's response was influenced by their past experiences, especially the lessons learned from SARS, so I re-curated the contents through the perspective of the lessons learned from SARS and added two more countries: the United States and Canada. Also, Frances Veasey had already given her excellent analysis in our class so we decided to use it as our main framework. Other countries' representatives immediately started working on this project, adding more data, reframing the structure, and editing.

IIGR and ANSER have been in partnership since 2014, and as usual the ANSER team performed their excellent job on this publishing project. I would like to thank Ronald McGonigle, Phil Skains, CEO Steve Hopkins, and their team for an outstanding job of making this publication happen, and Dr. Sibel McGee for her superb mentorship in applied systems thinking.

I have been in emergency management education and research for two decades, and I strongly believe that the most important thing to strengthen our resilience is learning from real-life lessons. That's the reason why I've been working on the case studies as an academic scholar, and have been conducting the continuous education programs to learn the lessons as an emergency management entrepreneur. I hope this paper will be inspirational to someone, somewhere, and will foster tomorrow's resilience.

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December 2021

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Introduction

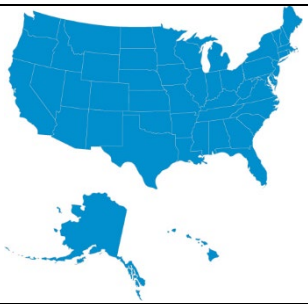
This collection of case studies will investigate how countries learned and adapted following their experiences with the SARS pandemic of 2002/2003, and how these adaptations may have led to effective responses to COVID-19 in the first year of the current pandemic. We invite readers to consider not just the key decisions made by leadership, but also more subtle and complex factors that shape and condition each country's unique response landscape.

Different Countries, Different Stories

When considering why different countries have different stories to tell about COVID-19, it is helpful to consider a variety of contexts and how they shaped outcomes. For example, several relevant differences can be seen between Vietnam and the United States. Because of its lower-middle income status, the healthcare resources of Vietnam are limited, besides which they have a large population (~98 million) with many super-compact cities and a long land border with China. This is why Vietnam has been considered highly vulnerable to all outbreaks, not just COVID-19. On the other hand, the United States has significant resources available for fighting pandemics, between having the world's largest economy, significant biomedical research resources, and the U.S. Centers for Disease Control and Prevention (CDC), long considered the premier public health agency in the world. Although the U.S. had several SARS cases in 2003, that disease was successfully contained, and the nation also has invested a great deal in preparedness.

Vietnam

- **Lower-middle income country**
- **Limited healthcare resources (human, financial, health facilities)**
- **Large population (~98 mil.), super-compact cities (~10 mil./each)**
- **Long land border with China**



The United States of America

- **World's largest economy**
- **Significant biomedical research resources**
- **Premier public health agency**
- **Successfully contained SARS in 2003**
- **Robust preparedness and emergency management programs**

Figure 1. Vietnam has many risk factors that make it vulnerable to disease outbreaks, while the United States has considerable resources for fighting infectious diseases.

All these factors seem to favor that the United States would be able to respond effectively to COVID-19, while Vietnam might struggle—but it didn't happen this way. Instead, in the first year of the COVID-19 pandemic, the United States was one of the hardest-hit countries, with around 30 million confirmed cases—nearly 10% of the population—and a half-million deaths.

Figure 2, a graph of daily new cases during the first year of COVID-19, shows the highest number of cases reported in a single day at around 314,000 on January 8. In contrast, Vietnam did quite well as the virus emerged. In Figure 3, their new case graph, the worst single day saw just over 100 total cases. This discrepancy isn't explained by total population numbers—the U.S. population is a little over three times Vietnam's population (330 million vs. 98 million). And yet, in the first year they had over 10,000 times as many cases.

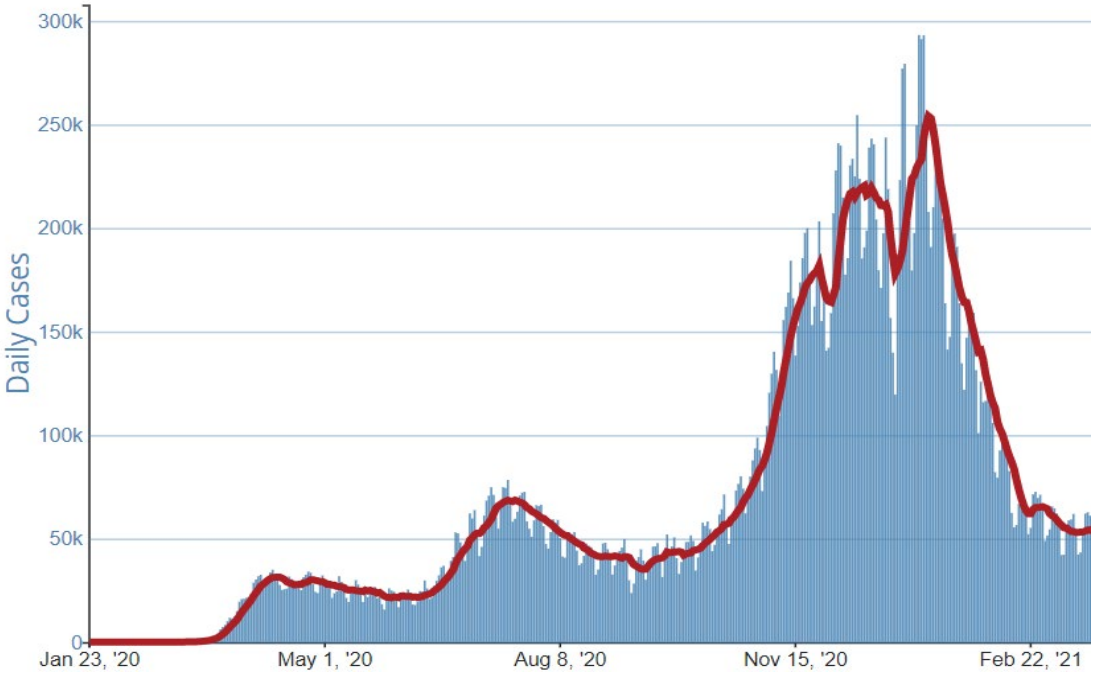


Figure 2. Daily New Cases of COVID-19 in the U.S. Reported to CDC[1]

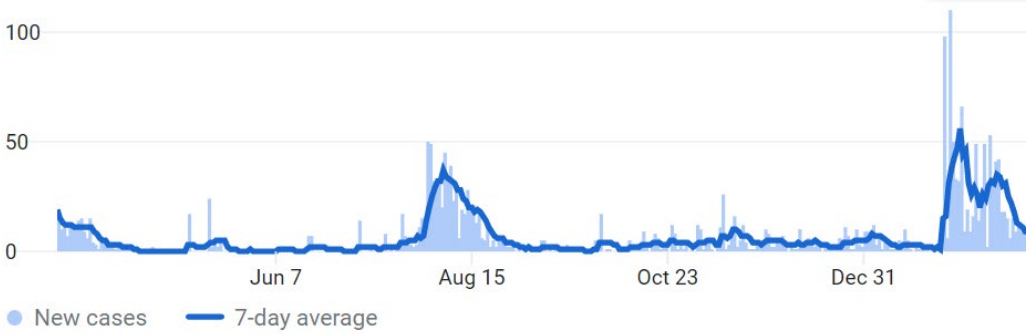


Figure 3. Daily New Cases of COVID-19 in Vietnam[2]

Understanding what explains the difference is critical to improving responses to public health emergencies. However, when people try to answer this question, they too often look only at charts like Figure 4. They identify newsworthy but surface-level events and try to connect them to the trends that follow. We then focus on decision points such as cancellations of flights, school closure, quarantine of travelers, decisions on social distancing, etc.—

milestones we can easily see and measure. Often, we can model what might have happened if closures or different measures were implemented earlier or later.

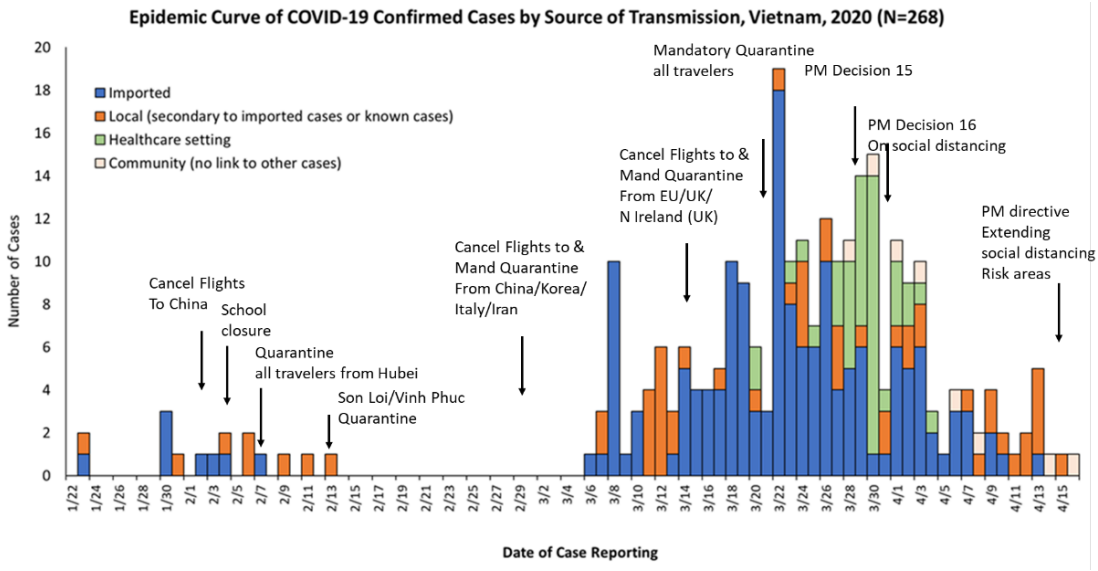


Figure 4. Epidemic Curve of COVID-19 Cases in Vietnam, 22 January-16 April 2020[3]

However, this timeline-based approach does not account fully for what makes for a successful response. There are so many decisions to be made at any given moment, the impact of most of these individual decisions over time is low. Overall decision making, however—*what is the process; what are the underlying structures that inform decisions; who are the people who decide*—those are the dynamics that allow a government to make not just one good decision, but a series of good decisions that result in an overall effective response. Even more importantly, we have to acknowledge that while political leadership influence epidemics, they are driven not by political decisions, but by human behavior—and human behavior is more complex than a timeline of cases and public health decrees can convey.

Why Systems Thinking?

Systems thinking advocates for an approach that allows for the complexity of human behavior.[4] It is a discipline and a way of approaching questions like this one that views issues and problems as part of a greater whole. It tries to understand how different actors, factors, and processes interact to drive systemic outcomes. Systems thinking offers methods for managing complexity, helping us to see the underlying, often invisible, structures that come together to create the outcomes we observe. By understanding why people—and systems—behave as they do, we can design more effective interventions that target root causes of problems, rather than the symptoms.

When people want to improve a situation, they usually respond to the visible outcomes of a problem. For example, a common response to a problem like escalating crime is investing more money in public safety in the form of police officers who enforce laws. While this can create disincentives or even remove people who have committed crimes from the public forum, it does not address why those people committed crimes to begin with (e.g., unavailability of licit job opportunities, lack of education, food insecurity). Because these root causes have not been addressed by the investments made in law enforcement, the system

continues to produce people who are motivated—by the same conditions—to commit crimes. Investments in food banks to address food security, in schools or adult education to address education gaps, and in the economy to produce life-sustaining jobs, however, address some of the root causes at play, and over time will likely reduce crime in a sustainable fashion. This example demonstrates the importance of not just addressing problematic behavior, but also understanding *why* people act the way they do, so interventions can be made in parts of the system that create sustainable change.

This series of case studies invites the reader to use a systems thinking lens by looking not just at the outcomes we have seen in the COVID-19 pandemic, but also the underlying structures and systems that make them possible, some of which were influenced by the ways countries experienced and responded to the first SARS outbreak. In support of this, an orientation is provided below to a systems thinking framework called *The Iceberg Model*, which is particularly useful for investigating deeper causes of observed events and outcomes.

The Iceberg Model

The Iceberg Model is so named based on the idea that what we see easily is only "the tip of the iceberg," referring to the small bit of floating ice visible from the surface of the water.[5] It is harder to see the great mass of ice underneath the surface, which is required to push the tip up over the waterline and into view. With an iceberg, what's below the surface gives the visible part its shape and structure, and when we look at ongoing events, the same pattern emerges—the outcomes and events that are visible and easily quantified are only symptoms of the behavior patterns, structures, and mental models of the affected population.

Figure 5. Around ninety percent of an iceberg is underwater and not visible from the surface. Similarly, underlying structures that shape people's behaviors cause the visible outcomes people experience.

The Iceberg Model posits that the visible parts of a problem are all shaped by elements lying under the surface. It instructs that people should care about these deeper levels because they can lead us to high-leverage interventions, as described in the crime example above. While treating the symptoms can yield temporary improvements, they often reappear after some time if the root causes are not addressed. Addressing the conditions caused by the system's structure leads to greater impact, because the system's behavior results from the incentives and disincentives created by the underlying structure. As we go deeper into the Iceberg Model's levels, we can understand the system better and our ability to make lasting change increases.

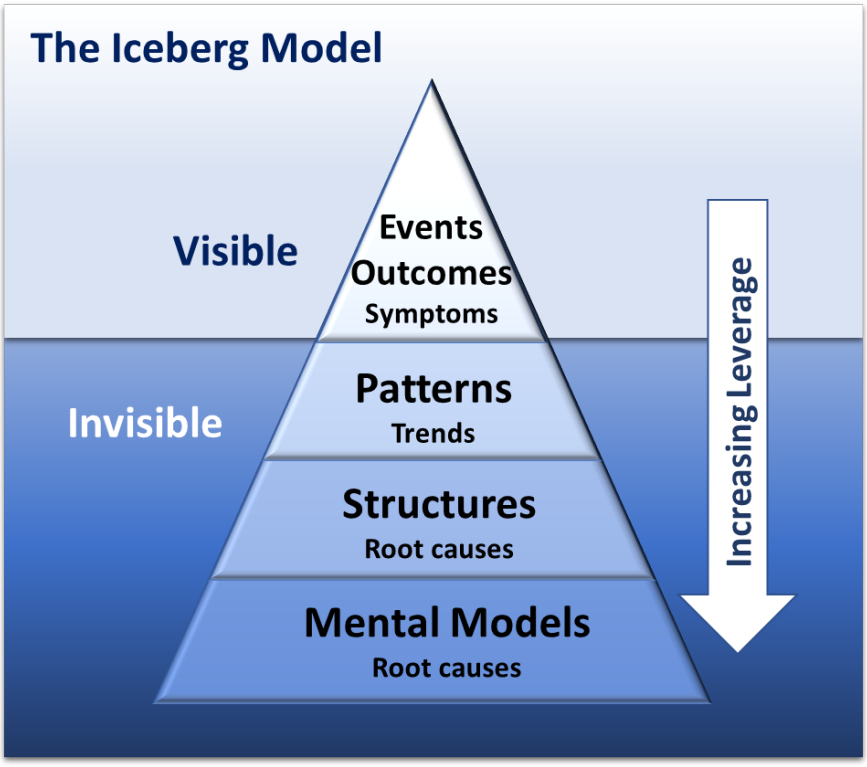


Figure 6. The Iceberg Model acknowledges that the visible outcomes and events people experience are shaped by underlying patterns, structures, and mental models. To change outcomes, these invisible causes must be addressed, with the greatest leverage coming from changes to root causes: the structures and mental models that shape behavior.

Events/Outcomes: These are the visible manifestations of the problem that are easiest for observers and people in the system to see, much like the symptoms of an underlying disease. For this reason, we often focus on single events encountered during daily life when identifying problems and potential solutions. This may include personal experience with a disease, illnesses or deaths of family members or friends, or related experiences with the consequences of public health measures that influence everyday life.

Patterns Level: The outcomes we see and measure—the rate of spread, case counts, deaths—occur because of trends and patterns of behavior like mask wearing, hand hygiene, mobility, and compliance with public health measures.

Structure Level: These patterns are produced by system structures, or how parts of a system are organized: who has power, who makes decisions, how information flows, even how we are physically distributed—high vs. low population density, how many family members live together in households, etc. Here, the public health system, the political environment, geography, economy, media, social practices, family structures, and cultures/customs all influence outcomes, along with other factors. A system's structure explains why that system behaves the way it does because it creates incentives, deterrents, and motivators that drive people's behaviors and, in turn, shape the systemic outcomes or events.

Mental Models Level: While understanding these structures is important, there is still another layer to discover, because these structures didn't appear out of nowhere. They are influenced by and reflect our mental models, which are the values and belief systems that create the society around us. These may include whether we have good science literacy, or a good idea of germ theory; our levels of respect for authority; ideas about the relative importance of community vs the individual; and more.

Summary

When it comes to public health, people often focus on behaviors, with little understanding of why people behave how they do. They think if they just tell people to do things differently, they will—but in reality, things are rarely that simple. When people are overweight, or obese, and diagnosed with a heart condition, they are often told to diet, exercise, and lose weight. Some will follow the new regime, but many won't, because our behavior is very complex. Similarly, when we look at case studies of emergency responses, we tend to focus on what decisions were made when, without much thought given to how the unique country context—its structures and mental models—shaped and conditioned those decisions.

A better way to approach complex problems is to look at system structures and mental models that drive behaviors, because those are the root causes of the problems. We encourage the reader to keep this in mind when reading this series of case studies. Identifying not only successful cases, but also the underlying structures and mental models that laid the groundwork for the results, will deliver the best ability make positive change in our own countries, whether our goal is to conquer COVID-19, fight the next pandemic, or make other important improvements.

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[1] "COVID Data Tracker" 2020
[2] Source: JHU CSSE COVID-19 Data
[3] Source: CDC Country Office, Hanoi, Vietnam
[4] Content on systems thinking and the Iceberg Model is adapted from a systems thinking course ANSER helped develop and conduct on behalf of the U.S. Agency for International Development. Sibel McGee, PhD, and Frances Veasey were the primary authors of the modules adapted here.
[5] Goodman, 2002

Case Studies

This section reviews case studies of six countries' experiences in the first year of the COVID-19 pandemic caused by the SARS-CoV-2 virus. All countries had previously experienced cases of Severe Acute Respiratory Syndrome (SARS), caused by the SARS-CoV-1 virus. The case studies review the countries' SARS experience, and provide insights on what changes had been made in the following years. Many of these changes resulted from lessons learned during those experiences; however, not all changes can be directly attributed to such learning, and many had other influences as well. The case study authors offer insights into how these changes shaped each country's experience, often by shifting their respective society's structures and mental models. These dynamics will be further explored and synthesized in the Conclusion.

The United States of America

From SARS to COVID: The U.S. Experience
By Frances Christine Fisher Veasey, MS, PMP

Canada

Preparing for Another SARS: The Canadian Experience
By Frances Christine Fisher Veasey, MS, PMP

Vietnam

Learning Lessons: Vietnam's Experience with SARS and COVID-19
By Frances Christine Fisher Veasey, MS, PMP

Singapore

Singapore's Lessons from SARS and the Test of COVID-19
By Lip-Heng Chew

Taiwan

A View from Emergency Management on Taiwan's COVID-19 Operations
By *Tswen-Juh Gu, CEM*

China

Emergency Management in China: Case Study Through COVID-19
By Victor Bai, CEM 白涛

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From SARS to COVID: The U.S. Experience

Frances Christine Fisher Veasey, MS, PMP

Lessons Learned from SARS

Overview. The United States' experience with the 2003 Severe Acute Respiratory Syndrome (SARS) epidemic was characterized by relatively minimal spread past the initial travel-associated cases, with no reported SARS-related deaths. Through July 15, 2003, the U.S. Centers for Disease Control and Prevention (CDC) had tracked 418 cases (344 suspect and 74 probable)[6] from at least 38 states (see Figure 7).[7] Serological testing confirmed only eight cases as positive, and excluded many more. However, convalescent serum was not collected for all patients; for the 28 reported probable cases and 175 suspect cases lacking these samples, laboratory confirmation or exclusion is not possible.[8] Based on subsequent revisions to the case definition, the United States recorded 8 confirmed cases, 19 probable, and 137 suspect cases, though it is unknowable whether the probable or suspect cases actually had SARS-CoV disease.[9] The WHO officially considers the United States to have had 29 cases, only one of which was not an imported case.[10]

Case status	Convalescent serum negative for SARS-CoV antibodies	Convalescent serum specimen not obtained	SARS-CoV infection confirmed by serology	Total
Suspect	169	175	0	**344**
Probable	38	28	8	**74**
Total	**207**	**203**	**8**	**418**

Figure 7. Serologic Test Results for Reported Suspect and Probable SARS Cases in the United States as of July 15, 2003 (n=418). (Source: U.S. Centers for Disease Control and Prevention MMWR July 18, 2003 / 52(28); 664-665)

SARS Response. Following a global alert issued by the WHO on March 12, the U.S. CDC began its response by activating its Emergency Operations Center.[11] The following day, they issued a health alert on an atypical pneumonia called SARS, hosted a media briefing on the subject, and issued a Health Alert Notice for any travelers arriving from Hong Kong or Guangdong Province in China. Over the rest of the month, the CDC issued guidelines and precautions to manage exposure and prevent spread in laboratories and healthcare facilities. They identified a new coronavirus as the potential cause of SARS and began tracking and evaluating suspect cases. As the pandemic spread, they extended travel advisories and dispatched quarantine staff to meet incoming vessels from high-risk areas.

In April, the CDC took multiple steps as the outbreak unfolded. They published the genetic sequence of a virus isolated from a SARS patient. In response to reports of stigmatization of those with Asian ancestry or recent travel to Asia, they established a community outreach team to reduce stigma related to SARS. Toward the end of April, the CDC issued a health alert for travelers to and from Toronto, which they later lifted and reinstated as cases evolved

in Canada. Throughout the summer, travel alerts were removed as outbreaks subsided globally, and CDC continued to review laboratory results and case definitions as it evaluated U.S. cases that remained under investigation (see Figure 8).

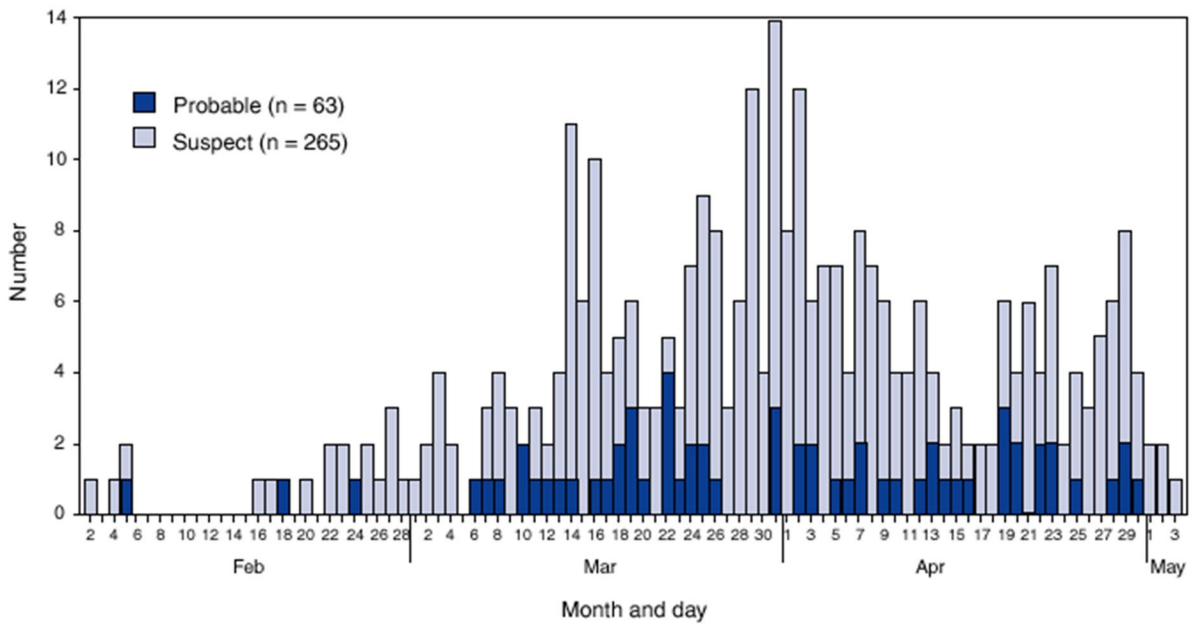

Figure 8. Reported Cases of SARS in the United States through Early May 2003 (n=328). (Source: U.S. Centers for Disease Control and Prevention MMWR May 9, 2003 / 52(18); 411-413)

Impacts. The United States was fortunate to avoid the worst impacts of SARS, experiencing few confirmed cases, minimal spread, and no deaths. This relatively low burden of disease is also reflected in the lower economic impact experience by the United States in comparison to more severely affected countries. While Hong Kong's GDP fell by 2.63% in 2003 due to the temporary shock of SARS and China's GDP dropped similarly by 1.05%, the commensurate U.S. decline was only 0.07%.[12] This translates to a loss of $7 billion to the U.S. GDP; however, impacts to the most-affected sectors were felt more acutely. For example, the airline industry in North America lost an estimated $1 billion due to SARS.[13]

That the United States was not worse affected may be attributed not just to the actions of the CDC and the public health and healthcare communities, but also to a certain amount of luck. Unlike some worse affected countries, the United States had no superspreader events like the ones recorded in Hong Kong at the Amoy Gardens complex (329 residents infected) and the Prince of Wales Hospital (138 staff, patients, and visitors infected).[14] The Seattle-King County Director of Public Health at the time, Alonzo Plough, commented "I think the United States, by adopting a very conservative case definition, allowed for early isolation of individuals and played a role, certainly, in containment. But we were lucky in that we did not have an individual who came with the kind of infection that characterized what happened in Toronto."[15]

Lessons Learned. Even though the United States did not experience a major outbreak during SARS in 2003, many felt that the episode revealed weaknesses within the U.S. healthcare

and governance systems that would hamper effective response during a larger outbreak or, worse, a pandemic. Senator Edward M. Kennedy noted that resources were consistently inadequate throughout the country, commenting, "Budgets have been cut to the bone and there is no excess capacity to meet new challenges like SARS."[16] Shortfalls were also noted in the laws that govern public health authorities, many of which were outdated and may not stand up to challenges in a court of law. While most of those asked to isolate did so voluntarily, one man was placed into involuntary confinement for the duration of his illness. This incident raised legitimate concerns about the American culture (and legal guarantees) of individual freedom, which can be at odds with the sacrifices needed for the common good during a public health emergency.

In view of the lessons to be learned, many reports were requested and written to capture what happened, and extrapolate steps the United States should take to better prepare for the next, perhaps worse, pandemic. A 2003 report to the U.S. CDC on lessons learned from SARS related to quarantine and isolation collected lessons learned in three broad categories, which can also be used to organize insights from other aspects of the response. This report from the Institute for Bioethics, Health Policy, and Law at the University of Louisville School of Medicine, led by Marc A. Rothstein, utilizes the categories of: legal and public health systems, public health and healthcare infrastructure, and law enforcement and ancillary services. Key findings from each category are summarized below.

Legal and Public Health Systems. SARS responses demonstrated that legal authority and coordination between levels of government need clarification, especially in the United States, where local, state, and federal officials must work together.[17] The team urged the United States to address legal constraints to implementing effective international and interstate travel restrictions, including civil liberties. They noted that public health is under-resourced across the country, and that human resources, technology, funding, and educational programs needed to be expanded. They identified misunderstandings of the Health Insurance Portability and Accountability Act as potentially hampering public health reporting, and also encouraged increased international cooperation on public health.

Public Health and Healthcare Infrastructure. Rothstein's team noted a shortage of epidemiologists, public health nurses, and other key public health personnel, cautioning that budget cuts in public health would continue to undermine the United States' ability to respond to a public health emergency. Fragmentation of the U.S. healthcare system, lack of surge capacity, insufficient quarantine and isolation plans, personal protective equipment (PPE) shortages, and lack of emergency funding were also identified as deficits. The layered approach to response (i.e., building onto existing federal, state/territory, tribal, and local authorities' emergency response plans) was anticipated to result in inefficiencies and gaps compared to a single public health response plan that would allow for better coordination and resource usage.

Law Enforcement and Ancillary Services. Recognizing the importance of law enforcement for addressing SARS, Rothstein's team made several recommendations for improvement, including provision of training in public health law to key stakeholders (e.g., healthcare providers, government officials, police officers, judges), development of memoranda of understanding between federal and state health officials to alleviate problems of concurrent jurisdiction, and establishment of emergency review procedures to help the legal system move at the pace needed for

public health emergencies (that is to say, a court case on whether a 14-day quarantine period is enforceable that isn't heard until after the 14 days are over is not particularly useful). Rothstein's team also urged the consideration of ways to provide logistical support for "thousands" who may be quarantined, pre-planning of culturally appropriate messaging, and guarantees of job protection and wage replacement of those whose employment may be jeopardized by compliance with public health measures. Finally, public education and communication were cited as needing additional research and planning, to include pre-coordination with key community stakeholders, and identification and consistent use of "a single or a very limited number of credible spokesperson(s)," which would enhance public understanding and build support for continued measures.

Steps Taken. A full list of all steps taken as a result of SARS lessons learned would be impossible to generate, in part because SARS was not necessarily a driving force for changes, but rather one of many contributors. SARS joined with other concerns that helped to shape policy around public health response, including: the attacks of 9/11, the subsequent Anthrax attacks and heightened concern for biological terrorism, avian influenza H5N1 (~2005) and H1N1 (~2009), and the Ebola outbreak in West Africa from 2013–2016. A high-level review of the main phases of counter-pandemic preparations in the United States follows.

Post-9/11 Era. Primary public health concerns in the era following the 9/11 and anthrax attacks of 2001 circulated around biological terrorism, biodefense, and responses to mass casualty events.[18] These terrorism-related concerns led primarily to investments in laboratory capabilities for detection of virulent pathogens (e.g., BSL-3 and BSL-4 laboratories, BioWatch program[19] to detect airborne pathogens), and in improving all-hazards response systems nationwide by adopting standard processes like the Incident Command System and the National Incident Management System.[20] Concerns about inadequacies of U.S. legal frameworks at the state level led to a CDC grant to develop a "Model State Emergency Health Powers Act," which the authors intended to serve as a template for states to update their authorities to implement key public health interventions like mandatory quarantine and isolation.[21] Two key cooperative agreements, the Hospital Preparedness Program[22] and the Public Health Emergency Preparedness Program,[23] were also started in 2002 to provide local public health entities with funding and other assistance to improve their ability to respond. While these and other improvements motivated by terrorist attacks did not specifically focus on naturally emerging diseases, their impacts covered a broad spectrum of homeland security threats that included infectious diseases. Still, many within the public health community felt the threat of a naturally emerging pathogen eclipsed that of a bioterrorist event.[24] It was under this backdrop that SARS emerged.

SARS and Pandemic Influenza Era (2003–2014). When SARS emerged in 2002/2003, the United States was largely spared the worst effects, contributing to a sense that U.S. systems were well-positioned to fight infectious diseases and undermining a more robust remediation effort.[25] The CDC developed extensive guiding documents for SARS that catalogued lessons learned in a "Guide for Communities"[26] under the headings of: command and control, surveillance, preparedness and response in healthcare facilities, community containment, non-hospital isolation and quarantine, managing international travel-related transmission risk, laboratory guidance, communication and education, and infection control in

healthcare, home, and community settings. The lessons learned and guidance for communities to prepare for SARS were published on the CDC's website in early 2004, and are now archived for historical purposes. While several efforts to harvest lessons learned were conducted, there was no commensurate surge in public health spending to implement suggested changes. Rather, public health spending as a share of total health expenditures peaked in 2002, buoyed by post-9/11 investments.[27] It had declined by 17% by 2014.

Although SARS by itself did not stimulate significant investments, the H5N1 influenza that emerged in Asia in 2003 did capture the attention of the George W. Bush administration (2001–2009), which launched a comprehensive government initiative for pandemic preparedness. This resulted in the development of the U.S. Department of Health and Human Services (HHS) Pandemic Influenza Plan,[28] published in November 2005, the National Strategy for Pandemic Influenza,[29] published in May 2006, and a related suite of complementary documents as well as training and exercises to validate and improve response systems. Congress allocated additional funding for development of countermeasures and updates to the Strategic National Stockpile (SNS). In December 2006, Congress passed the Pandemic and All-Hazards Preparedness Act (PAHPA), which established a new Assistant Secretary for Preparedness and Response within HHS and made other changes and investments "to improve the Nation's public health and medical preparedness and response capabilities."[30] The act created the Biomedical Advanced Research and Development Authority (BARDA) with the mission to "develop and procure medical countermeasures that address the public health and medical consequences of chemical, biological, radiological, and nuclear (CBRN) accidents, incidents, and attacks, pandemic influenza, and emerging infectious diseases."[31]

During this era, the Obama administration (2009–2017) also saw a significant global health threat emerge in its first year in office, as the H1N1 influenza pandemic began in April 2009. While intensive resources were applied to quickly develop a vaccine effective against this strain, the vaccine was no longer needed by the time it was developed.[32] This experience bolstered the Obama administration's belief that emerging infectious diseases continued to pose a significant threat to the United States. During this period, SARS-coronavirus was declared a select agent in the National Select Agent Registry Program, indicating it may pose a "severe threat to public health and safety."[33] Focus also continued on ways to expedite the development and large-scale production of medical countermeasures.

The GHSA Era (2014–2018). Subsequent experiences with the global outbreaks and epidemics—most notably the West Africa Ebola experience—led to increasing understanding that U.S. health security is dependent upon the global community's ability to detect, prevent, and respond to health threats in their countries. The U.S. National Security Council, recognizing this context, brought together U.S. government stakeholders to discuss options for dealing with the increasing threat of global infectious diseases.[34] Their efforts and cooperation with international partners led to the launch of the Global Health Security Agenda (GHSA), with the intent to build partner nations' capacities to respond to emerging infectious diseases. From April 2015 to March 2017, the U.S. CDC worked with 17 high-priority partner countries to improve emergency response management, public health surveillance, and laboratory systems.[35] These external efforts were accompanied by domestic preparedness initiatives by the Obama administration, exemplified by the

establishment of a Directorate for Global Health Security and Biodefense within the National Security Council. Concerns at the highest level of government led to development of a "Playbook for Early Response to High-Consequence Emerging Infectious Disease Threats and Biological Incidents," and establishment of the National Science and Technology Council's Pandemic Prediction and Forecasting Science and Technology Working Group to improve outbreak modeling and prediction.

The Pre-COVID-19 Era (2018–2020). As the Trump administration (2017–2021) came into office, most of the programs discussed above continued in some form or fashion, but overall emphasis on pandemic preparedness followed the prevailing cyclical pattern of crisis, urgency, and complacency (until the next crisis emerges).[36] In November 2019, the Center for Strategic and International Studies published a report raising alarms about the country's "false sense of security," which had left the United States "woefully ill-prepared to respond to global health security threats." Among other recommendations, they urged the restoration of health security-focused leadership at the National Security Council (reorganization and personnel departures within the Trump administration had folded the health security directorate into another governing body, reducing its prominence), stating that while the White House had taken several actions to promote biodefense and recommitted the United States to the GHSA, "critical gaps in leadership remain[ed]".[37] Meanwhile, the United States was reducing staff at CDC country offices around the world, including China[38] and partners in West Africa.[39]

The U.S. 2020 COVID-19 Response

While the United States was largely spared from SARS, COVID-19 has left an indelible mark. The United States has led the world in total COVID-19 cases and total deaths, and remained consistently in the top tier for both these metrics when adjusted for population.[40] By the end of 2020, one in one thousand Americans had died of COVID-19.

Initial Response (January to Mid-March). The initial U.S. government response focused on "slowing the introduction of the virus into the United States as we work to prepare our communities for more cases and possible sustained spread."[41] This approach included working with global partners to enhance their responses; implementation of passenger screening and, later, travel bans; monitoring of global disease spread; and preparing the United States for community spread. As state and federal government agencies scrambled to prepare for community spread throughout this time period, President Trump followed a deliberate strategy of downplaying the threat that COVID-19 posed; stating that it was "well under control," that "we pretty much shut it down coming in from China," and that "like a miracle, it will disappear."[42,43] While still maintaining that the "immediate" risk to Americans was low during public testimony on March 3, 2020, the CDC indicated they were working with state, local, tribal, territorial, and private sector stakeholders to help prepare them in terms of infection control procedures, laboratory testing capacity, strategies for PPE use, and surveillance.

Anticipating shortfalls in PPE supplies, HHS partnered with other agencies who they expected would also require significant PPE supplies in order to develop strategies that encouraged expansion of production, and prepared to deploy resources from the U.S. Strategic National Stockpile if needed. Public testimony noted that the SNS had "thousands of deployable face masks, N95 respirators, gloves, and surgical gowns" that could be provided if needed.[44]

Cognizant of the shortfall in PPE, officials downplayed the efficacy of and need for wearing masks to minimize supply disruptions that could imperil healthcare workers.[45] However, the federal government did not initiate a coordinated, nationwide strategy for procuring and distributing resources, leading states to compete against each other and ultimately either overpay or go without resources.[46] By early April, federal PPE supplies and medical equipment (including 11.7 million N95 masks) had been depleted, forcing states to continue their bidding wars for the necessary resources.[47] In an attempt to increase production and access to resources, HHS Assistant Secretary Robert Kadlec reportedly requested contingency plans for using the Defense Production Act to supplement emergency medical supply chains as early as January 14; however, the act was not invoked until early April.[48,49]

The CDC also encountered difficulty supplying adequate functional test kits to state and local laboratories. The test kits that arrived in public laboratories across the country on February 6 were defective, with a 33% failure rate.[50] The resulting constraints on testing due to lack of functioning kits led to tightened protocols that restricted who could qualify to even be tested, artificially understating the extent of the outbreak and delaying response.[51] Faced with impaired situational awareness on the scope and scale of the current outbreak; limited PPE, treatments, and countermeasures; and strong recommendations from public health experts, state governors began to enact broad, sweeping "stay-at-home" or "shelter-in-place" orders that mandated social distancing (i.e., closing schools and non-essential businesses, limiting access to public transportation, encouraging widespread telecommuting, and closure of government offices). From March 19 to April 7, 42 states (82%) issued such orders.[52] This coincided with the White House's "15 Days to Slow the Spread" initiative, which started on March 16, and included recommendations to restrict gatherings to 10 or fewer people.[53] Recognizing the economic impact these measures would have, and also addressing the continuing stock market crash, the President directed the Treasury Secretary to work with Congress on a stimulus bill to stave off unemployment and boost the economy. By the time this economic initiative was implemented, New York City and its surrounding states were already poised to become the first major epicenter of the U.S. COVID-19 pandemic (Figure 9).

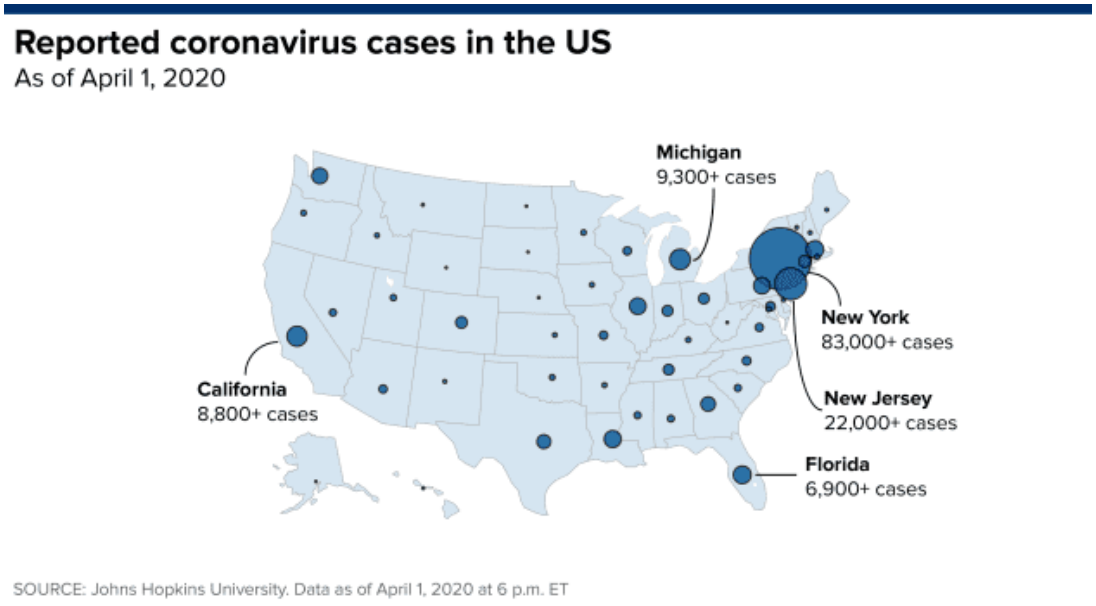

Figure 9. Reported U.S. Cases as of April 1, 2020. (Data Source as indicated; Graphic Source: https://www.cnbc.com/2020/04/01/coronavirus-latest-updates.html)

The First Wave (Mid-March to Mid-June). Even as mobility dropped nationwide on the heels of governors' stay-at-home orders (Figure 10), cases began to surge in New York City, which would eventually see over 200,000 cases and nearly 20,000 deaths from February 29–June 1, 2020.[54] While cases also rose in multiple states during this time, their outbreaks were in many ways dwarfed by the New York epicenter. Based on models at the time, several states did not expect to see their cases peak until May. As the nation watched crises unfold in New York City and abroad in Italy, President Trump announced his intent to "restart" the economy by the mid-April Easter holiday, drawing concern from public health officials.[55] Alarmed by rising unemployment and economic impacts, the U.S. Congress passed the Coronavirus Aid, Relief, and Economic Security (CARES) Act, which provided $2 trillion in economic and healthcare assistance. It was signed into law on March 27.

The New York City–associated outbreak hit its peak on April 10. As new cases in that region subsided, the outbreak appeared to be coming under control nationwide, leading to a push to lift lockdown orders and "reopen America." Toward the end of April, some states began to ease or lift stay-at-home orders, while others extended orders through the end of May.[56] On May 20, the CDC released guidance on "opening up America again," including a list of supporting activities and initiatives undertaken by the CDC, gating criteria, and resources for targeted activities (e.g., summer camps, schools, youth sports, restaurants and bars, and higher education).[57] As a federal agency, the CDC could only issue guidance for state, local, tribal, and territorial officials to implement within their own jurisdictions, so reopening decisions, like other public health measures, were decided on a case-by-case basis at the lower levels of government. Throughout much of May and June, states and jurisdictions implemented various approaches to reopening, with some reopening fully and others using a phased approach that opened lower-risk businesses first, placed limits on allowed capacities, and adjusted measures as cases declined. By mid-to-late June, most states were open in some capacity, though restrictions, mask requirements, and other social distancing mandates varied greatly.

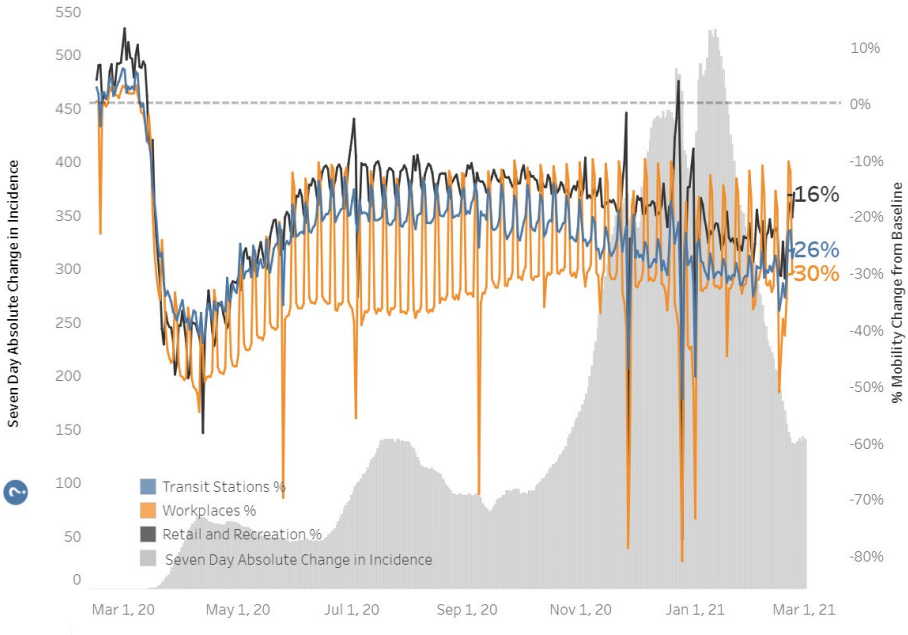

Figure 10. Mobility Data Overlaid with Seven-Day Average New Cases. (Source: https://covid.cdc.gov/covid-data-tracker/#mobility. Accessed 9 March 2021.)

The Second Wave (Mid-June to October). Following the nationwide shift toward lifting COVID-19 restrictions and reopening for the summer season, new cases again began to rise. This was likely accelerated by Independence Day celebrations during the July 4 holiday weekend, before beginning to subside again in August. As cases surged, some states postponed or rolled back their reopening plans, and although most large events (e.g., professional sports, concerts, theater) were canceled nationwide, some events held in states with fewer restrictions resulted in subsequent outbreaks elsewhere. The Sturgis Motorcycle Rally, for example, which is held every year in Sturgis, South Dakota, drew a crowd of nearly 500,000 over a 10-day period from August 7 to August 16. Neighboring state Minnesota alone identified 51 primary cases associated with the event, with 35 confirmed or likely secondary and tertiary cases.[58] More than one-third of Minnesota counties reported at least one related case, showing the widespread distribution and fallout from events in neighboring states, and underscoring the need for continued and coordinated public health measures. Although the U.S. public health system is not set up to precisely track infections associated with an event like this, one study estimated the rally may have caused over 266,000 cases by itself; which is approximately 19 percent of national cases reported in August.[59] Cost estimates suggest the rally could have been responsible for up to $12.2 billion in public health costs.[60] Congress at this time failed to pass another COVID-19 relief bill and adjourned for August recess.

Key nationwide events during this period also include the reopening of schools, and the run-up to the presidential and state elections, which occurred on November 3. School districts, parents, teachers, and other education stakeholders engaged in considerable debate over remote vs. in-person learning options, with some states and districts opting for fully-virtual learning, some remaining fully open, and still others implementing a hybrid approach that allowed for smaller class sizes and greater physical distancing. These decisions were made at the state, local, and even institution level, with private schools often opening even when area public schools were fully virtual, though the CDC did release updated guidelines and recommendations in August to assist with decision-making and mitigation strategies.[61] Early voting also began in the fall, with most states starting in-person voting in October, and many making mail-in ballots more accessible in order to reduce the potential for transmission at in-person sites. Scientific studies from the primary elections held earlier in the year suggest that in-person voting could have been a significant factor driving the surge in cases that started in October and continued through the winter.[62] Throughout the election season, voters received mixed messages as many elected officials and campaigns encouraged voting by mail as a way to reduce SARS-CoV-2 exposure, while President Trump repeatedly warned of election fraud through mail-in voting, and urged his supporters to vote in person.[63]

The Third Wave (November–December). Although COVID-19 cases had already begun to rise steeply in October, in November and December the United States faced the totality of a third surge, with cases, hospitalizations, and deaths soaring to new heights that dwarfed even the peaks of the first two waves. Unlike earlier in the year, governments did not generally impose stay-at-home orders, even as the holiday season began, though the CDC did issue travel- and holiday-related guidance and some states did reimpose some of the restrictions they had eased during their phased reopenings. Fewer than half of the states maintained travel restrictions during this time.[64] Many states and jurisdictions encouraged residents to limit attendance at holiday gatherings, with some introducing fines for noncompliance, as Akron, Ohio's rule prohibiting gatherings of more than six guests was backed by a $250 fine.[65] However, even where these guidelines were in effect, compliance was generally voluntary or not enforced, so social pressure became the key motivator to limiting holiday activities.[66,67]

Following the results of the presidential election in November, President-Elect Biden announced the formation of a coronavirus advisory board to assist in preparing the incoming administration to tackle the ongoing COVID-19 crisis.[68] As Biden's team prepared to transition into the White House, the Trump administration took no aggressive steps to combat the surge of cases.[69] The White House Chief of Staff, Mark Meadows, had stated publicly "[w]e are not going to control the pandemic," and urged focus on vaccine and treatment development. Indeed, on December 11 and 18 respectively, the Pfizer-BioNTech and Moderna vaccines received emergency use authorizations from the FDA, signaling a new turn in the national and global fight against COVID-19. While state and federal government officials scrambled to finalize and implement vaccination plans, public health officials urged the public not to abandon masks and to continue practicing social and physical distancing as they remained the key tools for controlling the pandemic during the vaccine roll-out phase.[70] Prior to the end of the year, the U.S. Congress passed an appropriations bill that, in addition to funding federal agencies, included $900 million in targeted COVID-19 relief.

Table 1. Timeline of Key COVID-19 Milestones and U.S. Government Activities from January 1, 2020 to December 31, 2020

Date	Event
3 January 2020	**CDC Director Robert Redfield alerts HHS Secretary Alex Azar of a potentially serious illness in China[71]**
7 January 2020	CDC establishes "a Center-led Incident Management Structure"[72]
8 January 2020	CDC issues Health Alert Network notice to healthcare providers and public health departments on the emerging pneumonia threat
9 January 2020	WHO announcement of coronavirus-related pneumonia in Wuhan, China[73]
20 January 2020	CDC begins passenger screening in three U.S. airports
21 January 2020	**First confirmed COVID-19 case in U.S.; U.S. deploys CDC to assist with investigation; CDC announces development of a laboratory diagnostic test[74]**
25 January 2020	Interagency Medical Countermeasures (MCM) Task Force established, including nine interagency partners*[75]
29 January 2020	President Trump stands up Coronavirus Task Force, naming HHS Secretary Alex Azar as lead[76]
31 January 2020	Global Health Emergency declared by WHO; U.S. issues travel ban for non-citizens who had traveled in China in the previous 14 days[77]
3 February 2020	Public Health Emergency declared by U.S.
6 February 2020	Defective CDC-issued coronavirus test kits available at public laboratories nationwide[78]
25 February 2020	**CDC officials publicly recognize the full pandemic potential**
26 February 2020	Vice President Mike Pence replaces Secretary Azar as chair of the President's Coronavirus Task Force, and Dr. Deborah Birx is named Response Coordinator
6 March 2020	Passengers on a Carnival cruise ship near San Francisco test positive
9 March 2020	U.S. stock market begins to crash[79]
11 March 2020	COVID-19 declared pandemic by WHO
13 March 2020	**COVID-19 declared National Emergency in U.S.; European travel ban issued**
14 March 2020	New York state reports first two COVID-19 related deaths (beginning of NYC epicenter)[80]

* The Assistant Secretary for Preparedness and Response (HHS), BARDA, CDC, Department of Defense, Department of Homeland Security, Food and Drug Administration, National Institutes of Health, Department of Agriculture, and Department of Veterans Affairs

Date	Event
16 March 2020	**"15 Days to Slow the Spread" initiative starts**[81]
17 March 2020	Trump Administration requests financial relief package from Congress
19 March 2020	First state issues "Stay-at-Home" order (California)
26 March 2020	3.3 million people reported to have filed for unemployment in the prior week[82]
27 March 2020	**Coronavirus Aid, Relief, and Economic Security (CARES) Act is signed into law, providing $2 trillion in economic and healthcare assistance**
31 March 2020	NYC reports over 1,000 deaths due to COVID-19[83]
16 April 2020	Trump administration releases "gating criteria" to "reopen" the U.S. economy
16 April 2020	Over 22 million Americans have filed for unemployment in the month since a national emergency was declared[84]
28 April 2020	**U.S. case totals surpass 1 million**[85] **Reports show Americans deferring healthcare due to COVID-19 concerns; many would avoid seeking care for COVID-19 symptoms due to cost**
6 May 2020	President Trump reverses announcement made previous day that the Coronavirus Task Force would be phased out and replaced by a reopening-focused group[86]
15 May 2020	Trump administration announces "Operation Warp Speed," a public-private partnership to accelerate vaccine testing and production[87]
28 May 2020	**Over 100,000 American deaths reported**
10 June 2020	**U.S. case totals surpass 2 million**
26 June 2020	White House Coronavirus Task Force holds first briefing in two months to address rising cases in Southern states
2 July 2020	Some states postpone or reverse reopening plans
7 July 2020	**U.S. case totals surpass 3 million**
15 July 2020	New reporting protocol raises concerns about data manipulation for political purposes
3 August 2020	Dr. Deborah Birx, White House Coronavirus Response Coordinator, states U.S. has entered a "new phase" characterized by a shift from concentrated outbreaks to a more widespread distribution across the country
7 August 2020	Congressional leaders fail to reach deal on a second COVID-19 relief bill
17 August 2020	COVID-19 becomes #3 leading cause of death in U.S.
1 September 2020	U.S. declines to participate in COVAX, an effort to distribute vaccines globally
14 September 2020	U.S. stops screening international travelers arriving through airports
15 September 2020	CDC reports on study finding restaurant dining, bars, and cafes increase risk of developing COVID-19
16 September 2020	**Operation Warp Speed Strategy for Distributing a COVID-19 Vaccine released**[88]
19 September 2020	CDC revises recent documentation acknowledging airborne spread is possible; then states it was released in error[89]
25 September 2020	**U.S. case totals surpass 7 million**[90] Surge in cases in Midwest states noted, with Labor Day celebrations, the Sturgis Motorcycle Rally, and school reopenings acting as contributors
29 September 2020	Federal government announces plan to provide states with 100 million rapid tests by year's end
2 October 2020	President Trump and First Lady Melania Trump test positive for COVID-19; President Trump hospitalized
8 October 2020	Outbreak of COVID-19 cases links a ceremony at the White House to 34 cases
15 October 2020	U.S. new daily infections surge to 60,000
3 November 2020	Presidential election; Joseph Biden elected to replace Donald Trump

Date	Event
4 November 2020	U.S. new daily cases hit 100,000
9 November 2020	**U.S. total cases surpass 10 million[91]** **President-Elect Biden names Transition COVID-19 Advisory Board**
11 December 2020	U.S. Food and Drug Administration issues emergency use authorization for Pfizer, BioNTech vaccine
12 December 2020	**U.S. total cases surpass 16 million[92]**
18 December 2020	U.S. Food and Drug Administration issues emergency use authorization for Moderna vaccine
23 December 2020	Federal government announces purchase of 100 million more Pfizer vaccine doses
27 December 2020	Consolidated Appropriations Act, with $900 million of COVID-19 stimulus relief, is signed into law[93]
29 December 2020	More transmissible variant, first detected in the United Kingdom, found in a patient with no travel history in the state of Colorado
31 December 2020	**U.S. has surpassed 20 million infections, representing over 6 percent of the total population, with 346,000 deaths (roughly 1 in 1,000); 2.8 million have received first vaccine dose, missing stated goal of 20 million by end of year**

Analysis and Conclusions

This section will review the U.S. response to COVID-19 through the lens of SARS lessons learned. There is a great deal of literature recounting the lessons learned from SARS, as well as comparative case studies that review common themes across countries. Here, the U.S. response is evaluated using the framework introduced in the first section.

Reflections on Key Change Themes

Legal and Public Health Systems. Effective response to limit spread and save lives requires a clear and effective legal framework for public health-related activities. This includes movement restrictions into and within the country; surveillance, reporting, and analysis of cases; and the ability to mandate compliance with the established measures. In addition to a sufficient legal framework, political will must also be present to create and enforce such mandates. A clear understanding of responsibilities and authorities at different levels of government (from international to local) is needed, as well as coordination among and between those levels. Legal frameworks for restriction of civil liberties during public health emergencies need to be well understood and enforceable if such measures are necessary. Effective response also requires a public health system robust enough to perform the required activities (e.g., surveillance, detection, isolation, reporting, contact tracing).

> *Reflections on U.S. COVID-19 Response:* After SARS, many in the public health community expressed concern that legal frameworks were insufficient for addressing public health emergencies. The federal system of government delegates a great deal of responsibility to the states, and the great variability in state and local laws leads to inconsistent authorities, and a variety of possible outcomes after legal challenges. As expected, legal challenges did arise in response to stay-at-home orders, mask mandates, restrictions on business operations, and other public health measures.[94,95,96] Although many of these were resolved (with a variety of outcomes) at the states' supreme court level, some cases were presented to the U.S. Supreme Court. On one issue—the authority of state governors to restrict the free exercise of

religion by imposing capacity limits—the U.S. Supreme Court initially upheld such restrictions; however, after the appointment of a new justice, the court issued rulings that barred restrictions on places of worship.[97,98] The variability of outcomes points to the conclusion that, as expected after SARS, legal frameworks in the country's many jurisdictions may range in their adequacy to address public health emergencies. Regardless of any jurisdiction's individual legal adequacy, however, the collective impact of the U.S. legal system undermines the ability to respond in a coordinated fashion across jurisdictions, and this is a concern that has gone unaddressed since it was highlighted after SARS.

The adequacy of the public health system is also hampered by similar effects introduced by the federal system of government in which states/territories, counties, tribes, cities, and other jurisdictions maintain their own public health infrastructures, which are loosely tied together via reporting mechanisms that mandate certain health threats be reported to state and federal public health agencies. Furthermore, these public health infrastructures interact with a highly decentralized network of private healthcare providers, a mixture of public and private laboratories, and public health service agencies (e.g., the Veterans Administration, military healthcare entities, Indian Health Service). While the system is set up well to report diseases and incorporate CDC guidance into operations, there is little infrastructure to conduct the massive amount of contact tracing and risk communication required by a large-scale outbreak, let alone to enforce mandatory quarantine and isolation periods. As a result, U.S. residents were generally given instructions and guidance from their providers and/or local health departments and left to follow these instructions independently, with little to no consequences for failure to comply. As a result, many individuals who had known close contact with confirmed cases failed to quarantine sufficiently (and, in fact, could be forced to go to work despite such contacts on penalty of firing), and people with confirmed positive cases frequently declined to observe the recommended isolation period.[99] While public health preparedness activities after SARS sought to prepare healthcare facilities for accepting large numbers of patients, insufficient priority was given to the particular challenges of how to get Americans to voluntarily comply with public health measures, and how to compel such compliance if it was not given voluntarily.

Public Health and Healthcare Infrastructure. Sufficient capacity and coordination are needed within the public health system at various levels of government to create an organized and effective response. The healthcare system also needs to have sufficient capacity in terms of human resources, facilities, and material resources (e.g., medications, ventilators, PPE, other equipment). Most countries lack sufficient public health practitioners, healthcare professionals, facilities, equipment, and medicine to provide the "surge" capacity needed in a large-scale epidemic; epidemic-related infections within the healthcare community exacerbate this problem. Prior planning and coordination among key stakeholders is necessary for a unified response that makes best use of time and limited resources.

Reflections on U.S. COVID-19 Response: Perhaps the most striking observation for a public health preparedness practitioner in the United States was not that the healthcare infrastructure failed, but rather that the failure was *immediate*. For decades, healthcare facilities had been encouraged and funded (through grants) to design, implement, and test approaches for improving surge capacity during mass casualties and other public health emergencies, including stockpiling of adequate PPE for healthcare workers to use during prolonged pandemic-like conditions. A root

cause analysis of the severe PPE challenges faced early in the pandemic distributed blame broadly to a variety of sectors: hospitals' minimizing of PPE expenditures to reduce operating costs (in service of profit or general revenue motivations); and the federal government's public health budget cuts, failure to stockpile and renew supplies, trade war with China, unwillingness to invoke authorities (like the Defense Production Act) to increase supply, and overall approach of minimizing the severity of COVID-19.[100] These preconditions met with both demand shock and supply chain issues as more people and entities raced to get a diminishing supply of available PPE, while its overreliance on imports made the United States particularly vulnerable to such shortages. The "just-in-time" ordering scheme may reduce operating costs, but it reduces resilience to shocks; as a result, American healthcare facilities were unable to provide adequate resources.

The PPE shortage had a long tail of impacts. First, it led to excessive healthcare worker deaths, particularly in the states that were hit with COVID-19 early in the pandemic.[101] This drained an already limited supply of healthcare workers, reducing the nation's ability to appropriately staff facilities and provide adequate care to patients. Second, it led to the calculated recommendation that the public not wear masks, because public health officials feared a public run on buying masks would further exacerbate the PPE shortages healthcare workers were already experiencing.[102] This led to testimony by the CDC Director Robert Redfield in late February stating, unequivocally, when asked whether members of the public should wear masks if they are healthy, "No." The U.S. Surgeon General Jerome Adams also reflected this message, tweeting "Seriously people—STOP BUYING MASKS," even as Asian nations quickly embraced mask wearing. By the time U.S. public health officials had begun to embrace masks as a key public health measure, many had already received the message, intended or not, that masks were useless accessories. Worse, many considered mask mandates an infringement upon their constitutional rights, leading to sometimes violent altercations when retail workers tried to enforce such policies.[103]

Law Enforcement and Ancillary Services. In order to support a public health response that relies on modification of public behavior (e.g., quarantine and isolation for COVID-19), countries will need to provide not only law enforcement for enforcing required measures but also complementary programs that help affected community members comply. For example, public education and communication; a way to replace wages lost due to public health measures; job protection/anti-discrimination policies; and delivery and/or provision of medical supplies and food are all needed to minimize negative impacts to the community when complying with public health measures. Other aspects of response need to be considered, such as precautions needed for mortuary service and waste disposal, as well as ensuring measures are culturally appropriate and acceptable to various groups within the population (for example, religion, ethnicity, race, and language of different community members should be considered, among others).

Reflections on U.S. COVID-19 Response: In this area, law enforcement is expected to assist with enforcement of public health measures. However, in the United States this by and large did not happen. While some states did assign fines for violations of stay-at-home orders, travel restrictions, mask ordinances, and other measures, in practice these were rarely enforced, only serving as a compliance motivator in theory. There were also no publicly-provided ancillary services to assist those affected by quarantine or isolation requirements by delivering food or medication. Instead, those

with sufficient financial means and the desire to comply with these public health measures could utilize delivery services like Amazon, Uber Eats, DoorDash, and a variety of grocery store delivery options, mostly facilitated by online apps and internet access. Those who could not afford such services may have been able to rely on community members to assist with deliveries or food purchases, but since income replacement during quarantine/isolation periods is generally a privilege of higher earners, service-sector and minimum wage employees often would have to choose between working while potentially infectious or staying home and losing their earnings, or worse, their jobs.

The CARES Act passed by the U.S. Congress in March 2020 expanded unemployment benefits, sought to protect jobs by subsidizing businesses who retained employees, and provided "stimulus" checks of $600 to most U.S. taxpayers. While this bill was a lifeline to many who had lost their jobs due to the pandemic, it did not address support requirements for those asked to isolate or quarantine for the public good.

Leaders within the United States also struggled to present a coherent message to the public, in part because the pandemic took place during a heightened period of political polarization that would have made public education and communication difficult for any administration. However, deliberate decisions by the Trump administration further exacerbated this preexisting vulnerability. The decision to downplay the severity of the virus essentially forced the administration to sideline public health experts from the CDC, like Dr. Nancy Messonier, the director of the National Center for Immunization and Respiratory Diseases, whose comments about preparing for "significant disruption of … lives" at a February 25 press conference undermined the preferred narrative and caused a drop in the stock market that spooked the White House.[104] After that incident, Vice President Mike Pence was put in charge of the Coronavirus Task Force, and the CDC no longer provided public communications in any meaningful way.[105] The impact of these decisions was devastating to public trust; by late April it was clear that the administration had lost the trust of the majority of the American people, with only 23% indicating high levels of trust in the information shared by the President.[106]

This played into the polarized partisan dynamic of the country, as the Democratic Party urged the nation to "follow the science" while the Republican Party took their lead from President Trump's decision to understate the severity of the situation in order to avoid panic.[107] Concerns mounted over perceived politicization of federal agencies, including White House pressure on the FDA to make certain statements about therapeutics, and direction to revise CDC guidance.[108,109,110] Partisan approaches also colored states' responses to the pandemic, as Democratic governors tended to respond more aggressively than Republican governors.[111,112] In some cases, legislatures sought to override governors' authorities by passing new laws to restrict their power; these incidents were underpinned by partisan politics as well.[113] The public health preparedness community had anticipated since SARS that it would be difficult to develop a unified message for education and risk communication due to the diversity of the American people as well as the many layers of government; however, the competing messages of the two primary political parties added another layer of complexity to this already challenging task. This was borne out by public perception polls indicating Democrats were more likely to consider COVID-19 a serious threat than Republicans, which in turn drove behavior and compliance with public health measures.[114,115] This demonstrates how the

failure of the different levels of government and public health officials to effectively speak with one voice and develop an effective public education campaign undermined the overall response.

Conclusion

The public health response community has long understood the United States to be vulnerable to health emergencies. Despite considerable resources in biomedical research, hosting one of the most highly regarded public health agencies in the world (the CDC), and the wealth of the world's largest economy, cultural, political, and institutional constraints inherently limit U.S. access to some of the public health tools available to leadership in other countries. The dispersed, privatized, and unequal distribution of the healthcare system; the relative autonomy of state and local governments; the complex legal system; the inherent polarization of a two-party political system; and the cultural and legal framework of individual rights and freedom hampered the United States' ability to muster and coordinate an effective response to emerging health threats. Although the SARS experience highlighted several of these concerns, many of the root causes of these dysfunctions are systemic, and therefore resistant to interventions focused only in the public health domain.

Although by and large the United States still faces the challenges identified during SARS, there is one area in which they can note considerable success: the rapid development and production of vaccines, and the dedication of considerable funds to expedite the testing and manufacturing of candidates using multiple different technologies. One of the key agencies involved, the Biomedical Advanced Research and Development Agency (BARDA), was founded in 2006 with the mission to "develop medical countermeasures that address the public health and medical consequences of chemical, biological, radiological, and nuclear (CBRN) accidents, incidents and attacks, pandemic influenza, and emerging infectious diseases."[116] Although the United States was not the only actor in the international effort to develop effective vaccines, the economic weight of the nation, along with BARDA's flexible funding mechanisms, were leveraged to reduce risk to participating pharmaceutical companies, allow for simultaneous clinical trials (as opposed to sequential ones, which take longer), and spread risk and promise across three potential platforms (mRNA, recombinant protein, and replication-defective live vector).[117] The United States was able to capitalize on maturing mRNA technology, coronavirus research from SARS-CoV and MERS-CoV, and advances in vaccine technology to bring effective vaccines to market roughly a year from when the virus first emerged—a feat without precedent.[118] In the end, some may decide this was the only SARS lesson the United States learned, but perhaps it will be the one that matters most.

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[54] "Characteristics of Cumulative Laboratory-Confirmed COVID-19 Cases, Hospitalizations, and Deaths among New York City Residents Reported to the New York City Department of Health and Mental Hygiene — New York City, February 29–June 1, 2020"
[55] McGraw and Oprysko 2020
[56] Elassar 2020
[57] Centers for Disease Control and Prevention 2020
[58] Firestone et al. 2020
[59] Shammas 2020
[60] Dave et al. 2020
[61] Christensen 2020
[62] Cotti, et al. 2020
[63] Kiely and Rieder 2020
[64] Ledsom 2020
[65] Even where these guidelines were in effect, compliance was generally voluntary or not enforced.
[66] Gold 2020
[67] "California Under New COVID-19 Rules for Next Three Weeks" 2020
[68] Subbaraman 2020
[69] Stolber et al. 2020
[70] Cimons 2020
[71] Schwellenbach 2020
[72] U.S. Senate 2020, p. 4
[73] "A Timeline of COVID-19 Developments in 2020"; all dates in timeline are taken from this source unless noted otherwise.
[74] Schwellenbach 2020
[75] "BARDA Coronavirus Response Timeline" for Jan. 25, 2020
[76] "Statement from the Press Secretary Regarding the President's Coronavirus Task Force" 2020
[77] Whitmore 2020
[78] Temple-Raston 2020
[79] Amadeo 2021
[80] Kerr 2021
[81] McGraw and Oprysko 2020
[82] Ibid
[83] Kerr 2021
[84] Long 2020
[85] Soucheray 2020
[86] Cole 2020
[87] "Trump Administration Announces Framework and Leadership for 'Operation Warp Speed'" 2020
[88] "From the Factory to the Frontlines: The Operation Warp Speed Strategy for Distributing a COVID-19 Vaccine" 2020
[89] Elfrink et al. 2020
[90] Schnirring 2020
[91] Stein 2020
[92] McKay 2020
[93] Cochrane et al. 2020
[94] Hall et al. 2020
[95] Price and Diaz 2020
[96] Saunders 2020
[97] Gerstein 2020
[98] Lithwick and Stern 2021
[99] Sampson and McMahon 2020
[100] Cohen and van der Meulen Rodgers 2020
[101] Ibid
[102] Molteni and Rogers 2020
[103] Bhattarai 2020
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[105] Kuznia et al. 2020
[106] Pace and Fingerhut 2020
[107] Haberman 2020
[108] McGinley et al. 2020
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[110] "White House Task Force Directed CDC to Weaken COVID Testing Guidelines" 2020
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[113] Quinton 2021
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[115] Clinton et al. 2021
[116] U.S. Department of Health and Human Services 2021
[117] "Operation Warp Speed: Accelerated COVID-19 Vaccine Development Status and Efforts to Address Manufacturing Challenges" 2021
[118] Ball 2020

Preparing for Another SARS: The Canadian Experience

Frances Christine Fisher Veasey, MS, PMP

Lessons Learned from SARS

Overview. During the 2002–2003 outbreak of SARS, Canada was the hardest-hit non-Asian country, with 438 probable and suspect cases, and 44 deaths. SARS cases in Canada were concentrated in Toronto, with some cases also present elsewhere in Ontario. Healthcare workers were disproportionately affected, accounting for over 100 of the SARS cases identified. The SARS outbreak in Toronto came in two waves, which are referred to as Phase I (March 13–25, 2003) and Phase II (May 23–June 30, 2003).[119] During these two phases, several obstacles were encountered in bringing the epidemic under control. At the onset of the SARS outbreak in Canada, the Ontario government designated SARS a "reportable, communicable, and virulent" disease according to its Health Protection and Promotion Act.[120] Once this designation was made on March 25, 2003, public health officials were authorized to issue orders to detain and isolate individuals to combat the spread of SARS. Over the course of the epidemic, approximately 30,000 individuals were quarantined in Toronto. This is comparable to the number quarantined in Beijing, China; however, Toronto

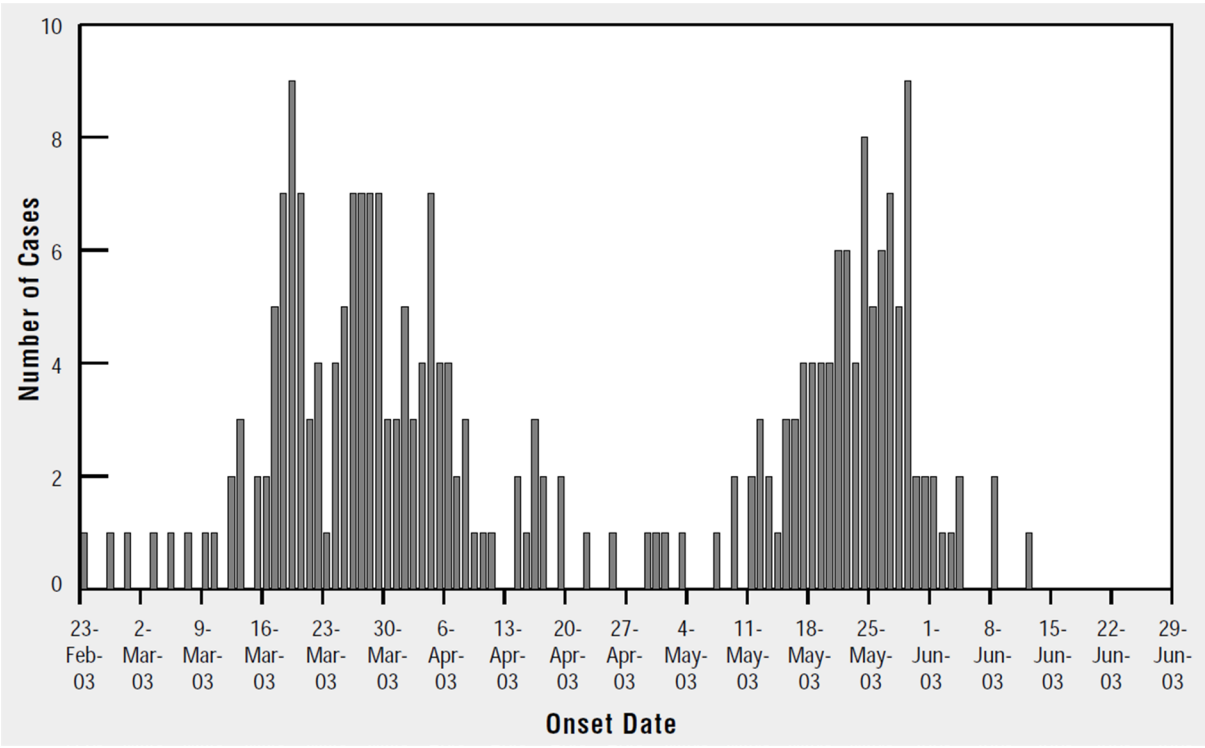

Figure 11. Number of Probable SARS Cases in Canada. (Source: Learning from SARS: Naylor et al. Renewal of Public Health in Canada, p. 27. Note: N=250; this excludes one patient for whom the onset date is unknown.)

actually experienced about one tenth the number of probable SARS cases as Beijing (approximately 250 vs. 2,500).

Initial spread of SARS within Toronto occurred primarily through contact with a woman, "Mrs. K," who returned from a trip to China with pneumonia. She infected her son, "Mr. T," who remained in the emergency department of the Scarborough Hospital for 18–20 hours while awaiting admission.[121] During this period, many healthcare workers and other patients were exposed to SARS before the patient was fully isolated. Once tuberculosis was ruled out and SARS suspected, measures were belatedly implemented to limit further spread, including confining members of the patient's family to negative-pressure isolation rooms. Once a "Code Orange" was declared, placing area hospitals in emergency status, hospitals utilized isolation units for suspected SARS cases. They also suspended non-essential services, limited visitors, and increased personal protective equipment (PPE) use by staff. Additionally, contacts of SARS cases that remained asymptomatic were asked to sequester themselves in a 10-day home quarantine.

Nevertheless, by the time these actions were implemented, the outbreak was already in full swing. Family members, healthcare workers, and other hospital patients and visitors who had come into contact with infected patients in turn became ill, and many also infected others. This led to a significant cluster of cases related to the Scarborough Hospital, as well as another cluster at York Central Hospital that arose when a patient who had been in the emergency department with Mr. T was transferred to that facility. Over 50 more cases were generated at York Central Hospital, eventually closing down that facility. A concurrent case arose in British Columbia on March 13; however, due to the patient's limited contacts outside the hospital and medical staff quickly masking and isolating the patient, no additional infections occurred. In Toronto, hospitals were quickly overwhelmed, lacking sufficient negative-pressure rooms for isolation of SARS patients. Health Canada began closely tracking progress of the disease. The Ontario government activated authorities pursuant to the *Health Protection and Promotion Act*, declared a provincial emergency, and directed Toronto hospitals into "Code Orange." Hospitals were required to limit visitors and non-essential services, implement enhanced infection control measures, and designate separate units for SARS patients, increasing the number of negative-pressure rooms available.

Over the next month, Canada's health agencies worked to bring infections under control, encountering numerous challenges along the way. As a result of enhanced infection control procedures, careful epidemiological work, and stringent quarantine and isolation measures, case numbers declined and health agencies began to sense the outbreak was over. Hospitals began to ease restrictions, reducing PPE and physical distancing requirements, and admitting more patients. On May 14, WHO essentially declared the outbreak over by indicating Toronto had no recent local transmission, and on May 17, the emergency declaration was lifted. During this time, clusters of pneumonia were being investigated for SARS and ruled out due to lack of epidemiological links to known SARS cases. One such cluster went undetected as SARS until a nurse, who had been caring for elderly patients in an orthopedic unit, tested positive for SARS after being admitted for pneumonia. This incident kicked off a new round of infections, as area hospitals had been receiving patient transfers from the affected orthopedic unit throughout May.

In Phase I, no facilities had been considered SARS hospitals. Rather, individual hospitals were expected to isolate SARS patients internally. In the two hospitals that ended up with the highest SARS case load, physicians with the most expertise and experience managing SARS

had either become ill or had been quarantined following exposure. Illness and quarantine led to staff shortages that were left unfilled as other area hospitals found themselves unwilling or unable to respond to requests for staff support. Phase II saw a different approach with the designation of four hospitals as SARS facilities, and the broadening of the "Code Orange" to all Ontario hospitals, a measure that many criticized as unjustified and overly broad. The grueling public health work resumed, and eventually brought the second wave to an end. Realizing that different decisions and approaches could have prevented this second wave, the public pressured the Province of Ontario into conducting a formal investigation, and the Canadian government followed suit.

Lessons Learned. The official 2003 Health Canada report on SARS—*Learning from SARS: Renewal of Public Health Canada*—identified many deficiencies in Canada's public health response.[122]

Reviews of the initial response to SARS have noted that procedures varied from unit to unit and province to province. Healthcare workers did not receive uniform guidance with regard to quarantine, isolation, and protective equipment use, nor were they always provided with adequate equipment or tools to prevent infection. This finding was echoed by an ad hoc Scientific Advisory Committee cited in the Health Canada report, which stated that "different public health units seemed to have different thresholds for the use of quarantine." The variation in use of quarantine and other measures likely stems from the decentralized nature of the Canadian public health system.

Key Lessons Learned Identified in Health Canada Report

- Lack of surge capacity in the clinical and public health systems
- Difficulties with timely access to laboratory testing and results
- Absence of protocols for data or information sharing among levels of government
- Inadequate capacity for epidemiologic investigation of the outbreak
- Lack of coordinated business processes across institutions and jurisdictions for outbreak management and emergency response
- Inadequacies in institutional outbreak management protocols, infection control, and infectious disease surveillance
- Weak links between public health and the personal health services system, including primary care, institutions, and home care

The federal government of Canada maintains the authority to quarantine and isolate persons in transit, even though it did not do so in the SARS epidemic. Despite concern over transiting persons spreading SARS, no incoming or outgoing travelers were actually quarantined.[123] Deployment of a thermal scanner resulted in 832 passengers referred for examination, out of a total of 2.4 million total screened passengers. Upon examination, none of the 832 referred passengers were determined to be a probable or suspected SARS case.

A more common use of quarantine in Canada was home and workplace quarantines for contacts of probable SARS cases.[124] Included under this case definition were family and household members of SARS patients, healthcare staff, visitors, co-workers, and fellow hospital patients who might have been exposed to SARS cases. It is important to note that these persons were only quarantined if they had not worn PPE deemed sufficient to inhibit transmission. In these cases, individuals were requested to stay at home for 10 days, during which a local public health worker would monitor them by phone.

In hindsight, there is general concurrence that Canada faced significant challenges in coordinating response, quarantine efforts, and public information.[125] The Canadian government itself issued the following analysis:

> "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. 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."

In the end, most Canadians complied voluntarily when asked to quarantine themselves. Only 27 cases required a written order issued in accordance with Ontario's Health Protection and Promotion Act.[126] Nevertheless, law enforcement authorities were expected and required to assist public health officials in establishing and enforcing quarantines. There were instances in which law enforcement personnel were asked to conduct spot checks or investigate reports of persons who broke quarantine and infected others. One such person died from his illness before he could be apprehended.

Public support for quarantine in Canada was shored up not only by the country's culture of solidarity as evidenced by their universal healthcare system, but also by steps the government took to assure citizens that they would be compensated for time they spent in isolation.[127] The federal government relaxed waiting periods and other conditions for use of sick leave, and passage of the SARS Assistance and Recovery Strategy Act by Ontario's government ensured qualified people would receive unpaid leave if asked to participate in quarantine or isolation. Additionally, a 24-hour hotline was established to answer questions about SARS, including addressing questions about loss of income, housing, and business due to SARS containment measures.

Although isolation and quarantine were considered by Toronto officials to have helped control the outbreak and reduce community exposure, coordination and implementation of quarantine measures were decentralized and haphazard.[128] The response prompted Health Canada to write that "the SARS experience illustrated that Canada is not adequately prepared to deal with a true pandemic."[129] The report recommended reorganizing public health systems throughout Canada, and creating a national agency responsible for emergency disease response with the authorities and linkages to respond effectively to outbreaks. As a result, the Public Health Agency of Canada was formed.[130]

Steps Taken. On the heels of a SARS outbreak that has been described as "extremely frightening, extremely traumatic," Canada made significant organizational and cultural changes to their healthcare system in order to improve preparedness and response capabilities.[131] The 2003 Health Canada report on SARS had outlined recommendations for comprehensive reform, and much of the suggested changes were in fact implemented, including the creation of a new Public Health Agency of Canada.[132]

> *Government Coordination.* Given issues with federal-provincial collaboration and coordination during SARS, the Health Canada report recommended organizational and legislative fixes, including the creation of a new agency for public health, led by a Chief Public Health Officer of Canada, charged with developing a national strategy for public health.[133]

Increased Investment in Public Health. The Committee recommended not only to increase investment in public health at the national/federal level, but also to create dedicated funding streams for public health at all levels, including provincial, tribal, and municipal.[134]

Health Emergency Management. The Committee recommended strengthening programs specifically targeted at the control of infectious disease. This included surveillance, enhancement of emergency preparedness and response networks, establishment of Health Emergency Response Teams (HERT), creation of a new health emergency–focused network, review and updating of legal frameworks for multi-jurisdiction emergencies, and adaptation and broad implementation of risk communication training.

Public Health Improvements. The Committee recommended funding and accountability streams though partnerships meant to reinforce local public health functions and collaboration, and a significant "reinvigoration" of the National Immunization Strategy. They made recommendations to increase human resources in the public health sector and to strengthen public health laboratories, improving diagnostic capacity and integration. They also suggested improved funding and promotion of research aimed at infectious diseases and public health.

Targeted Improvements for Provincial/Local and International Partners. In addition to the system-wide recommendations summarized above, the Committee reviewed the effectiveness of various provincial and local strategies in view of their effectiveness, and made recommendations for provincial and tribal governments and public health agencies to consider during their own improvement planning. The Committee also noted the need for increased collaboration with international partners, both to coordinate a global response and to improve partners' abilities to respond to the next global pandemic.

Of note, as COVID-19 began to transition to a global pandemic in March of 2020, the lead author of the 2003 Health Canada report on SARS, Dr. David Naylor, indicated that while most of the recommendations were implemented, Canada still has fallen short in areas of digitalization of healthcare and public health, as well as in funding for biomedical research, where he indicated Canada had not kept pace with the U.S. in terms of scientific leadership and investment.[135] However, he indicated that one lesson Canadians had learned was to take the threat of infectious diseases seriously.

Canada's Response to the COVID-19 Pandemic

Canada's first year of the COVID-19 pandemic, like SARS, came in two waves. The first peaked in late April/early May 2020, and then subsided as public health measures like social distancing and mask wearing were implemented. With lower case rates in June and July, provinces eased restrictions, and the EU began allowing travelers from Canada to return. Despite a small surge in July on the heels of July 1 Canada Day celebrations, case rates remained relatively low until the fall, when they soared over the fall and early winter months.[136]

Initial Response (January 2020–February 2020). In the early stages of the pandemic, Canada's health officials followed information coming out of China and the WHO, while providing statements that mainly reassured the public not to be overly concerned.[137] On

January 22, a screening protocol was implemented at three major airports, with symptomatic passengers asked to voluntarily isolate; this protocol remained in place for the following two months.[138] These procedures were contrasted with measures taken in Taiwan, which identified higher-risk travelers, assigned them to quarantine at home, and used GPS to enforce such quarantines.

From late January through February, provincial public health officials identified a series of travel-related cases, as well as some community spread.[139] Following the WHO's lead, which was at the time advising against travel restrictions, Canada's government did not bar travel from China or other affected countries.[140] This decision was informed by economic concerns, international health regulations that recognize travel bans can also limit the crucial movement of the scientific and medical community, and growing concern about racism and stigmatization of people of Asian descent. The Canadian government at this time felt the screening protocols and isolation of symptomatic individuals would be sufficient, and indicated there was not sufficient evidence to justify quarantine of those who were not symptomatic. From January 23 through February, cases continued to crop up in British Columbia and Ontario, most of which had direct links to international exposure.

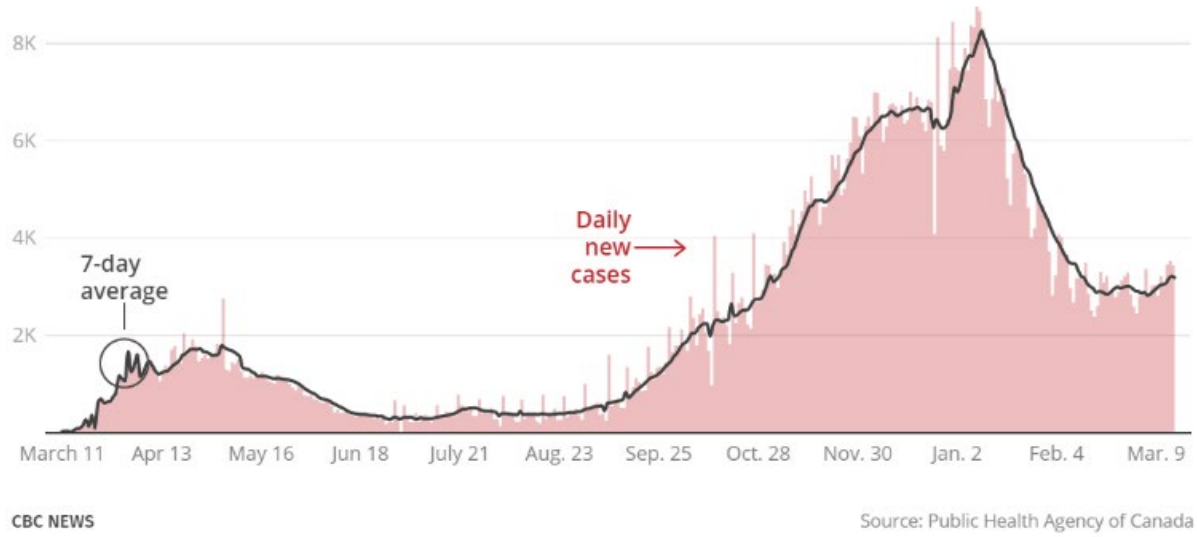

Figure 12. Daily New Cases in Canada from March 2020 to March 2021. (Source: https://www.cbc.ca/news/business/canada-covid-19-cases-surge-eu-travel-u-s-trump-1.5761649)

First Wave (March 2020–August 2020). In early March, Prime Minister Justin Trudeau established a Cabinet Committee on COVID-19, followed by increased investments in coronavirus research and a response fund of $1 billion CAD. Community spread was noted throughout the month, prompting a nationwide "lockdown" that closed Canada's borders to all but the United States, various other federal restrictions,[141] and emergency declarations by provinces and territories. Nationwide, provinces and communities began implementing social distancing measures like school/daycare and non-essential business closures, entry restrictions, and banning of gatherings. Toward the end of March, as cases began to sharply increase throughout Canada, Federal Health Minister Patty Hadju invoked the Quarantine Act, which had been passed in 2005 after the SARS crisis, to mandate a 14-day quarantine for all travelers into the country.[142] In early April, while noting 18,447 cases and 401 deaths, the Public Health Agency of Canada presented a briefing that modeled 11,000–22,000

deaths, even if strong epidemic controls were used, versus 300,000–350,000 deaths with no controls.[143] As controls were enacted, the first wave reached its peak in early May, after which cases began to decline. Reduction in case numbers led to implementation of phased reopening plans in the provinces, which they followed over the course of the summer.[144,145]

Second Wave (September 2020–December 2020). As cases began to rise steeply in September, PM Trudeau announced Canada was in the midst of a second wave.[146] Trudeau urged continued use of face masks and social distancing, as well as use of the COVID Alert app that could be used to notify users of potential exposures. He announced a four-pillar plan to protect the people from the disease: keep people safe; support those experiencing economic instability; build a better, more equitable economy; and promote diversity and inclusion by addressing systemic racism and injustices to Indigenous peoples. Emergency unemployment benefits introduced earlier in the pandemic were renewed,[147] and the Canadian people braced themselves for new restrictions going into place before the fall and winter holidays.[148] As the virus surged to new heights, experts and politicians pointed toward complacency, in-home holiday gatherings, and insufficient testing as drivers of transmission, even when aggressive lockdowns were in place.[149]

Table 2. Timeline of Key COVID-19 Milestones and Canada Government Activities from January 1, 2020 to December 31, 2020

Date	Event
9 January 2020	**Chief Public Health Officer of Canada Dr. Theresa Tam tweets that travelers to China should check the health travel notice for Hubei province and see a healthcare provider if they are ill when they return[150]**
17 January 2020	Canada indicates plans to provide health information and screen travelers from central China[151]
23 January 2020	**First confirmed case of COVID-19 in Canada presents at hospital in Toronto**
27 January 2020	National Microbiology Lab confirms diagnosis of first COVID-19 case[152]
29 January 2020	Plane chartered to repatriate Canadian citizens from China[153]
3 February 2020	**Dr. Tam reaffirms decision not to restrict travel or trade[154]**
14 February 2020	Fifth case of COVID-19 announced in British Columbia[155]
1–28 February 2020	Officials in British Columbia and Ontario continue to report on resolution of cases and discovery of new cases, most of which stem from international travel[156]
26 February 2020	Federal Health Minister Patty Hajdu recommends stockpiling of food and medication[157]
4 March 2020	Cabinet Committee on COVID-19 established by PM Trudeau[158]
7 March 2020	Government announces $27 million CAD allocated to coronavirus research[159]
9 March 2020	237 Canadians to be repatriated and quarantined after exposure on Grand Princess cruise ship[160]
11 March 2020	PM Trudeau announces response fund of $1 billion CAD, including $500 million CAD for provinces and territories[161]
13 March 2020	**PM Trudeau announces financial aid package under development;[162] Parliament adjourns for five weeks;[163] cases have been confirmed in provinces of Ontario, British Columbia, Alberta, Quebec while Manitoba and Saskatchewan have identified presumptive cases;[164] nationwide "lockdown" announced on the heels of 47 new cases**
16 March 2020	Travel restrictions announced to start March 18; entry into Canada restricted to citizens, permanent residents, and their immediate families[165]

Date	Event
31 March 2020	**Dr. Tam indicates people who are not sick do not need to wear masks;[166] March unemployment report shows loss of 1 million jobs, with 5.47 million people applying for emergency assistance[167]**
6–7 April 2020	**Dr. Tam and PM Trudeau advise use of masks to protect others from infection[168]**
9 April 2020	Models released showing 11,000–22,000 deaths with strong public health measures; 300,000 with none
20 April 2020	Masks mandatory on all airline flights; $1000 CAD penalty[169]
20 May 2020	Dr. Tam more strongly recommends wearing masks in public as provinces reopen[170,171]
18 June 2002	**Canada reaches 100,000 COVID-19 cases with 8,348 deaths reported[172]**
24 June 2020	British Columbia moves to Phase 3 of reopening[173]
30 June 2020	E.U. reopens to travelers from Canada, along with 13 other countries[174]
22 July 2020	COVID-19 cases surge in four provinces, driven in part by July 1 Canada Day gatherings and other parties[175]
23 September 2020	**PM Trudeau announces "second wave," and a new four-pillar plan to combat COVID-19[176]**
19 October 2020	Canada reaches 200,000 COVID-19 cases with 9,760 deaths[177]
23 October 2020	Amid surge in Canadian cases, E.U. bars travelers from Canada[178]
16 November 2020	Canada reaches 300,000 COVID-19 cases with 11,027 deaths[179]
4 December 2020	Canada reaches 400,000 COVID-19 cases with 12,496 deaths[180]
19 December 2020	Canada reaches 500,000 COVID-19 cases with 14,154 deaths[181]
31 December 2020	**Canada ends the year with 581,428 total cases and 15,606 deaths, roughly equating to 1.5% of the population having been infected and .04% of the population dying from COVID-19[182]**

Analysis and Conclusions

This section will discuss Canada's response to COVID-19 through the lens of SARS lessons learned, first reviewing change themes that flowed from SARS, and then providing an assessment of additional themes that emerged during COVID-19.

Assessment of SARS-Related Change Themes

Here, the Canadian response is evaluated based on key thematic areas from the Health Canada report.

Government Coordination. Creation of the Public Health Agency of Canada and the position of Chief Public Health Officer facilitated response by allowing for "one voice" in communications and a central focus point. Coordination between federal and provincial officials was improved, though coordination and communication challenges were still noted.[183]

Increased Investments in Public Health. Increased investments in public health allowed a more robust response to COVID-19. Such investments are credited with improving Canada's rapid detection capability during COVID-19, which enabled more aggressive public health measures.[184]

Health Emergency Management. Strengthening of programs specifically targeted at the control of infectious disease allowed for improved surveillance, enhancement of emergency

preparedness and response networks, and improved functioning of deployable assets like the Health Emergency Response Teams (HERT). Health emergency–focused networks were leveraged, and updated legal frameworks for multi-jurisdiction emergencies also facilitated response.

Public Health Improvements. Partnerships and increased human resources in the public health sector were critical, as was strengthening public health laboratories to improve diagnostic capacity and integration. However, biomedical research funding has not kept pace with the requirement. The Canadian government, however, did work with science leaders and corporations to dedicate funding for COVID-19 research early in the pandemic, and the scientific community was able to quickly turn around case reports and lessons learned from treatment of early cases to help with effective case management in hospitals.[185]

Targeted Improvements for Provincial/Local and International Partners. Provincial and tribal governments and public health agencies were better situated to respond than during the SARS outbreak. Canada also has increased collaboration with international partners and worked closely with the WHO.

> *Reflections on Canada's COVID-19 Response:* From the practitioner's perspective, Canada has improved in many ways. A report from the team that treated the first COVID-19 patient in Toronto compared the experiences to assess whether lessons were learned (Figure 13). Based on the resources available at the onset, clinicians noted improvements in many aspects of patient care and public health coordination, including: funding and human resources, information sharing protocols, public health–hospital linkage, rapid diagnostic testing, and availability of required beds and personnel. Improvements were also noted in infection prevention and control (IPAC) in terms of triage, surveillance, isolation, awareness, reduction of high-risk procedures, hand hygiene, workplace policies, disinfection procedures, and the existence of a pandemic plan. The number of isolation rooms available increased from 20 to 46, and isolated air systems with negative pressure were installed, along with a protective barrier at triage. The clinicians reported that N95 masks were available with regular fit-testing, and they had clear recommendations for what PPE to use. They also noted that their assessment regarding whether there was adequate funding and human resources would need to be revisited if the situation evolved into a pandemic.
>
> The initial experience of treating the first Canadian COVID-19 case demonstrated great improvements had been made based on the lessons learned from SARS. Resources were more available, coordination had improved, and infection prevention and control systems were in place to reduce in-hospital transmission, which was a key driver of SARS in Toronto. Unfortunately, healthcare and public health infrastructure was only one aspect of COVID-19 response. During SARS, few if any asymptomatic cases were uncovered, and patients were not particularly contagious until they developed symptoms. This has introduced two dynamics that SARS did not prepare them for: (1) extensive community-level spread, and (2) the potential for non-COVID-19 patients to be nonetheless infectious.

	2003: SARS in Toronto[a]	2020: COVID-19 Toronto case
Public health structures and infrastructures		
Adequate funding and human resources	No	Yes[b]
Protocols for information sharing among different levels of government	No	Yes
Link between public health and hospitals	Weak, fragmented, uncoordinated	Coordination and information sharing present
Rapid and accurate diagnostic testing	No	Yes
IPAC program structure and related hospital program		
ICP staffing level	Understaffed 3 ICPs for 1257 total beds (0.23 ICP/100 beds)	Adequate 13 ICPs for 1355 total beds (0.96 ICP/100 beds)
ICP certification (Certification Board of Infection Control and Epidemiology)	Not universal	Required
Occupational Health & Safety	Disconnected from IPAC	Coordinated with IPAC
IPAC administrative controls		
Syndromic triage in ED	No	Yes
Febrile respiratory illness surveillance	No	Yes
Isolation of all patients with acute respiratory symptoms	No	Yes
Awareness of super-spreading events and individuals	No	Yes
Minimizing AGMP and protected intubation policies	No	Yes
Hand hygiene program	No	Yes
Healthy Workplace Policy (work restrictions for HCWs with acute infectious symptoms)	No	Yes
Presence of a pandemic plan	No	Yes
Engineering and environmental controls		
Number of airborne infection isolation room	20 (0 in ED)	46 (8 in ED)
ED infrastructure	Shared air system; no protective barrier at triage	Isolated air system with negative pressure in each zone; protective barrier at triage
Terminal disinfection completed twice at patient discharge for high-consequence pathogen	No	Yes
PPE		
Regular N95 fit-testing of HCWs	No	Yes
Clear recommendation on PPE for any novel high-consequence pathogen	No	Yes

Abbreviations: AGMP, aerosol-generating medical procedure; ED, emergency department; HCW, healthcare worker; ICP, Infection Prevention and Control Professional; IPAC, Infection Prevention and Control; PPE, personal protective equipment.

[a]Based on historical local data and the Naylor report [10].

[b]Subject to reassessment in the event of a pandemic.

Figure 13. Comparison of Clinical and Public Health Resources Between SARS (2003) and COVID-19 (2020). (Source: Marchand-Senécal et al. 2020)

Assessment of COVID-19 Key Themes

Although the Health Canada report on SARS lessons learned was comprehensive, additional themes have emerged during COVID-19 response that were not clearly linked to the report. Many of these, however, do have ties to the Canadian SARS experience. These will be reviewed in this section.

Use of Public Health Measures. During SARS, Canada was able to address a coronavirus epidemic without resorting to broad measures like social distancing and universal mask wearing. Infections primarily occurred in healthcare settings with limited community-based spread, and travelers found to have high fevers during screening protocols generally self-quarantined voluntarily. During that epidemic, enhanced infection prevention and control

procedures at healthcare facilities, combined with contact tracing, isolation, and quarantine, were sufficient to resolve the outbreak.

> *Reflections on Canada's COVID-19 Response:* Canadian leadership was hesitant at first to use the seemingly heavy-handed, broad public health measures being adopted by the Asian countries who were on the "front lines" of the COVID-19 pandemic. This is likely in part due to legal frameworks, but it may also be related to their experience in controlling SARS effectively without such measures. The underlying assumption behind this approach was that SARS-CoV-2 would behave similarly to its close cousin, SARS-CoV-1, the virus that caused SARS. In some ways this would seem to be a reasonable assumption, because they were both transmissible respiratory diseases prone to superspreading events—but SARS-CoV-2 is not the same virus, and in reality it behaved very differently.[186]
>
> SARS-CoV-1 patients were most infectious when severely ill, often more than a week after their illnesses began; therefore, transmission was negligible if the patient was isolated within five days of symptom onset,[187] whereas SARS-CoV-2 spreads more easily through asymptomatic and pre-symptomatic individuals, and during the first 48 hours of symptom onset. While reproduction rates (R_0 or R-naught) can vary in different environments, the WHO estimates SARS-CoV-1's basic R_0 to be 2-4, making it actually "less transmissible than most other respiratory infections and therefore potentially more susceptible to control measures."[188] The mean R_0 of the SARS-CoV-2* is estimated within a range of 3.6-6.1.[189] The differences between the two viruses' transmissibility factors leads to significant deviations in outcomes, and they require two different approaches for containment. While screening for symptomatic people at airports and implementing stricter infection protection and control procedures worked for SARS, COVID-19 needed a more aggressive approach than the one Canadians had previously experienced as successful.
>
> Similarly, Canada followed previous lessons learned when delaying application of travel restrictions. Public health professionals tend to shy away from such restrictions, as they are understood to not work very well.[190] Strict border closures can sometimes delay introduction of cases, but rarely insulate a country fully from a growing health crisis elsewhere. More often, they delay or prevent the movement of critical medical, research, and public health staff that could be used to mitigate spread. While this is the accepted approach, it's possible a more aggressive approach to travel bans in Canada during the early days of COVID-19 could have delayed introduction of some of the initial seeding cases. Although this would not have entirely prevented the COVID-19 pandemic from hitting Canada, it could have delayed their first peak enough that they would have had more evidence and knowledge on which to base their ensuing restrictions.

Lifting of Restrictions. Canada essentially declared the SARS outbreak over in late May, lifting restrictions and allowing hospitals to revert to standard infection prevention and control measures, instead of the enhanced protocols they used to get the first wave under control. This premature lifting of restrictions was, in hindsight, an error, as SARS had been spreading undetected in a vulnerable hospital community. In June, infections again began to climb.

> *Reflections on Canada's COVID-19 Response:* Although the COVID-19 pandemic and its effect on Canada were both much larger than SARS, the Canadian experience in

* Based on data from the Alpha variant, which was predominant in the first year of COVID-19's emergence

both presented similar patterns. The first wave catches everyone by surprise; this surprise is followed by a period of aggressive countermeasures, which in turn lowers case rates. Buoyed by this success, restrictions are lifted prematurely, and a second, larger wave commences. In the words of Dr. Richard Schabas, Chief of Staff of York Central Hospital during SARS, "SARS was not avoidable. We were struck by lightning. Everything after that was [*avoidable*]."

Because of the economic, social, and mental health tolls of public health measures, there is always (understandably) a rush to get back to "normal." However, in both cases the rush to normalcy exacted a devastating toll in terms of preventable lives lost. The urge to jettison the very public health measures that are controlling a disease needs to be resisted; and this is a lesson from SARS that went unlearned in Canada.

Protecting Healthcare Workers. During SARS, healthcare workers were noted to carry increased risk of infection due to contact with infectious patients, and these healthcare worker infections also contributed to spread.[191] Increased emphasis on infection prevention and control aimed at direct contact, respiratory droplets, and airborne transmission routes helped control hospital spread. Negative-pressure rooms, isolation, staff management strategies, and intensive training were used in Canada during SARS. SARS also elevated traumatic stress for healthcare workers, with 29–35% of hospital workers reporting a "high degree of distress."[192] Calls for better psychological care for healthcare workers focused on the mental health impacts of infection control procedures, risk communication, interactions with the media, access to resources for processing stressors, and support from their respective institutions.

Reflections on Canada's COVID-19 Response: It is difficult to entirely take away the mental health effects of death, isolation, and chronic stress on any population, especially the healthcare workers on the front lines of a global pandemic. However, Canada has implemented some programs during COVID-19 that acknowledge the difficulties faced within this professional community. The Centre for Addiction and Mental Health (CAMH), Canada's largest mental health teaching hospital, compiled a website specifically focused on providing resources and support to healthcare professionals.[193] Unfortunately, mental healthcare only addresses one aspect of the threat the workers face—management of the ongoing crisis and after-effects. To truly protect healthcare workers, their physical safety also must be assured through adequate PPE, infection prevention protocols, and supportive employers and organizations.[194] The level of sickness and deaths among the healthcare community and reports on the inadequacy of their protective gear and lack of support from employers demonstrate that insufficient care was taken to protect the most critical asset in pandemic response: healthcare workers.[195]

Conclusion

There is little doubt that Canada was better prepared for COVID-19 than it was for SARS. The complete overhaul of the public health system that followed a deep introspection in the wake of the 2003 SARS outbreak reoriented the country's health emergency management in ways that alleviated many of the shortfalls identified during SARS. Canada's ability to contain the disease inside healthcare facilities likely improved; however, this turned out to be a distraction from fully addressing the potential for community spread in pandemic planning.

During SARS, political decision making at the federal level did not have significant impacts in terms of outcomes. But the scope and scale of COVID-19 made broader measures more impactful than the targeted public health response in Toronto during SARS. Key critics of the Canadian response note their failure to follow the "precautionary principle," which calls for using an abundance of caution in selecting between response options in an uncertain situation.[196] This concept holds that it is better to overreact than to underreact, and demands the use of stricter controls up front, which then can be loosened as more is understood about the health threat. For emerging infectious diseases like COVID-19, this should translate into defaulting to airborne precautions for PPE until it is fully understood how a disease is spread—not using droplet precautions until there is evidence that it also spreads via airborne particles, as the WHO encouraged and Canada followed. It would also suggest stronger border closures and public health measures are advisable in the absence of evidence showing they are not needed. By this measure, Canada did not succeed, as its leadership was slow to adopt an aggressive posture during the initial response.

It is possible that Canada spent so much effort learning from SARS that while they were prepared for another SARS, they were not prepared for its more transmissible cousin, which required much more extensive community-based measures. The lessons from previous SARS outbreaks informed Canada that border closures don't work or are not needed; that stigmatization can lead to violence; that care should be taken not to disrupt the economy; and that controlling infections in hospitals is the critical focus, not addressing community spread. Those lessons led Canadian leadership to apply the precautionary principle toward maintaining the status quo—by applying the least disruptive measures first. These lessons were in line with what worked for SARS, but their experience in 2003 may have given Canada a false sense of security by limiting their perspective on how rapidly a pandemic can get out of hand.

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Learning Lessons: Vietnam's Experience with SARS and COVID-19

By Frances Christine Fisher Veasey, MS, PMP

Lessons Learned from SARS

When a novel coronavirus emerged in China in November 2002, Vietnam was among the first countries to report cases of SARS-associated illness. In February, an outbreak of severe viral pneumonia was detected in Hanoi, with the first confirmed case admitted to the hospital on February 26, 2003.[197] Over the course of 41 days, Vietnam reported 63 cases of SARS, resulting in 5 deaths. Vietnam reported its last new case on April 8, and was declared "SARS-free" by the World Health Organization (WHO) on April 28, 2003.[198]

Vietnam, like other affected countries, faced many challenges during the course of that outbreak. A self-assessment presented in a Ministry of Health (MOH) briefing from July 2020 revealed insights into the lessons Vietnam learned from the experience.[199] Areas identified as needing improvement included case management and contract tracing in the initial stages, the extensive spread among healthcare staff (with around half the total cases affecting healthcare workers), and a limited approach that didn't include a "whole of society" mindset. Limitations of laboratories' ability to confirm SARS (or rule out other agents) with microbiological evaluation led to use of only clinical signs and symptoms of atypical pneumonia to determine case status.[200] Strengths identified in that response included immediate and high-level commitment from the government, and an early and aggressive response. They also cited strong cooperation with WHO and other partners, as well as timely and transparent communication.

In the years since SARS, Vietnam has experienced other outbreaks (including avian influenza H5N1), contributing to recognition that the country is highly vulnerable to future outbreaks due to its large population, high population density in cities, a long land border with China, and limited healthcare resources. This understanding shaped investments to improve Vietnam's public health infrastructure, leveraging internal and external (e.g., WHO, U.S. government) resources to improve laboratory capacity, rapid response capabilities, incident management systems, communication systems, detection protocols, and other critical enablers of effective response.[201]

A full list of investments and preparatory activities Vietnam conducted in the 17 years between SARS and COVID-19 would be quite extensive. From 2000 to 2016, public health expenditures per capita increased 9.0 percent per year, on average.[202] This reflects an increase in public health expenditures at 1.7 times the rate of GDP growth.[203] Examples of such investments, which demonstrate a commitment to continuous improvement and preparedness, are included below.

- **Planning.** Developed and refined overarching Public Health Response Plans and supporting documents to guide response; established public health emergency operations centers at national (2013) and regional (2016) levels; adopted Incident Management System for use in these centers.[204]
- **Event-Based Surveillance.** Worked with U.S. CDC to develop, test, and refine an Event-Based Surveillance system to complement traditional Indicator-Based Surveillance systems. This approach uses unstructured reports that incorporate stories, rumors, travel histories, case histories, and other information about potential health threats, and are

thus more likely to catch an outbreak of a novel disease that may escape detection in a standardized, structured reporting regime.

- **Training.** Trained staff in Incident Management System; participated in the Public Health Emergency Management Fellowship, where countries send public health professionals to the United States to receive specialized, in-depth training; participated in Field Epidemiology Training Program, with multiple graduates (known as "disease detectives") actively working in Vietnam.
- **Testing and Exercises.** In partnership with U.S. CDC, conducted practical exercises of plans, procedures, and capabilities in a five-part drill series in 2017, and a full-scale exercise in 2018 (see Figure 14). These exercises tested Vietnam's response to simulated human cases of avian influenza and MERS-coronavirus, respectively.[205]

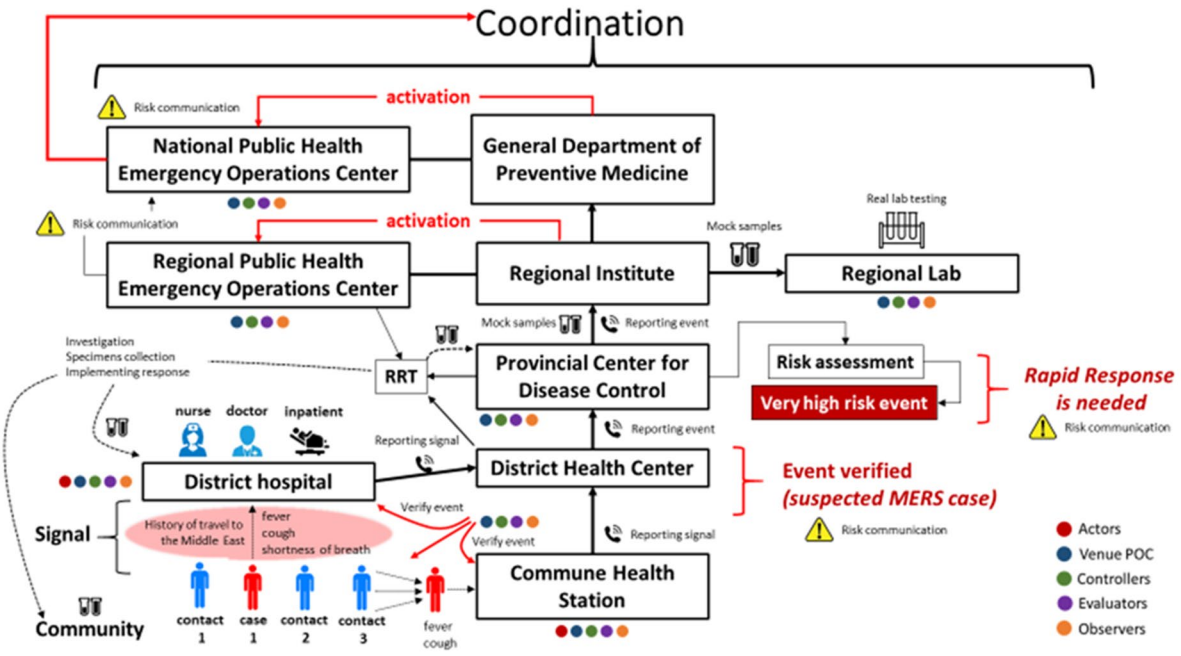

Figure 14. Vietnam's 2018 full-scale exercise was designed to test the public health systems in place to respond to a new outbreak of severe viral pneumonia caused by a coronavirus. (Source: Clara et al. 2021, graphic used with author permission.)

- **International Collaboration.** Joined Global Health Security Agenda in 2014; works intensively with U.S. CDC and WHO on multiple initiatives.
- **Laboratory Capacity.** Invested in laboratory capacity at four regional laboratories; certified multiple province-level laboratories to perform diagnostic testing.
- **Equipment.** Worked with U.S. Defense Threat Reduction Agency to install video teleconferencing equipment that enables regional laboratory institutes and the MOH to collaborate in real time.

- **Rapid Response Teams.** Developed rapid response team capabilities at province, regional, and national levels; coordinated with U.S. CDC for training needs.
- **Infection Control.** Invested in training, equipment, facilities, and systems to improve infection control in hospitals.[206]

As COVID-19 emerged in China in November 2019, Vietnam, as a result of these and other preparatory activities, was poised to activate a nationwide public health response.

Vietnam's COVID-19 Response

Vietnam's first case of COVID-19, a 65-year-old man who had recently returned from Wuhan, China, was admitted to Cho Ray Hospital on January 22, 2020, along with his son, who had not traveled to affected areas. Contact tracing revealed 28 close contacts, none of whom went on to develop symptoms of COVID-19. A week later, the MOH had established a National Steering Committee and took several steps to limit travel from hotspots and prevent community spread (see Table 3).

Vietnam's Ministry of Health reports that their COVID strategy was informed by their experience with SARS in 2003, as well as other recent outbreaks.[207] They set prevention as their first priority, with strong government commitment at the highest level. In mid-January, strict health screening measures were enacted at points of entry to prevent importation, and this was complemented by aggressive early detection activities. Vietnam also focused on three other areas during their response: free treatment for all patients; open and transparent communication; and a proactive, whole-of-society approach. They applied these measures in a flexible and scalable manner, depending on the complexity of the outbreak, with engagement, coordination, and cooperation with WHO and other stakeholders (including local authorities) to encourage high community participation.

Prevention as First Priority. Vietnam prioritized prevention, using a variety of public health measures to contain and prevent spread within communities. These included early detection, use of a "ring-fencing" strategy, and targeted isolation and lockdown for 28 days—in the whole community if there was a cluster of cases, or spot isolation (for instance, one floor of a building or a similar small area) if there was a single confirmed case. They also gradually adopted other community containment measures like school closures, cancellation of public events, mandatory masking, enhanced hygiene, and more extensive lockdowns as needed.

As part of the prevention-first strategy, Vietnam enhanced surveillance with the intent of detecting every case. They expanded the suspect case definition to include any severe viral pneumonia, as well as influenza-like illness (ILI) and severe acute respiratory infections (SARI). They enacted a prioritized testing strategy, using the more accurate but also time-consuming RT-PCR test for suspected cases, close contacts, and people in centralized quarantine facilities and isolation areas, while using an antibody quick test to detect emerging cases in high-risk areas.

The aggressive surveillance and detection approach also included contact tracing not just of the first line of close contacts (F1), but those people's contacts (F2), and then those people's contacts (F3) as well—three tiers of contact tracing, regardless of whether they show symptoms. All three types of contacts were quarantined for 14 days. Centralized quarantine facilities housed all suspect cases, first-tier contacts, international entries, and discharged patients. Second- and third-tier contacts were asked to quarantine at home and report any symptoms. Public health

workers also conducted quarantine and close monitoring of suspected cases and close contacts in the designated/appropriate healthcare facilities.

This commitment to three levels of contact tracing drove the need to manage a large number of people in quarantine. As of early July 2020, with 352 confirmed cases and 27 hospitalized, the scale of effort needed to keep numbers low was considerable. At that time, around 350,000 tests had been administered, with a positivity rate of .09%. Half a million people were being monitored; over 100,000 of these were in centralized quarantine facilities; and over 200,000 suspect cases had already been released after satisfying quarantine requirements.

Treatment Strategy. Recognizing that home-based care is often a major driver of communicable disease, Vietnam developed a deliberate strategy to treat all confirmed cases in healthcare facilities, where staff could follow more rigorous infection control and prevention procedures. They used a tiering system to triage and manage cases: Suspected cases were generally treated at community health stations and mild cases at provincial and district hospitals, with more severe cases transferred to national hospitals as needed. The government also prepared for large-scale treatment needs in the event of broader community spread by activating military and field hospitals. Treatment was provided for all confirmed cases free of charge.

Whole-of-Society Approach. Vietnam prides itself on its whole-of-society approach using not just their MOH, but also a variety of capabilities and approaches that mobilized every part of the country to fight the disease. The Ministry of Transportation assisted the MOH with contact tracing, while the Ministry of Public Safety provided support at the isolation areas. The Ministry of Defence assisted with activities to prevent importation at points of entry. Vietnam partnered with the media to support communication, and also initiated public support programs, like rice ATMs and “free of charge” stores where people in need could get groceries. Many of these stores were actually funded by local companies, not just the government. Volunteer organizations have also contributed to the response. Vietnam applied this whole-of-society approach from the first stage of outbreak, with the intent of mobilizing and utilizing all the local resources available.

Communication and Information Management. Vietnam also had a very robust communication approach. They shared information early and maintained a high level of transparency. They used a proactive strategy of releasing information quickly, right after they had performed a risk assessment. They tried to be transparent by communicating clearly about the virus and the nation’s policy to contain the pandemic, sometimes providing real-time information twice per day. All potential channels (e.g., TV, radio, mobile phones, websites, social networks, hotlines, loudspeakers) were used to share information on symptoms, personal protective strategies, testing sites, and official information sources. Vietnam emphasized timely and transparent communication with the intent to prevent panic and also convince people to believe in and support the government actions. They also made sure to engage the grassroot authorities and social organizations, even down to villages and streets, to assist in providing public health communication and access at the household and individual level. In addition to pushing information out, they also monitored for misinformation and disinformation. They leveraged the police, communication, and technology sectors to monitor, survey, and detect false information as soon as possible. They then strongly penalized anyone who provided incorrect information, through fines, potential arrest, and publication of the names of those providing disinformation.

Table 3. Timeline of Key Milestones in Vietnam's COVID-19 Response from 1 January 2020–31 December 2020.[2]

Date	Event
9 Jan 2020	MOH issues warning of concerning pneumonia in China
21 Jan 2020	MOH gives direction to prepare isolation areas in hospitals and clinics
23 Jan 2020	**First COVID-19 case identified**
30 Jan 2020	National Steering Committee established Visas suspended for Chinese tourists
31 Jan 2020	Mandatory testing and quarantine for travelers from hotpots Nationwide closure of schools; task forces established in hospitals
2 Feb 2020	**Enhanced domestic PPE production**
7 Feb 2020	Test kit developed by Hanoi University
13 Feb 2020	**16 total cases; targeted lockdowns initiated; will continue through March**
15 Feb 2020	Travel from China suspended
19 Feb 2020	MOH issues Guidelines for Infection Prevention and Control of COVID-19 in healthcare establishments
25 Feb 2020	**All 16 initial cases have recovered**
3 Mar 2020	Test kit developed by Vietnam Academy of Science and Technology
5 Mar 2020	Test kits developed by Military Medical University and commercialized by Viet A (a Vietnamese company)
6 Mar 2020	**17th case identified, followed by spread**
10 Mar 2020	NCOVI app launched for sharing information and health status
14 Mar 2020	Closure of high-risk businesses
15 Mar 2020	Travel from United Kingdom and European Union suspended
16 Mar 2020	**Mask mandate**
20 Mar 2020	Borders closed to non-citizens
21 Mar 2020	Mandatory quarantine (international) and health declaration (domestic) for travelers; 88 total cases
28 Mar 2020	Bach Mai Hospital locked down due to 45 associated cases
30 Mar 2020	Survey published showing 62% of Vietnamese feel their government is doing the "right amount"[208]
1 Apr 2020	**National lockdown/border closure**
21 Apr 2020	Launch of Bluetooth-enabled contact tracing app (Bluezone)
22 Apr 2020	**Lifting of national lockdown; other measures continue; 269 total cases**
28 Apr 2020	Thai Duong company launches test kits
4 May 2020	Reopening of universities and middle/high schools
11 May 2020	Reopening of elementary schools
29 May 2020	Domestic flights resume; 327 total cases
15 Jun 2020	Two months since last case from local transmission
1 Jul 2020	Visa issuance resumed for 80 countries; 355 total cases
24 Jul 2020	**99 days without local spread**
25 Jul 2020	**416th case—start of "second wave" originating in Da Nang**
1–31 Aug 2020	Strict lockdown in Da Nang; enhanced quarantine/testing/tracing elsewhere
26 Aug 2020	1,034 total cases
26 Nov 2020	1,331 total cases
31 Dec 2020	**1,465 total cases (.001% of total population), 0 deaths**

[2] Timeline derived extensively from Pollack et al. 2021, "Emerging COVID-19 success story: Vietnam's commitment to containment"

Analysis and Conclusions

This section will review Vietnam's COVID-19 response through the lens of its SARS lessons learned. In fact, the MOH itself reports that their COVID-19 strategy was informed by their experience with SARS in 2003, as well as other recent outbreaks.

Self-Assessment

Vietnam MOH's self-assessment from their SARS experience led to several lessons, which were reviewed in the first section. Here, progress against self-identified lessons learned is reviewed.

Areas where Vietnam felt they did not do well during the SARS outbreak:

Case management and contact tracing. Vietnam significantly improved their case management and contact tracing approaches between the two health emergencies. They implemented a structured, centralized isolation and quarantine system, and issued guidelines for triage and treatment of patients. Their contact tracing for COVID-19 was robust, with hundreds of thousands of contacts identified and monitored.

Spread within hospitals and healthcare staff. During the first SARS outbreak, around half of those affected were healthcare workers, indicating significant spread within hospitals. Following this insight, they invested in infection prevention and control systems that would prevent such spread. During COVID-19, initial evidence seems to indicate that these investments were successful. While some spread has occurred in healthcare settings, a recent study suggests healthcare workers are substantially less affected than during SARS. Of 408 healthcare workers in a major COVID-19 hospital, none showed antibodies to SARS-CoV-2, the virus that causes COVID-19, indicating that few or none of them have been exposed to or sickened by the virus.[209]

Whole-of-society approach was not fully applied. Vietnam felt their response to SARS fell short of mobilizing every resource to fight the disease. For COVID-19, they placed more emphasis on engaging all parts of the national government, private sector, community advocates, international stakeholders, and more in their response.

Areas Vietnam felt went well during the SARS outbreak:

Immediate government commitment at highest level. Strong leadership from government officials is needed to implement an aggressive response. For COVID-19, this was apparent as the Prime Minister visibly promoted Vietnam's approach, with language that engaged and motivated the people. For example, stating that fighting the epidemic is like fighting an enemy. He also communicated that while they may need to make sacrifices in the short term, particularly in the economy, they believe it is worth it to save lives and assure the health of everyone in the country.

Early and aggressive response. Vietnam continued their proactive response, leaning forward to prevent infections rather than waiting for a serious problem to emerge before taking action. They acknowledged that rapid and prompt isolation, contact tracing, and close monitoring are essential to controlling an emerging communicable respiratory illness. Centralized quarantine also reduced transmission in households and the community, and targeted lockdowns helped prevent broader community spread. Despite such a large scale of effort, Vietnam considers their approach cost effective, leveraging their strengths in public health.

Strong cooperation with WHO and other key stakeholders. Vietnam has over the years continued a partnership with the U.S. CDC, through the presence of their country office. They engaged in multiple training, planning, and testing initiatives that led to greater cooperation between the countries. Vietnam also coordinated closely with WHO, as well as stakeholders throughout the country through their whole-of-society approach.

Timely and transparent communication. Vietnam identified communication as a key enabler during SARS. For COVID-19, they similarly emphasized open and honest communications that helped inform the public, convincing them to accept government restrictions and follow public health guidelines.

External Assessment

There is a great deal of literature recounting the lessons learned from SARS, as well as comparative case studies that review common themes across countries. Here, Vietnam's response is evaluated using a framework derived from a report to the U.S. CDC on lessons learned from SARS related to quarantine and isolation. This report from the Institute for Bioethics, Health Policy, and Law at the University of Louisville School of Medicine, aligns lessons learned in three broad categories: legal and public health systems, public health and healthcare infrastructure, and law enforcement and ancillary services.

Legal and Public Health Systems. Effective response requires a clear and effective legal framework for public health-related activities. This includes movement restrictions into and within the country; surveillance, reporting, and analysis of cases; and the ability to mandate compliance with the established measures. In addition to a sufficient legal framework, political will also must be present to create and enforce such mandates. A clear understanding of responsibilities and authorities at different levels of government (from international to local) is needed, as well as coordination among and between those levels. Legal frameworks for restriction of civil liberties during public health emergencies need to be well understood and enforceable if such measures are necessary. Effective response also requires a public health system robust enough to perform the required activities (e.g., surveillance, detection, isolation, reporting, contact tracing).

Reflections on Vietnam's COVID-19 Response: Vietnam's centralized government and one-party political system are generally helpful to the legal aspect of emergency response. The central government maintains a level of authority over provinces, districts, and communes that facilitates coordination when compared to decentralized government with multiple layers of competing legal authorities. The one-party system also reduces political maneuvering against competing political groups that can undermine a coordinated response. Also, while elections are held every five years, in practice the Communist Party has a firm grip on the nation's government, reducing political turnover. This can be very helpful in that it ensures political officials are knowledgeable about the relevant laws and public health systems, as opposed to countries with higher political turnover, where response professionals often have to teach every new leader about how the response systems work, legal frameworks, etc. in order to get the leaders to follow the relevant laws and the systems that are in place.

Conflicts between public health mandates and civil liberties are also less of a concern in Vietnam, where the Constitution stresses not only the rights but also the responsibilities of citizenship. Article 15 states that "Citizens' rights are inseparable from Citizens' duties."[210] Article 38 specifies that while everyone has the right to medical care and protection, this is accompanied by a duty to "comply with regulations with regard to

prophylaxis, medical examination, and treatment." Article 14 also expressly allows restrictions on human rights and citizens' rights for the reason of "community well-being," among others. In part due to these factors, Vietnam is able to enact aggressive public health measures and operate a centralized quarantine operation, which eases the burden of tracking and monitoring hundreds of thousands of people (though it adds the logistics burden of supporting those in quarantine).

Investments in public health infrastructure as outlined above have also contributed to Vietnam's ability to mount an effective response. Recent exercises have helped with coordination, and contributed to the MOH's strong understanding of public health law. Overall, Vietnam's legal and public health systems facilitated their effective response in ways consistent with the lessons learned from SARS.

Public Health and Healthcare Infrastructure. Sufficient capacity and coordination are needed within the public health system at various levels of government to create an organized and effective response. The healthcare system also needs to have sufficient capacity in terms of human resources, facilities, and material resources (e.g., medications, ventilators, other equipment). Most countries lack sufficient public health practitioners, healthcare professionals, facilities, equipment, and medicine to provide the "surge" capacity needed in a large-scale epidemic; epidemic-related infections within the healthcare community exacerbate this problem. Prior planning and coordination among key stakeholders are necessary for a unified response that makes best use of limited resources.

Reflections on Vietnam's COVID-19 Response: Vietnam recognizes that as a low-middle income country, they do not have the medical surge capacity to handle a large-scale epidemic. This understanding has informed their aggressive prevention strategy. While centralized quarantine facilities require significant logistics and support, it is more of a question of administrative capability and less-skilled labor, which are readily available to surge, in comparison to the inability to feasibly "surge" the availability of highly skilled medical professionals, adequate facilities and equipment, medications, and personal protective equipment. Thus, the strategy of aggressive prevention makes sense in view of the existing public health and healthcare resources.

In addition, Vietnam has attempted to make best use of their existing resources by designating appropriate tiers for treatment of mild, moderate, and severe illness. Over the years since SARS, they have improved coordination among the levels of public health organizations (national, regional, provincial, city, community) through deliberate planning and exercises. These efforts, along with the centralized political system discussed above, have enabled coordination and unity of effort in their response activities.

It should be noted that Vietnam's "ring-fencing" strategy, their aggressive efforts to encircle a community outbreak and prevent the virus from escaping past where it already is, is only feasible when overall case rates are low. Tracking three tiers of close contacts can quickly generate a large number of people to monitor. If the outbreak grows past Vietnam's public health system's capacity to track, this aggressive approach will become impossible and broader community measures will be necessary.

Law Enforcement and Ancillary Services. In order to support a public health response that relies on modification of public behavior (e.g., quarantine and isolation for COVID-19), countries will need to provide not only law enforcement for enforcing required measures but also complementary programs that help affected community members comply. For example, public education and communication; a way to replace wages lost due to public health measures; job protection/anti-discrimination policies; and delivery and/or provision of medical supplies and

food are all needed to minimize impact to the community when complying with public health measures. Other aspects of response need to be considered, such as precautions needed for mortuary service and waste disposal, as well as ensuring measures are culturally appropriate and acceptable to various groups within the population (for example, religion, ethnicity, race, and language of different community members should be considered, among others).

> *Reflections on Vietnam's COVID-19 Response:* Vietnam's whole-of-society response has mobilized resources across the country to provide significant contributions to their overall response. The isolation and quarantine centers provide three meals per day for each resident, and have been managing such services for hundreds of thousands of residents. The Ministry of Public Safety has also been used to support isolation areas, and law enforcement was leveraged to assist with information management. While mortuary services have not thus far been overtaxed, this and waste disposal may become problematic if cases surge.
>
> Coordination with local organizations and stakeholders as part of their whole-of-society approach also helps to make messages and interventions more appropriate for local community members. Risk communication principles indicate that it is not just the message that is important—it is also the messenger. Therefore, trusted messengers who are credible in a variety of communities need to be involved in crafting and delivering health information. Vietnam used this principle in engaging grassroots authorities and social organizations to make sure they reached every household and individual. In addition, Vietnam leveraged community-based businesses in providing free-of-charge stores and rice ATMs that help local families and individuals manage the impact of the pandemic and the public health measures intended to contain it.
>
> Vietnam has clearly considered requirements for integration of law enforcement and ancillary services during outbreaks. They have made arrangements for these supporting elements, and they seem sufficient for implementing a prevention-first strategy. It is not clear that these services will be sufficient or appropriate if prevention efforts fail and widespread infections occur, necessitating an even greater amount of support. The scale of the management and administrative challenge also depends on the willingness of people to cooperate. Realizing this, Vietnam has carefully crafted messages that build trust in the government's response, increasing voluntary compliance and reducing the need for enforcement activities. If the government loses trust in any way, this may result in additional resource requirements.

Conclusion

Vietnam has clearly learned the lessons of SARS, which were reinforced over time with other infectious disease outbreaks in the country. Their strategy of prioritizing prevention by aggressively investing resources up front is appropriate given their large population and limited healthcare resources available. Conversely, many other countries hesitated to take early action, and found themselves quickly overwhelmed. Even though a country may spend more resources at the beginning of the outbreak, it can be more cost effective because the disease is caught and addressed at a state when it is manageable, instead of having to implement the broad, region- or country-wide lockdowns seen elsewhere. The measures taken, including strict health screening at points of entry, early detection through aggressive contact tracing and testing, "ring-fencing," free treatment for all cases, open and transparent communication with real-time information, and a whole-of-society approach mobilizing all local resources, have proven effective during the first year of the COVID-19 pandemic.

It is important to note that these activities do not happen spontaneously. They are enabled by the underlying structures (e.g., political system, healthcare capacity) as well as the attitudes and beliefs of the general public, which shape their willingness to voluntarily comply with public health measures. Vietnam benefits from a centralized, stable political system that has over the years invested consistently in improving the country's health systems. The country also benefits from a culture and a Constitution that recognize each person's contribution to collective well-being of the community and country. Both of these aspects were present in the first SARS outbreak, and likely contributed to their successful response then. Fortunately, Vietnam did not rest on its laurels, but committed to steady, incremental progress to build on that success. This commitment to learning from past experiences, combined with cultural and political attributes that facilitate rather than hinder a coordinated response to a health emergency, combined to produce a relatively successful first year of fighting the most significant pandemic since the 1918 influenza pandemic.

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Singapore's Lessons from SARS and the Test of COVID-19

Lip-Heng Chew

Introduction

In *A Defining Moment: How Singapore Beat SARS*, the then Minister for Home Affairs and Chairman, Ministerial Committee (SARS) Wong Kan Seng, described how SARS "tested the resolve of Singaporeans to overcome together *our first major crisis as an independent nation*"[211] (emphasis added). Seventeen years later, the government announced in parliament that COVID-19 posed "the most serious crisis this country has faced since Independence."[212]

With SARS as Singapore's first milestone, and COVID-19 continuing at the time of this writing as a moving goalpost, it is the intent of this paper to discuss if and how the lessons learned during SARS impacted Singapore's performance in its first year of fighting COVID-19 in 2020. While COVID-19 is an infectious disease, a matter of epidemiology, this paper does not plan to have discussions centered on medicine. Instead, the focus is on crisis management, political and public service leadership, strategic choices, and risk communications.

Lessons Learned from SARS

Overview. Singapore's SARS event is comprehensively documented by Chua.[213] The nation's first SARS patient (Patient #1) was admitted on 1 March 2003. For days hospital doctors struggled to make sense of her condition, alerting the Ministry of Health (MOH) on 6 March. It took another week for doctors to be informed when the World Health Organization (WHO) issued a global alert on 12 March. By mid-March, Tan Tock Seng Hospital (TTSH) housed the "Ops Room," where the fight against SARS was monitored and managed. At the same time, MOH formed the SARS Task Force. TTSH was designated the SARS hospital and all cases were directed there.

While Patient #1 survived, those related to her were not so fortunate. Both her parents, her uncle, and her pastor, all of whom had visited her, died of SARS. She was likely infected in a hotel in Hong Kong and returned with SARS, where she directly infected up to 24 cases; in all, some 120 cases were attributed directly and indirectly to her.[214] The same source in Hong Kong would export SARS to Vietnam, Canada, the United States, and Ireland. An estimated 4,000 cases worldwide could be traced to the one individual who infected Patient #1 at the Metropole Hotel in Hong Kong.[215]

The initial days of Singapore's SARS event were focused on hospitals and border control. SARS was elusive, and patients helped spread it between hospitals, where it multiplied. The Infectious Diseases Act was invoked on 24 March, with provisions to impose quarantine. Schools were closed as parents were increasingly worried. Temperature screening formed a key pillar of defense. By April, SARS was receiving attention at the national level with the government activating its cross-ministry senior crisis management team, the Executive Group (EG), and forming the Ministerial Committee on SARS.[216]

Apart from Patient #1 and the hospitals, cases started to grow in April with links to the Pasir Panjang Wholesale Centre; 2,836 persons linked to the centre were put on quarantine on 27 April. By then, Singapore's death count had reached 24. A further eight would die of SARS, including the final two on 22 May, bringing the total cases to 238 and death toll to 33. These grim figures were matched with progress; there had been no hospital infections for two weeks by

3 May. Border controls were increasingly relaxed in Singapore and overseas, WHO took Singapore off the SARS list by the end of May, and the final SARS patient checked out of hospital on 13 July. The MOH announced the eradication of SARS on 16 July.[217]

Following announcement of the eradication of SARS, there were two further alarms. First, a laboratory researcher was infected in September due to lapses in safety. Second, a Taiwanese researcher tested positive on returning to Taiwan. Fortunately, these two cases did not lead to any additional cases.[218]

In all, the most intense actions were conducted in the three months from March to May, with various measures being relaxed in the months afterward. The final Disease Outbreak Response System Condition (DORSCON) step down to a Level Green alert was performed on 1 April 2004, 13 months after Patient #1 presented with an "unidentified pneumonia-like disease."[219]

While the entire SARS episode was unexpected, the Singapore government's response was rather predictable; a highly organized government machine, led by a political party that had held the majority since independence in 1965, moved swiftly to contain and fight SARS. That the SARS crisis happened meant it, or a similar crisis, could happen again in the future, and in such a case it would be imperative to draw on the lessons from the 2003 SARS outbreak and be ready for the future.

Lessons Learned. There is no lack of "lessons" when one does a casual Google search for "Singapore SARS lessons." The search generates over 705,000 results. Many in government, research, and media are interested in the topic of Singapore fighting SARS. This paper will focus on *if* and *to what extent* the SARS lessons were applied during the first year of COVID-19, and if these lessons were effective in the fight against COVID-19. It is self-evident that any lessons from SARS would have to generally follow the official narrative, because the "official" lessons learned from SARS are those that led to "official" review, rethink, and revision of preparedness and approaches to tackling a future episode in Singapore. The critical application of these lessons learned to the COVID-19 pandemic will hopefully alleviate criticism of this paper being biased in terms of Singapore scoring its own SARS report card.

Just how does Singapore operate and learn? The Head of the Singapore Civil Service, Lim Siong Guan (1999 to 2005), explains how Singapore experiments with the single line:

> "Let us **reflect** on what we have that should be
>
> retained,
>
> modified or
>
> abandoned, and on
>
> what we do not yet have that **we should bring in.**"*[220]

Singapore would grade its own performance as a B+, with Vietnam deserving an A for its swift isolation of the hospital. WHO's representatives in Singapore and Geneva were more generous in their appraisal, emphasizing how the Singapore government was totally focused on SARS, communicated candidly, and led the response decisively. Two additional points are worth adding: rallying the community to cooperate with measures and with each other, and motivating healthcare workers to fight on (with five making the ultimate sacrifice). WHO also praised

* Restyled, emphasis added.

Singapore for its efforts in early warning, sharing of data, improving the knowledge of SARS, and state-of-the-art infection control.[221]

The fear of SARS cannot be underestimated. Healthcare workers were avoided to the extent that buses would even skip the stops at hospitals. With panic at the doorstep, the Singapore government managed risk communication by reaching out to the public on all channels: through public campaigns (a regular feature of the government); mass media broadcasts (including a SARS television channel); print (traditional print posters, brochures); and door-to-door grassroots outreach. These were further extended to include feedback channels involving surveys and meetings with community, business, religious, and diplomatic groups.[222] Remarkably, a public survey reported low knowledge of SARS and infection control, but a high degree of confidence in the government. This indicated that, though there was a high level of compliance, more could be done to instill personal responsibility and infection control.[223] A top-down approach may work for Singapore, but developing fertile grounds for a higher degree of resilience needed to be considered.

As can be expected, Singapore never shies away from being critical of itself and learning from experience. Chua lists five points in *A Defining Moment: How Singapore Beat SARS*.[224] First, intra-hospital transmission of SARS could have been arrested earlier if infection control standards were regulated for all hospitals. Second, patients discharged from TTSH should not have been allowed to be admitted to other hospitals, subsequently causing inter-hospital transmission. Third, operations such as closing down Pasir Panjang Wholesale Centre needed to be calculated. As it was, closing down and turning away stallholders made contact tracing very difficult later on. Fourth, the EG and the Ministerial Committee could have been activated earlier—enabling a whole-of-government (WOG) response sooner, and avoiding the initial struggles. The EG was originally set up after the Laju hostage incident in 1974, and only activated on a few occasions in the years following.[225] However, when SARS struck, it became clear that the new threat posed a very different challenge from that of a hostage situation—one that involves no clear boundaries and an ill-defined end-point. It cannot be seen or be negotiated with, is incredibly complex, and is poorly defined. During SARS, the need to separate the health-related measures necessary to fight against a disease and the coordination necessary for a WOG approach became apparent. The direct fight against the disease was overwhelming enough, and the coordination and other functions needed to be separate. In conventional organizational theory, this is somewhat similar to separation between *line functions* (health-related as lead agency or primary) and *staff functions* (coordination or secondary).

Finally, manual records were used for hospital visitor records, quarantine, and contact tracing in the initial days. This delayed both the sharing of critical data between hospitals and the interface with national databases housing addresses and phone numbers. Once decisions were made and resources were committed, technology did make a difference. The command and control system was stood up in two days, and the contact tracing database was operational within two weeks. As an extension to technology, innovation during the crisis created thermal scanners, diagnostic kits, and quarantine tagging devices. The SARS Clinical Consortium further pushed the boundaries of science in sequencing the virus.[226]

Singapore's COVID-19 Response

The first report of pneumonia of unknown cause was issued by the Chinese authorities on 30 December 2019. By the next day, the WHO had picked up the information and reported the news to the press (WHO, *News*). By 2 January 2020, MOH issued a statement expressing awareness and intended measures.[227] On 3 January 2020, temperature screening began at Changi Airport

for passengers arriving from Wuhan. The response was timely, methodical, and showed staff were prepared.

Lessons learned from SARS and H1N1 no doubt contributed to this level of preparedness. The *MOH Pandemic Readiness and Response Plan for Influenza and other Acute Respiratory Diseases* (revised April 2014) is based on these lessons. In particular, the color-coded framework Disease Outbreak Response System Condition (DORSCON) is the strategy developed for how Singapore would deal with an epidemic or pandemic. This framework takes into consideration the disease situation overseas, how fast it is spreading, how likely it is to hit Singapore, and its potential impact on Singapore.[228] The DORSCON framework has four levels escalating in degree of impact: Green, Yellow, Orange, and Red. For each level, there is elaboration on the disease, its impact on daily life, and advice for the public (see Figure 15).

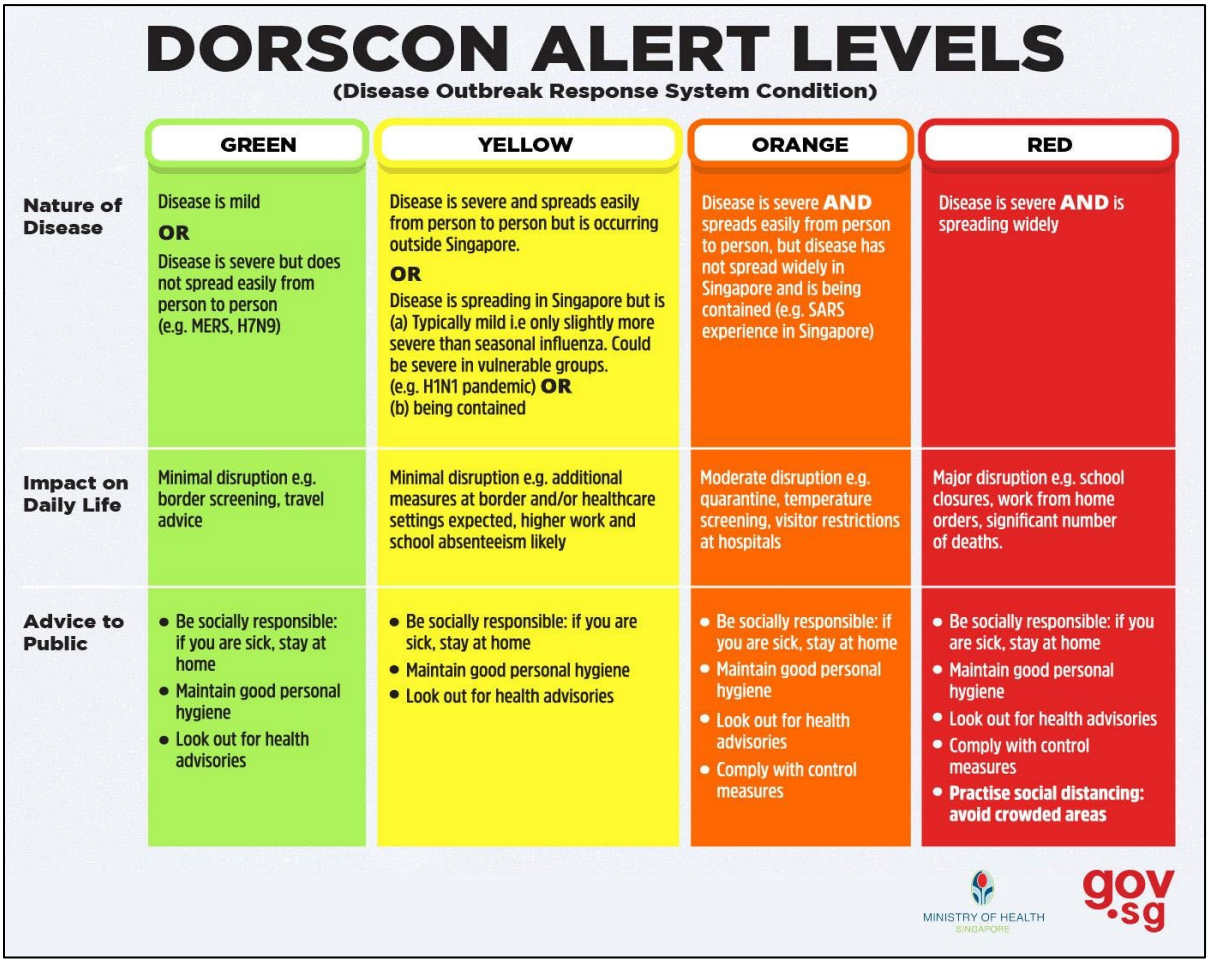

Figure 15. DORSCON Alert Levels[229]

Until the first imported case of COVID-19 was confirmed on 23 January 2020, Singapore was in DORSCON Level Green. Immediately, the MOH Multi-Ministry Task Force on Wuhan Coronavirus met and decided to increase border control activities, among other measures. The DORSCON alert level was upgraded to Level Yellow on 24 January.[230] Once cases with no apparent link to previous cases or to travel from China were reported, the DORSCON alert level was further upgraded to Level Orange on 7 February 2020, with additional precautionary measures such as

temperature screening at school and at work, and emphasis on personal hygiene.[231] Even though there were only about 30 cases of COVID-19 at this time, the upgrade to DORSCON Level Orange was not unexpected given the cautious nature of the Singapore government. Although confirmed cases increased in the following weeks, Singapore's response to COVID-19 was performing well and received praise from WHO and commentators in mid-February and March. What was unexpected and shocking is the exponential rise in the number of cases in April, with the cumulative number of cases exceeding 30,000 by 22 May (see Figure 16).[232] The jump from 30 to 30,000 in three months presents a question: Why weren't the lessons learned from SARS in 2003 and H1N1 in 2009 helping in the response to COVID-19?

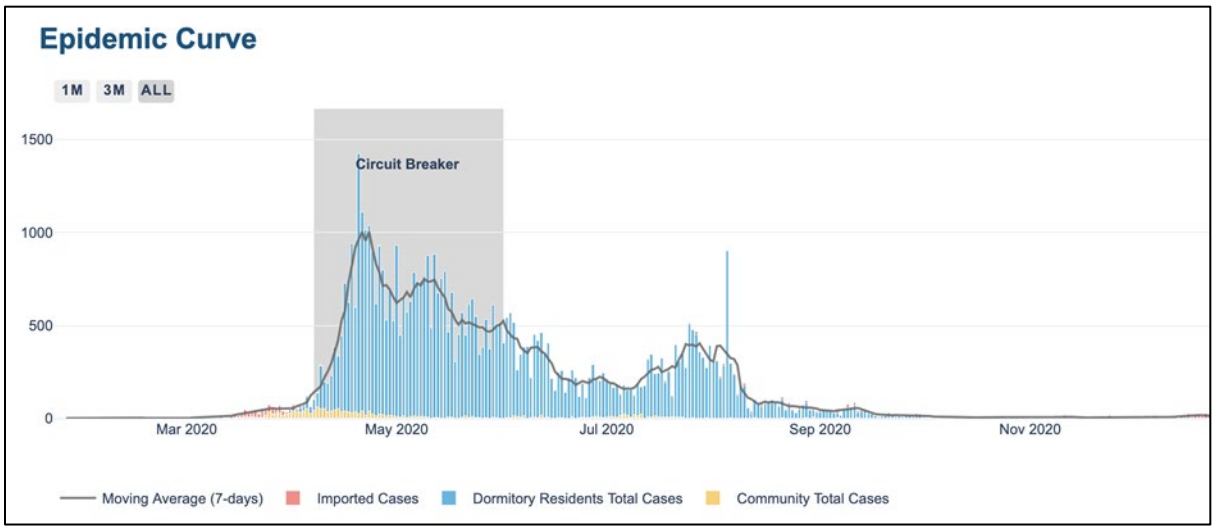

Figure 16. Epidemic Curve of COVID-19 Cases in Singapore, 1 January 2020–31 December 2020[233]

It must be pointed out that the spike in COVID-19 cases was related to foreign workers staying in dormitories or foreign worker dormitories (FWD).[234] This was a severe vulnerability that was pre-existing, where workers were living in very tight quarters under sometimes questionable standards of hygiene. Hospitals, military barracks, and prisons are well regulated and managed; however, dormitories were not run well from a public health safety viewpoint. Because dormitories are regulated by the Ministry of Manpower (MOM), not the MOH, this blindsided public health authorities.

In response to the spike, lockdown was imposed in dormitories, with the military providing medical support services. Healthy foreign workers were relocated to other premises such as military camps and sports halls. Workers were monitored and healthcare services were made available on site. This strategy involved active screening of workers, and separating those who were infected from those who were not. The entire operation was urgent, intense, and massive.

As the cases spiked during DORSCON Level Orange, a "Circuit Breaker" (CB), similar to a lockdown, was introduced on 7 April 2020. These measures kept most non-essential workers at home, away from work and school, only allowing people to venture out for food and essentials. A CB is different from a curfew in that the person is allowed to leave their home, but cannot linger or socialize. The CB was extended through 1 June 2020, with measures to lift the CB beginning on June 2, as a three-phased approach to return to normalcy was announced by the Singapore government for a safe reopening.[235] A timeline of Singapore's response to COVID-19 is presented in Table 4.

Table 4. Timeline of Singapore's Response to COVID-19[236]

Date	Event
2 January 2020	Health Ministry issues statement recognizing the potential threat
3 January 2020	Changi Airport commences temperature screening for arrivals from China
23 January 2020	**First case confirmed in a 66-year-old man from Wuhan, China**
21 January 2020	**DORSCON alert level raised from Green to Yellow**
7 February 2020	**DORSCON alert level raised from Yellow to Orange; panic buying follows**
18 February 2020	Budget Day; government announces various measures to help Singaporeans and businesses
20 March 2020	***TraceTogether* contact tracing Bluetooth app for mobile phones launched**
21 March 2020	First two deaths announced; elderly are found to be particularly vulnerable
23 March 2020	**Cases are peaking at 50 a day; short-term visitors are not allowed to enter or transit Singapore after midnight**
26 March 2020	All bars, cinemas, and entertainment outlets are closed
7 April 2020	**CB measures in place: social distancing and isolation, workplaces and schools closed, work from home and home-based learning instituted; social interactions limited to within the household; food outlets only allowed to provide takeaway or delivery service**
13 April 2020	**Peak of daily community cases** **All FWD placed under lockdown to curb transmission**
14 April 2020	Mask wearing outside of home is made compulsory, a change from an earlier stand of only requiring a mask to be worn when unwell; nationwide distribution of masks followed
20 April 2020	**New FWD cases peak at 1,369**
21 April 2020	CB, originally planned to end 4 May, extended to 1 June; number of unlinked cases has not decreased
2 June 2020	**CB relaxed: Phase 1 reopening begins; some businesses are allowed to resume**
8 June 2020	Essential travel is allowed with China and a few other countries
19 June 2020	**Phase 2 reopening begins, allowing dining at restaurants, and a limit of five household visitors; people are able to reconnect after two months**
10 July 2020	On Polling Day, Singapore's 13th general election resulted in a clear majority retained by the People's Action Party, while the opposition captured the most seats since independence in 1965
9 August 2020	The nation celebrates the "safe-distanced" National Day Parade
14 September 2020	**Distribution of *TraceTogether* tokens starts, an alternative to the same app on mobile phone, with the advantage of being self-powered and always on**
1 December 2020	Singaporeans allowed to use their $100 tourism vouchers to boost local destinations, and provide an alternative to the usual overseas holiday trip
14 December 2020	The first COVID-19 vaccine by Pfizer is authorized for use in Singapore
21 December 2020	The first shipment of the COVID-19 vaccine arrives in Singapore
28 December 2020	**Phase 3 reopening begins, allowing groups of eight to dine together**
30 December 2020	Vaccination begins with 40 staff members from the National Center for Infectious Diseases
31 December 2020	**58,599 total cases (approximately 1% of total population), 29 deaths**

The DORSCON alert levels got everyone on the same page, but the extended timeframe and wider range of measures required two additional adaptations. First, CBs as quick boosters within DORSCON Level Orange were implemented. Second, phased extensions were added post-CBs. The incremental calibration offered by these two adaptations helped to minimize the need to flip-flop between tightening and loosening measures, an important consideration when sustaining public confidence.

Measures involving safe distancing were imposed, with clear guidelines for different periods, regulating if and to what extent people could mingle. Public, work, and practically every social space had certain seats that were marked to prohibit close-proximity seating. Working from home became normal. These measures were far more extensive and longer lasting than experienced during SARS. Similarly, for at-risk individuals or confirmed cases, quarantine orders and stay home notices were issued.

Eventually, efforts to deal with cases in the FDW and to tackle the spread in the wider community through CB paid off. Cases started to fall and measures were relaxed in June. By the fourth quarter of 2020, cases generally flatlined (see Figure 16). The ripples of cases that persisted were found to be imported cases from residents returning from overseas.

As of 31 December 2020, the total number of cases was 58,599, of which 1,811 were imported, 54,506 were FWD based, and 2,282 were community based. Remarkably, there were only 29 deaths in 2020. The small number of deaths may suggest cases were identified early and treated at hospitals that were not overloaded. However, it may also reflect the relatively young age and good physical health of the foreign workers compared to the general population, which includes more vulnerable older/elderly persons as well as those with pre-existing conditions that likely occur less frequently in those who move abroad to work. As of 31 December, there was only one case in intensive care.[237] The fight against COVID-19 continues at the time of writing this paper.

The Seven Pillars of Response. There are various factors contributing to the response to COVID-19. Some have been carried forward from Singapore's experience with SARS. The following are some factors that form the pillars of the narrative of the 2020 COVID-19 fight.

1. *Leadership.* During COVID-19, the Ministerial Committee and EG were activated at the earliest possible time. This provided a highly functional WOG leadership to deal with the crisis. Having a firm connection between political leadership and the public service leadership enabled decisions to be made with speed, allowing the response to move quickly. Holding an election right after the CB further helped strengthen the political base with a new mandate from the people to do what was necessary. The government deferred to current, evidence-based science and medicine for guidance on how to best deal with COVID-19. The only guidance that puzzled the public was the initial advisory of not needing to wear a mask.

   While speed was of the essence during the crisis, response measures put in place were not removed in haste. This was in sharp contrast to many countries where flip-flops in measures occurred week to week. Being prudent was the hallmark of the government. Adaptation of DORSCON alert levels, to include CB, was a strategic move that preserved the integrity of the alert levels while being flexible about applications: DORSCON Level Orange was maintained while actionable features of DORSCON Level Red were applied (e.g., school closure and social distancing). CB measures were the strictest imposed since independence in 1965, and brought tremendous economic and social costs.

2. *Health Front.* On the health front, the SARS experience identified what was needed to improve hospital operations. Past issues with intra-hospital and extra-hospital disease transmission were not a problem during COVID-19. Additionally, all state hospitals were able to admit suspect and confirmed COVID-19 cases. Hospital capacity was further supplemented by first-line Public Health Preparedness Clinics (PHPC). At the same time, bed capacity was increased by making a large number of beds available at repurposed facilities called Community Care Facilities (CCF) and Community Recovery Facilities (CRF). This increased capacity freed up hospitals for the most severe cases.

   Temperature screening was implemented at key entry points of public places such as malls, sports facilities, and office buildings, increasing the likelihood of detecting a person with a fever. Once detected, the individual with a fever would be refused entry and advised to see a doctor. Just as technology has advanced to non-contact temperature screening for monitoring cases at home, wrist devices were made available by authorities that provided notification when an individual was leaving the place of required stay. This involved either Bluetooth or GPS, and mobile phone coverage.[238] This allowed the authorities to monitor compliance 24/7, and notification of exit from the designated place of stay would activate the necessary resources for follow-up.

   Over time, nationwide contact tracing became very challenging with the increase in cases. Mobile phones, carried by nearly everyone in Singapore, helped with the introduction of *SafeEntry,* a program enabling an individual to scan a location-based Quick Response (QR) code on a mobile phone to register entry into any location, such as a workplace, market, mall, shop, or eatery. This was further enhanced with implementation of *TraceTogether,* where mobile phone Bluetooth capability provided continuous sensing of other mobile phones in close proximity.

   Towards the end of 2020, the *TraceTogether* token, a true standalone mobile solution for those who may not own or prefer not to use a mobile phone, was made available to the public.[239] This meant mobile phones could be spared the power drain from always having the *TraceTogether* app on. While these technologies were technically and operationally sound, reception by the public was mixed because of privacy concerns. Public acceptance was also affected when the government clarified—after introduction—that data from tokens could be used by law enforcement agencies as a means to investigate serious crimes or terrorism; a condition that most did not disagree with, but was still resisted by some.[240]

3. *Logistics.* Adequate healthcare supplies and provisions were ensured. At no time was there a real shortage of healthcare-related supplies or public provisions. At first, there were some hours of panic buying, but these were always addressed within a day. Because land-scarce Singapore imports nearly all of its food supplies, food security has been a focus for many decades.[241] Singapore's WOG approach, along with government-linked companies, the union cooperative, and private sector, ensures security of provisions.

4. *Funding.* The availability of funding affects strategic choices relating to emergency response and the economy. In good years, Singapore has consistently saved funds in its national reserves to prepare for crises. The government has only drawn on these reserves once, during an economic crisis, and on that occasion the reserves drawn were fully returned. In the COVID-19 crisis, drawing SGD52 billion (approximately USD38.7 billion) from reserves was inevitable given the cost of response and the state of the

struggling economy. The availability of the funds has played an important role in maintaining the quality of the fight against COVID-19 and Singaporeans' quality of life.

5. *Military as Auxiliary.* The military was a highly scalable force that could be called upon at short notice. This became evident during the CB. For example, 11,000 beds were built for patients with the help of the Singapore Armed Forces (SAF) and Ministry of Defence; 20,000 pulse oximeters were ordered in anticipation of need, before it was documented that rapid desaturation of oxygenation levels in COVID-19 patients could lead to patients' requiring ICU, making a difference in early detection of critical oxygen levels and lowering the number of foreign workers being admitted to ICU; the Defence Science and Technology Agency provided project management and built stations for swabbing and temperature screening, and software for contact tracing; the Singapore Armed Forces Medical Corps provided care to 1,800 patients at a CCF.[242] In this non-military situation, the military forces were aware the tour of duty was temporary, and had no difficulty deactivating once their services were no longer needed.

6. *Risk Communications.* The all-important weapon to fight emergencies involves risk communications. Risk communications was especially daunting in the initial days of the response when there was only a preliminary understanding of COVID-19, and the WHO had not even formalized the name of the disease. The need to wear or not wear a mask was a contentious topic with the conspiracy theorists who believed the reason the government had not encouraged mask wearing was because supplies were running out. Use of traditional mass media channels—television, radio, and newspaper—was maximized. Fear can breed behaviors such as spreading conspiracy theories, panic buying, or mental health issues related to social disconnection. When the population was required to stay home during CB, various aspects of life were disrupted and the Prime Minister spoke to the nation via television.

   What has changed since SARS is widespread use of social media such as Facebook, Telegram, and WhatsApp, with the adoption of the mobile phone by almost everyone in Singapore. Social media has led to the challenge of the fragmentation of shared views and the propagation of "fake news" being perceived as real.[243] This impacted topics relating to enforcement, areas to avoid, and curfew. To counter falsehoods, the government monitored topics receiving significant traction and debunked them via official channels before real problems could arise.[244]

   For communications to be trustworthy, frequency is as important as accuracy. The government's use of a WhatsApp channel proved highly effective, allowing them to message subscribers at least once a day with updates on COVID-19 cases and official announcements.[245] As a subscriber, the writer believes this daily contact reduces the influence of "fake news" and maintains a connection between the government and the general population, who have moved on from closely following televised and printed news.

7. *Regulatory Measures.* Laws were passed very quickly to offer relief to those affected by the crisis, such as the COVID-19 (Temporary Measures) Act 2020, covering relief from contractual obligations, rents, financial distress, and others. The governing party, having a clear majority in parliament, required little time to pass these laws, with some being passed within a day. In general, regulatory and enforcement measures are applied with a light touch, but COVID-19 presented an extreme crisis, and some individuals were charged in court for breaching stay-at-home notices or gathering in numbers exceeding the legal limit.[246] Those who made a mockery of the legal protective measures by

blatantly breaching and sharing on social media were more likely to receive the attention of authorities. Entertainment and dining venues were also dealt with for breaching measures. The message was clear: take COVID-19 protective measures seriously or face the consequences of enforcement measures.

This set of seven pillars forms a WOG and principled approach to fighting a pandemic such as COVID-19. It is fairly robust and is adaptable for attendance to other crises, even outside of public health emergencies.

Analysis and Conclusions

Discussion

Plans and Preparation. An outbreak of infectious disease was recognized as a major concern of Singapore, considering its population density and how fast a disease would spread. The island state is one of the smallest and most densely populated countries in the world at nearly 8,000 people per square kilometer.[247] The uniqueness of Singapore is in its limitations in terms of size and lack of natural resources. A sociologist once remarked that "Singapore, certainly to the sociologist or anthropologist, is one of the most interesting and rewarding societies for study anywhere in the world."[248] The same ruling party (the People's Action Party) has enjoyed majority rule since independence in 1965. The small state does not have layered federal, state, and local government—simplifying government structure. Coupled with the stable government, public service is known to be capable, efficient, and relatively free of corruption.

In hindsight, Singapore's response to SARS could have been better, and the lessons learned helped close gaps in performance, especially those relating to hospital operations. H1N1 in 2009 infected many and killed 18. It came and went like the seasonal influenza, although the WHO classified it as a pandemic.[249] The episode provided further refinement to the Pandemic Readiness and Response Plan.[250]

The Pandemic Readiness and Response Plan was designed for "the next big one." If a replica of SARS or H1N1 were to occur again, the plan would perform with flying colors, but COVID-19 was far bigger than "the next big one." It became increasingly clear that no plan would be good enough. This is not saying that the SARS lessons learned were not relevant or that the preparedness measures in place were not meaningful. If these were not present, the healthcare system would itself be compromised and would not have been able to cope from the start, and case numbers would have multiplied far sooner and far worse than experienced, especially in terms of number of deaths. In this respect, Singapore's response, one that is WOG and principled, performed far better than what a Prussian military commander supposedly said: "*No plan survives first contact with the enemy*."

However, the pandemic pressure pushes against all possible vulnerabilities. In the case of Singapore, the FWD became that one vulnerability that evaporated all the positive results achieved in the initial quarter and overloaded the activated plans and systems. As a result, damage control via CB, as described earlier, was implemented.

The Black Swan. The FWD episode can be labeled a "black swan" event on three counts. First, it is an "outlier" that no one expected, as there was no past occurrence. Second, it caused a severe and negative impact on the fight against COVID-19. Third, while it was an "outlier," it was easy to rationalize afterwards, to explain how the situation had come about.

Acknowledging Singapore's modus operandi, plans for the FWD since the initial outbreak have been mapped out to reform the FWD accommodations and quality of life.[251] Spread of disease at FWDs is less likely to be a problem in the future, but something else may become the next black swan in a crisis. Singapore is ready for "the next big one," but how is it expected to deal with the next black swan event? There are no ready answers, but the pre-existing posture of readiness especially in the form of the EG is worth discussing.

Cross-Ministry Senior Crisis Management Team, Executive Group. Born out of a very unusual hostage situation, the EG is now almost five decades in the making. In that time, it has dealt with a number of incidents, including an airliner hijacking and a major building collapse. As a WOG crisis management group, the EG embodies part of the spirit of the standard Incident Command System (ICS) first developed in the 1970s by the United States to combat forest fires: fulfilling the need for command and control when multiple agencies must work together in an emergency. The nature of ICS suggests a strong military influence—very mission focused, temporary in nature, involving elements that have to come together at short notice, highly scalable, and supposedly resilient to changing situations. The management of threats with the fusion of civilian and military agencies through leadership is a helpful feature of Singapore.[252] This has come about because of a siege mentality, the concept of Total Defense, the transition of leadership from military to civilian life, and sheer pragmatism.[253] Some top career military leaders transition to become political leaders, with a good number filling leadership positions in the public sector. This and the compulsory National Service, requiring all males to serve a two-year full-time service followed by reserve service, ensures that Singaporeans are familiar with military-style leadership, management, and operations. The very social fabric of life has the military woven in, albeit camouflaged to some extent.

Seven Pillars of Response. The military is but one of the Pillars of Response discussed earlier. The seven pillars are distinct, but when combined they support the innumerable response operations required to combat emergencies. An example is the availability of vaccines to the public. Leadership needs to prioritize vaccination for the population; health experts have to agree on choice, efficacy, and safety; the procurement regime has to actively source; funding has to be adequate to get ahead of the queue; and risk communication has to reassure the public. For all the pillars to fall into place, embracing WOG is not a choice, but an indispensable approach to tackling a complex emergency.

Whole-of-Nation. If whole-of-government sounds like the be-all and end-all to crisis response, it would be a shortsighted perspective. "The next big one" may be even bigger than COVID-19. It may overwhelm the best of WOG's preparedness and assets. Singapore's approach to most aspects of life is one often described as the nanny state where the state will decide, provide for, and be accountable. While this has worked effectively over several decades, competing agendas are now fighting over scarce resources and funding. Indeed, COVID-19 has stressed the WOG framework like never before. How human resources were reorganized, such as having grounded airline cabin crews repurposed to fill hospital service positions, deserves credit. However, what is lacking is the extent to which the community is assuming responsibility for its shared journey and destiny. Supporting a position that one is being offered is different from voicing concerns that may lead to change. Beyond WOG is the concept of whole-of-nation. Whole-of-nation should not be confused with the top-down WOG approach of marshaling resources to augment state resources and form a larger pool for response. As the authors of the MOH Pandemic Plan put it:

> "Given the possible variations in severity of a pandemic, the need for flexibility in the response plan to address different scenarios has been emphasized. There is a need to continue engaging and working with the public to raise the level of preparedness at the

> individual, community, and national levels. Through our collective efforts, we will be ready to implement a robust and sustainable national response to a pandemic threat…"[254]

A case in point is the black swan event. The FWD warning signals were already present before COVID-19.[255] Had the government increased its sensitivity to the warnings and attended to the state of the FWD in the years prior to COVID-19, the outbreak in dormitories might have been avoided. In essence, the whole-of-nation approach is not a force multiplier to the mission-critical WOG approach, although any configuration may be possible in a crisis. Instead, whole-of-nation is more attuned to a sensing, thinking, and working platform involving all, and always active. If only one lesson can be added, the whole-of-nation concept is a candidate worthy of consideration.

Another consideration that can benefit from whole-of-nation treatment is technology, as it will be increasingly debated. For example, facial recognition technology can be used for contact tracing, as well as for other unintended uses. On the one hand, authorities will defend such use with the greater good in mind, along with exceptions for unintended uses. On the other hand, individuals will be concerned about the erosion of privacy as technology becomes smarter. Perhaps the intermediary to bridge the concerns of both stakeholder sets lies with the use of *blockchain*, a system where data is logged but the key to release needed data rests with the individual. It is anticipated that the balancing act between what advances in technology can offer and the greater need for personal data protection will be more acute in the future. At some point in time, any pandemic, including COVID-19, can and will tip the balance.

Singapore does not pretend to teach the world about how best to deal with crises. How it conducts its business is often discussed as a model for others, but there are considerable limitations in application. Not many states are as small as Singapore or have a political, public service, and social backdrop similar to Singapore. Similar results may be difficult to replicate elsewhere due to differences in societal and political conditions.

A Global Perspective. While discussion so far has covered "the next big one," the global-perspective "big picture" deserves brief consideration. Expanding the discussion, there are at least two points to contemplate. First, most countries have been severely affected by COVID-19, and the hope is the vaccine will bring an end to the pandemic. In the most extreme situation, COVID-19 may evolve and blow out all attempts to fight it. DORSCON Level Red would be declared in Singapore. How humanity would respond can only be imagined. Second, with this potential calamity and future crises in mind, the need for a global coordinating agency such as WHO is even more pressing. But how states would respond to it is still unknown. The first year of COVID-19 demonstrated how states look inward in distressing times. And perhaps the answer is in how states may emerge collectively from COVID-19, learning from the experience, learning to work with each other, and reforming what is expected of a credible and effective world health organization.

Conclusion

This paper has attempted to narrate Singapore's experience with SARS and its first year of fighting COVID-19. While the lessons learned from SARS were useful and strengthened Singapore's readiness to deal with a similar event, COVID-19 presented a far larger and more complex crisis to respond to. A textbook case of response at first; however, the vulnerability relating to FWD resulted in rapid, exponential growth in cases. Fortunately, leadership at the ministerial level and the EG were prompt in implementing CB to stem the growth in cases and to prevent an overload on the healthcare system. At the end of 2020, a remarkably small number of deaths were recorded. The Seven Pillars of Response contributing to the positive outcomes

were identified as leadership, health front, logistics, funding, military as auxiliary, risk communications, and regulatory measures. The confluence of these seven factors was found to be complementary in its support of emergency response operations in such complex activities as acquisition and distribution of vaccines for Singaporeans.

The spike in cases due to the FWD episode qualified as a black swan event and prompted the suggestion that WOG may be enlarged to a whole-of-nation approach. While the Singapore model of response is tempting to follow, it is cautioned that the state is unusual in its size and sociopolitical nature. Finally, COVID-19 is a global challenge, but this crisis has provided an opportunity for states to learn about working with each other and to reimagine how global health should be organized and operate.

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A View from Emergency Management on Taiwan's COVID-19 Operations

Capt. Tswen-Juh Gu, ROC Navy (Ret.), CEM

Lessons Learned from SARS

Taiwan, an island 70 nautical miles off mainland China, has a population of approximately 23 million. Each year, several million travelers from the mainland and Taiwan visit each other across the Taiwan Strait. Due to extensive business and cultural ties, Severe Acute Respiratory Syndrome (SARS) sources' proximity to the island became a risk to public health and a factor in emergencies in the region. The unprecedented outbreak of SARS from March to July 2003 resulted in Taiwan's public health systems being overwhelmed. Of the total of 688 confirmed cases of SARS, 181 were fatal. The number of quarantined persons reached 151,270. Following Hong Kong and mainland China, Taiwan reported the third-largest number of SARS infections and deaths. The lessons learned from this 2003 epidemic influenced and improved the preparedness of Taiwan's public health system. The following are some significant findings and lessons learned.

Hospital Infection Control. Health workers were at high risk of infection from SARS. Hospital infection control protocols and practices were not well developed, including triage, segregation, negative-pressure isolation rooms, personal protective equipment (PPE), and visitor policies. The local Taiwan Center Centers for Disease Control (CDC) staff and U.S. subject matter expert organized a joint team. Three days after reporting the first suspected case of SARS, the Health Department set up several mobile groups to observe and demonstrate infection control practices to all Taiwanese hospitals.

Surveillance and Reporting. The CDC* established a surveillance and reporting system from local governments to the ministry level, but reporting lagged and was not timely. Each reported SARS case took three days to review. This delay made follow-up tracing more difficult and in vain.

Contact Tracing. Since there is never a vaccine available to suppress the spread of newly emerged infectious diseases, initial response must rely on breaking the chain of transmission through contact tracing, quarantine, and isolation. It is therefore necessary to investigate the suspected or confirmed cases' travel histories, and locations of contact sites and sources. Before the 2003 SARS disaster, Taiwan had not been hit as seriously by pandemics as other countries. Therefore, this containment strategy was still largely theoretical—in the form of a plan that had not previously been put into practice. During SARS, the CDC collected information on the patient's recent close contacts, and local public health workers would pursue tracing the confirmed case and ensuring adequate home quarantine of all close contacts.

Quarantine and Isolation. From the 2003 SARS disaster, the government learned that it was helpful to create two different types of quarantine. Class A included patients, hospital staff, patients' families, and other close contacts, who were quarantined in a health facility. Those involved in a Class A quarantine were placed into 14 days of quarantine. Class B covered travelers from epidemic-affected areas or states. These individuals were required to quarantine for 14 days at home or in designated hotels.

The Government's Response Mechanism. During the SARS outbreak, the CDC did not establish a

* CDC refers to the Taiwan CDC throughout this paper.

command and control center or information networking system to support operations. The data collection and fusion still relied heavily upon paper materials and voice transmission. Based on the 2003 SARS experience and lessons learned, the Ministry of Health and Welfare (MoHW) has improved its response system and expanded the medical workforce for improved disease prevention. The public also learned important lessons, including cultivated habits of keeping social distance, donning face masks, measuring body temperatures, and sanitizing hands. These measures are very crucial to avoid community spread.

Taiwan COVID-19 Response

According to the Lowy Institute of Australia's COVID-19 Performance Index, Taiwan ranked third in the world for its initial response to COVID-19 among 98 evaluated countries, just after New Zealand and Vietnam.[256] As it reached the end of the first year of the pandemic, the total number of confirmed COVID-19 cases in Taiwan approached 1,000 (see Figures 17 and 18). Several foreign media outlets gave a great deal of credit to Taiwan's combat of the COVID-19 disease, and several academic papers explored and described Taiwan's pandemic control efforts. However, all academic papers are analyses from a medical or public health viewpoint. The pandemic crisis has caused a need to alert, coordinate, and mobilize a massive amount of resources; no single action or decision can prevent the spread of diseases.

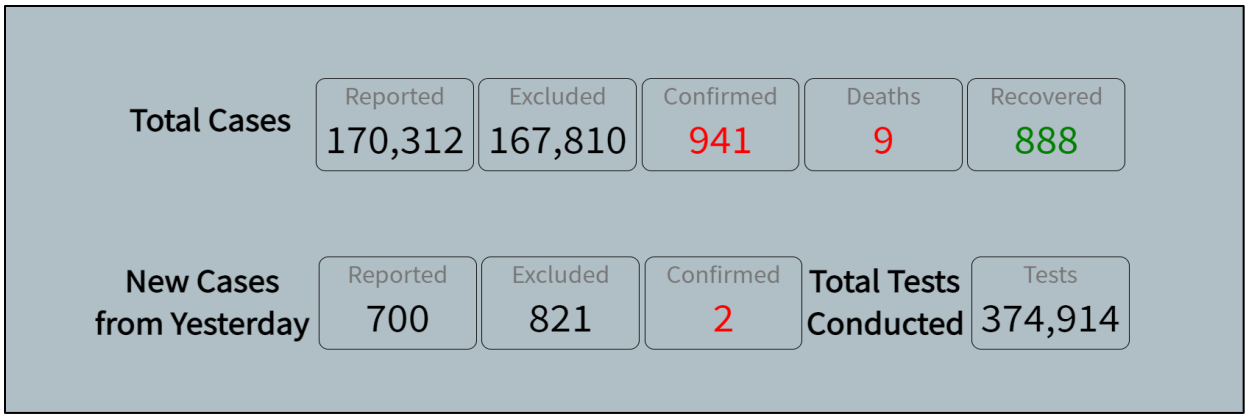

Figure 17. Reported Cases and Test Results (update February 19, 2021)

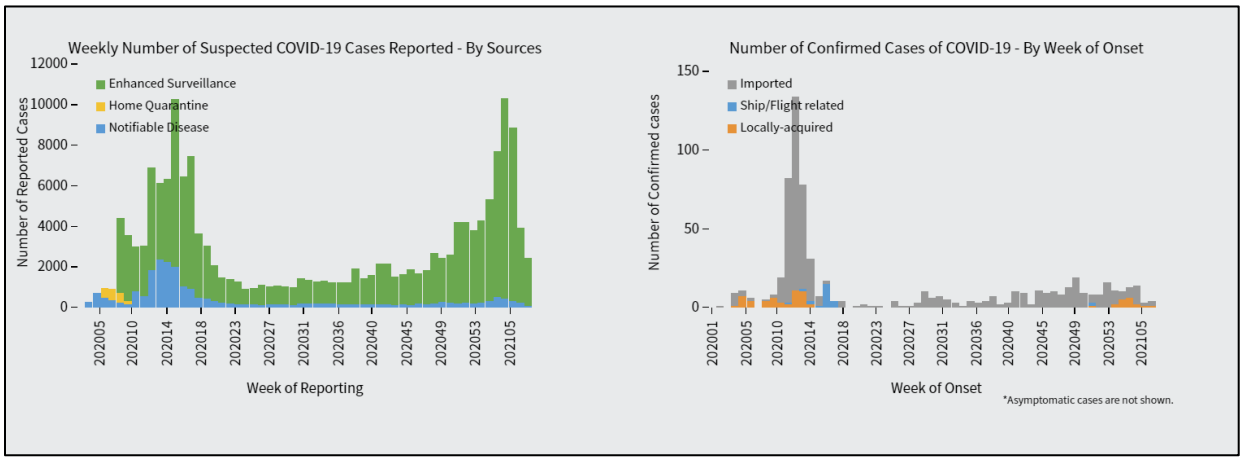

Figure 18. Statistical Data on Suspected and Confirmed Cases

Taiwan's performance in disease control during COVID-19 has its roots in the painful memories of the 2003 SARS disaster. When China reported an identified viral pneumonia outbreak in Wuhan, Hubei Province, to the World Health Organization (WHO) on December 31, 2019, Taiwan took action. On January 2, 2020, Taiwan's CDC response team was set up and began health screening of passengers on board flights from Wuhan.[257] Even though travelers transmitted the disease worldwide in 2020, Taiwan still keeps a low infectious rate. The timeline and response of COVID-19 since December 31, 2019, is shown in Table 5, below.

Table 5. Timeline of COVID-19 in Taiwan

Date	Event
31 December 2019	**China reports unknown outbreak to WHO**
2 January 2020	First response-task force meeting organized; CDC starts health screening inbound flights from Wuhan
5 January 2020	All medical institutions are requested to strengthen infection control measures and enhance diagnosis capabilities
7 January 2020	**China confirms outbreak is due to novel coronavirus**
12 January 2020	Taiwan CDC develops 24-hour and 4-hour laboratory test kits
14 January 2020	Comprehensive nationwide assessment completed in accordance with WHO's Capacities Review Tool
16 January 2020	Wuhan travel advisory elevated to level II; amendment of definition and reporting for suspected cases
20 January 2020	Central Epidemic Command Center (CECC) activated
21 January 2020	First imported case in Taiwan Group tours to Wuhan suspended
28 January 2020	**Two new imported cases and first local case**
29 January 2020	GPS tracking of home-quarantined individuals begins
30 January 2020	Government requisitions masks for central distribution
2 February 2020	Elementary and high schools postpone semester for 2 weeks
11 February 2020	WHO names novel coronavirus disease COVID-19 All passengers required to fill out health declaration card
16 February 2020	20 total cases and first death from COVID-19 reported Testing criteria widened to include anyone with travel or contact history in high-risk group
18 March 2020	**100 total cases**[258]
30 March 2020	300 total cases
28 April 2020	100th day since the activation of CECC
20 May 2020	13 consecutive days without new COVID-19 cases and 38 consecutive days without any local cases
16 September 2020	500 total cases; 7 deaths
1 December 2020	Fall–winter COVID-19 prevention program launched
30 December 2020	Searching and negotiating with vaccine suppliers
31 December 2020	**Taiwan's year ends with 799 cumulative cases (.003% of the population) and 7 deaths**

As related by various sources, Taiwan's achievements include the following COVID response strategies:

Two-Pronged Strategy: Cutoff and Containment. For comprehensive and integrated emergency management, the ability to prevent, promptly detect, and quickly control and contain outbreaks with pandemic potential has never been so significant. Taiwan's status as an island nation helps

with implementing preventive measures, including initiation of travel advisories, suspension of group travel to mainland China, and screening and testing of samples collected at airports and seaports. Cutoff operations prevent epidemic penetration from the airports and seaports, the only available entrance points for COVID-19. Containment operations also included quarantine of all passengers and airline crews from suspected areas. Anyone who had close contact with confirmed cases had a mandated 14-day self-monitoring period at home or at a designated sanitized hotel. The local health department would follow up to monitor, care for, and transport possible symptomatic persons. All travelers are required to report contact histories and tracing. The linkage of personal travel history with residents' National Health Insurance records also enables local public health workers, police, and social workers to trace patients efficiently. Reporting and tracking patients or suspected cases are tasks that fall under the jurisdictions of several government agencies. Information is collected and shared to support this two-pronged strategy. The CDC monitors home quarantine and contact tracing at all times.

Applying Information Technologies as a Tool. Information technology plays a significant role in managing the COVID-19 epidemic in Taiwan. From surveillance, contact-tracing, quarantine, sharing health records, and face mask distribution, all activities utilize newly developed mobile technology. Residents who decide to quarantine at home inform local health workers of their health status through their mobile devices. In collaboration with telecom operators, an electronic security monitoring system was set up in February 2020 to provide the location information of isolated persons. Persons under quarantine must carry both government-provided and private cellular phones together. If the quarantined person exits the designated site, the tracking system will inform law enforcement and other designated persons to clarify the situation. Researchers have identified three measures as critical steps in controlling the spread of COVID-19: contact-tracing,[259] testing, and quarantine or isolation-treatment. Effective execution of these measures hinges on effective leadership and a vital public health infrastructure.

Hospital Infection Control. After the end of the 2003 SARS epidemic, government agencies regulated hospital preparedness and assumed the authority to inspect their stockpiles and other material capacities. They also reviewed the hospital's exercises for practicing triage, quick isolation, controlling patient and crowd routes and flow, establishing medical task forces, stockpiling materials, and the medical care system's operations. Hospital infection control becomes critical when doctors start to treat confirmed COVID-19 cases. Hospitals are highly probable risks where clusters are induced and the disease is likely to spread. According to the nosocomial control guidelines, hospitals must separate patients into two groups: epidemic and non-epidemic. Each group has its designated route, movement, and area to avoid nosocomial infection. One hundred thirty-four response and isolation hospitals have been readied for mobilization since the COVID-19 outbreaks in January 2020.

Public Awareness and Alert. Since the 2003 SARS incident, wearing face masks during influenza season or in crowded public areas has become accepted as social etiquette in daily life. By law, refusal to wear a mask is subject to a fine of US$100 to US$300. Both culture and legalities result in the public voluntarily wearing face masks. Once the government requests that people wash their hands and keep physical distance of 1.5 meters, most citizens follow these instructions in public areas. The government uses budgeted funds to purchase media and broadcasting spots to inform the public; this effort educates residents about wearing masks in confined indoor environments and on all transportation systems (e.g., schools, buses, subways), even during periods when there has been no community transmission.

Analysis and Conclusions

Emergency Management's Role in Pandemic Response. Disasters have happened and affected human society throughout our existence on this planet. Earthquakes, nuclear incidents, and epidemics have often caused several thousand deaths with each occurrence. Managing disasters that cause chaos is crucial to saving lives and property. The fundamental theories of emergency management were derived from hazards-related knowledge, skills, and abilities (KSAs), but it also includes knowledge of the science of hazards and the social sciences involving human behavior—it is a multidisciplinary approach. As a practice, emergency management is a profession, and as an academic program, it is rapidly expanding, improving, and developing.

All-Hazards Approach. Emergency management is the managerial function charged with creating the framework within which communities reduce vulnerability to hazards and cope with disasters.[260] In Taiwan, the government has promulgated three separate laws to cover natural disasters, pandemic influenza, and nuclear incidents. In accordance with the legal system, three government ministries and agencies are responsible for regulating governmental responses to these threats. Each government agency is only responsible for the designated disaster under their jurisdiction. As a result, there is a lack of standard organizational structure, common operational concept, and coordination, whereas an "all-hazards" approach is commonly accepted as an international standard.

Integration of EM Professionals. The MoHW is the lead agency responding to COVID-19, and to date public health bureaucrats have taken a central role in the COVID-19 emergency response. Almost all the leaders of MoHW have extensive medical backgrounds and specialize in medical and public health issues. MoHW has also let fully fledged emergency management professionals get involved, but this involvement could be expanded. It is important for the emergency management profession to connect with public health emergency organizations during protracted response operations. The emergency management organization can initiate an Incident Command System (ICS) to assist health workers and shift some administrative work to other government agencies. This allows the healthcare experts to focus on specific technical issues. Therefore, the closer the relationship between these two groups, the more powerful their combined abilities are to face the challenges of a COVID-19 pandemic. The synergistic effects of collaboration between experts from the two disciplines will undoubtedly result in more robust and dynamic pandemic disaster operations.

Whole-of-Government Response. During the early stage of a pandemic, vaccines are not generally available as governments need time to test and prove their efficacy and safety.[261] Before effective vaccines are available, the most efficient way to prevent the virus from spreading is through non-medical interventions that limit community spread (e.g., wearing facemasks for personal protection and maintaining social distance). Some preventive actions or response protocols can only be implemented with the cooperation of other departments and agencies; in other words, all COVID-19 countermeasures require efforts by an entire administration because COVID-19, like the pandemics to come, strains the capabilities of the public health community. For the first year, the MoHW—in combination with emergency management professionals—was able to organize resources and handle the unfolding situation competently due to the number of confirmed cases being at a controllable level. If the case counts increased exponentially, the current response system would be severely challenged.

Recommendations for Continuous Improvement

Often, the first five steps in mitigating an outbreak are more critical than the final 50 moves. Taiwan deserves credit for controlling the COVID-19 epidemic by taking preventive actions earlier than neighboring countries, and for taking advantage of its natural island geographical features. All of Taiwan's success relies upon holding the front line on border control and quarantine. Could Taiwan still maintain its successful record if some leakages caused cluster spreading and community transmission? Would medical resources be overwhelmed if COVID-19 were to break out in the domestic venue? Today's performance cannot ensure tomorrow's success. In addition to the recommendation to sustain and maintain Taiwan's successful preventive measures, the following are some further recommendations to continue improvements.

Merge Emergency Management into the Public Health Response. Merging emergency management with public health emergency services would combine these two professional and knowledgeable disciplines, resulting in a multiplier effect to improve the quality of emergency operations. This could be accomplished using a widely accepted conceptual framework to serve as the guiding principle. The term "Emergency Response Conceptual Framework" (ERCF) is used in empirical studies to describe how to approach emergency management in a tiered response and work as a team (see Figure 19).[262] The ERCF is a descriptive model that structures the entire response with military-developed Network Centric Warfare theory, notably operational deployment and tactical actions. The emergency management mesh comprises command nodes, operations centers, control centers, and individual nodes.

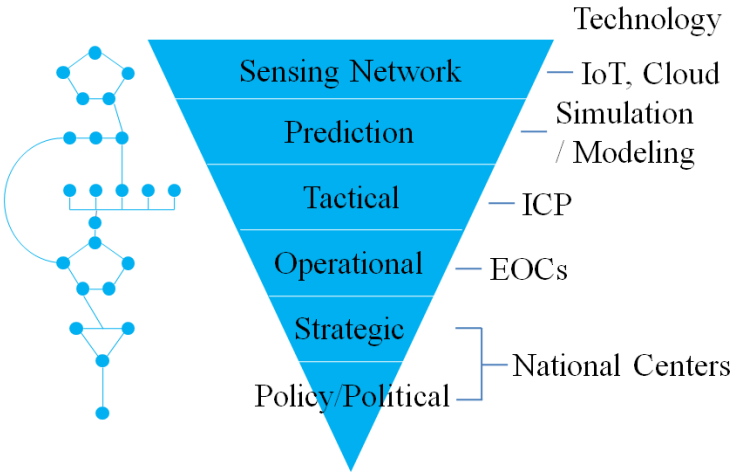

*Figure 19. Emergency Response Conceptual Framework**

The ERCF could be easily adapted to meet a pandemic response. Reporting for clinic, hospital, laboratory, and border control would take advantage of the Sensing Network level's surveillance sensor units. The Prediction level would predict and simulate the possible outcome. The Tactical level would include confirmed case information, contact tracing, quarantine, isolation, and field on-site action. The Operational, Strategic, and Policy/Political levels would consider broader and deeper issues to neutralize the epidemic threat. The knowledge, skills, and abilities used in emergency management would enhance the public health community's capability to face the challenges from COVID-19. Professional emergency managers can support various types of

* IoT refers to the Internet of Things; an ICP is an Incident Command Post; an EOC is an Emergency Operations Center.

gaming and exercises in the preparedness phase to test these operations, plans, and operational concepts.

Public health and medical capabilities on the front lines include domestic and international disease surveillance and situational awareness. People fighting such threats as a pandemic should also consider medical countermeasures to respond to public health threats and evaluate the trained healthcare system's surge capacity to respond to an influx of patients due to a disaster or emergency. ICS, a proven organizational structure in disaster management, creates a proactive approach to help health workers respond to pandemic incidents or planned events.

Leadership and Command Philosophy. The MoHW and the CDC have taken the lead in responding to the epidemic, tasking other government agencies as needed. In 2020, the CECC's tasks included policy and strategy, as well as mask pricing, production, and rationing. This typical central command style has historically shown it can handle a relatively small emergency efficiently and decisively. If the number of confirmed cases is within a limited scope and there is no local community and clustering spread, the centralized authority command works well. However, if more extensive outbreaks should happen, the centralized command and control approach may need to be adjusted into a hybrid central and distributed style—for example, central command and distributed control, or other similar suitable leadership styles. More confirmed cases would flood the CECC or, even worse, overwhelm it to the point that it loses control. Distributed control means that agencies and the local government share more responsibilities and can therefore respond to a larger emergency that would overwhelm a single center.

Expanded Laboratory Capacity and Mobile Capability. Taiwan's laboratory capacity is minimal. With the nucleic acid test, the diagnosis capacity requirements range from 12 laboratories for 520 cases per day to nearly 50 laboratories for around 6,000 cases per day.[263] Again, this works when case levels are kept low, but a domestic COVID outbreak will overwhelm laboratory capacity. Surveillance operations, supported by laboratory tests, provide the fundamental intelligence data necessary to understand and correctly assess the situation. Without raw data, the decision-making process would not be complete. Based on the 2003 SARS experience, this writer recommends the extension of laboratory capacity with rapid and mobile testing. Expanding laboratory tests and offering widespread screenings are both necessary to strengthen the surveillance function at the operational or strategic level when confronting COVID-19 and any other epidemics.

Conclusion

The world is still learning about this coronavirus, SARS-CoV-2. We cannot yet fully predict how an evolving COVID-19 epidemic will behave in a given population. We must understand that even well-prepared communities can be overwhelmed by COVID-19. The updated strategy described in this article explicitly mentions the need to improve the capabilities to detect and respond to COVID-19 attacks, secure dangerous pathogens, improve surveillance functions, and develop medical countermeasures. There should be collaborative and coordinated partnerships and relationships among public health workers, emergency managers, and other jurisdictional units in the domestic environment. Anti-pandemic efforts should further move toward increased cooperation in international society. COVID-19 knows no nationality or borders, and the world is increasingly interdependent. Better international collaboration and information sharing would lessen the impact of epidemic diseases in the future.

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Emergency Management in China: Case Study Through COVID-19

*Victor Bai, CEM 白涛**

Introduction

China is one of the most disaster-affected countries in the world. The Chinese people have been fighting disasters for thousands of years, and much structured and non-structured development has been accomplished since 1950 to improve disaster resilience. A modern emergency management system was formed after the SARS epidemic in 2003 to advance integrated rapid response and recovery capability from health and safety incidents to national security issues, including pandemics. Since then, China's emergency response capability has been continuously improved, with the greatest test yet occurring in 2020.

Toward the end of 2019, a novel coronavirus, previously designated 2019-nCoV, was identified as the cause of a cluster of pneumonia cases in Wuhan, a city in the Hubei Province in central China. This disease subsequently spread throughout China and elsewhere, becoming a global health emergency. In February 2020, the World Health Organization (WHO) designated the disease COVID-19 (coronavirus disease that emerged in 2019), with SARS-CoV-2 as the internationally-recognized name for the virus causing COVID-19.

Lessons Learned from SARS

This section will discuss the emergency management system put in place following the SARS epidemic.

China's Emergency Response Agencies. According to the *Master State Plan for Rapid Response to Public Emergencies* of China, all emergency scenarios are divided into four types, namely natural disasters, industrial incidents, public health emergencies, and social security emergencies.[264]

- **The Ministry of Civil Affairs (MCA)** generally leads natural disaster relief, with support from other related departments.
- **The State Administration of Work Safety (SAWS)**, reporting to the State Council, is the non-ministerial agency of the government of China in charge of the regulation of risks to occupational safety and health. They are responsible for technology disasters such as hazmat, traffic incidents, mine safety, and others.
- **The Ministry of Public Security (MPS)** is the principal policing authority on the mainland of China. It is the agency that is responsible for most day-to-day law enforcement actions. All fire brigades and armed police are managed under the MPS for routing crisis responses.
- **The Ministry of Health (MOH)** of China is an executive agency of the state that plays the role of providing information, raising health awareness and education, and ensuring the accessibility of health services. It continually monitors the quality of health services

* *International Association of Emergency Managers, IAEM China, Shanghai 200433, China; Shanghai United Promotion Center for Emergency Management and Disaster Risk Reduction (SUPER), Shanghai 200433, China*

provided to citizens and visitors in mainland China. The MOH is also involved in the control of illnesses, diseases, pandemics, food safety issues, and coordination of resources and expertise when necessary. The MOH also cooperates and communicates with other health ministries and departments, including those of the special administrative regions and the WHO.

Until 2018, China did not have a nationwide consolidated emergency management department like the U.S. Department of Homeland Security's Federal Emergency Management Agency. To create a consolidated emergency response department, the new Ministry of Emergency Management was formed in April 2018 by merging SAWS with the MPS Fire Department, with 16 functions from various other departments also transferred to the new agency. At the same time, the MOH reformed into the National Health Commission of the People's Republic of China (NHC), and continued to lead pandemic and health emergency management. In 2020, the new NHC was the leading body in most COVID-19 emergency operations centers (EOCs).

Public Health Emergencies. In China, the mass epidemic of SARS in 2003 was eradicated owing to the efforts of devoted Chinese healthcare professionals and direct supervision from the Chinese government. Nevertheless, it was a trial for Chinese public health policy. The aftermath of such a disaster led to reflection and revealed defects in the guidelines for Chinese public health policy. During the consolidation process of the Chinese economy, the government neglected the vital importance public health plays in national security, which led to insufficient investment in public health, negligence of prophylaxis, and a lack of effective measures to deal with emergency cases. These factors were the underlying causes of the mass epidemic of SARS.

The Chinese government realized its mistakes in public health policy and restructured the national public health system in the best interest of the majority of Chinese people. However, there was more pressure besides SARS, even within the health scope. For instance, in 2005, China recorded 4,122 public health emergencies, with a record number of contagious diseases, food poisoning, occupational disease, and negative vaccine responses. This notable increase in public health emergencies, added to the pressure from SARS, contributed to the restructuring of the national public health system.[265]

This increase in public health events not only added pressure on hospitals, but also created a big challenge to the public health system. This led to an appeal to enhance emergency medicine, starting with increased stockpiles of medical resources for better preparedness. In an attempt to improve efficiency and to have tighter control over usage, the government transitioned stockpiles from a distributed deployment scheme back into centralized storage. Unfortunately, this resulted in many lessons to be learned during the 2008 Sichuan earthquake, when practitioners realized it was very difficult to get supplies from a central base location when responding to a widely distributed emergency covering many rural areas, or when ground traffic is disrupted by the disaster. This incident led to discussions on balancing availability and efficiency. However, based on the completed risk assessment, the amount of storage was not increased, and by February 2020 all COVID-19 affected areas reported shortages of medical resources such as PPE.

China's COVID-19 Response

COVID-19 Stages and Government Actions

Under the pressure of COVID-19 impacts in Wuhan, Hubei, and many other affected provinces, the Chinese government kicked off an emergency response led by the State Council. An integrated emergency management framework was coordinated based on key medical and

public health professionals' recommendations that early action had to be taken to control the spread of the disease.

Initial COVID-19 Situation. In late 2019, COVID-19 was first identified amid an outbreak of respiratory illness cases in Wuhan City, Hubei Province, in central China. It was initially reported to the WHO on December 31, 2019. On January 30, 2020, the WHO declared the COVID-19 outbreak a global health emergency, and later, on March 11, 2020, the WHO declared COVID-19 a global pandemic—WHO's first such designation since declaring H1N1 influenza a pandemic in 2009.

In the early stage of the outbreak, Shanghai United Promotion Center for Emergency Management and Disaster Risk Reduction (SUPER) and the International Association of Emergency Managers (IAEM), China, tracked all confirmed cases by city and mapped disease control methods (e.g., lockdowns) during the first quarter in 2020 (Figure 20). Before February 2020, COVID-19 had already impacted China's medical resources in the central area. The Spring Festival of 2020 (January 10 to February 18), during which people undertook 1.476 billion[266] migrations, occurred as COVID-19 spread widely in China. Traffic data shows most potentially infected people left Hubei to go to Shanghai, and to Guangdong and Hainan Provinces. This surge in cases revealed many issues with Chinese public health and challenged the health emergency management system.

Figure 20. Spread and Lockdown in China by February 2020. (Source: SUPER China)

China's Actions Fighting COVID-19. Early reaction to an emerging disease is important because protective measures that reduce the transmission rate can lower the total number of persons infected at the epidemic's peak, so the healthcare system's capacity to treat patients is not exceeded. An emergency response plan that enacts protective measures and targets resource management at an early stage has a better chance of lowering peak demand so the healthcare system's capacity is not exceeded. Effective control thus gives the healthcare system a better chance to overcome the emergency.

China's central government enacted a *Fighting COVID-19: China in Action* campaign with coordinated prevention, control, and treatment through the whole country. [267] Key tenets of this campaign included:

- Centralized command,
- A tight prevention and control system involving all sectors of society,
- An effort to treat patients and save lives at all costs,
- Release of information in an open and transparent manner as required by law, and
- Science and technology as the foundation of efforts.

The Chinese government assembled task forces to respond and mobilize the whole country to fight the epidemic. They also worked to coordinate prevention and control with social and economic development. In a review of all these actions, the Chinese government recognized the following five stages in the first half of 2020.

Stage I: Immediate Response to the Public Health Emergency (December 27, 2019–January 19, 2020)

The Chinese government took several actions in the immediate response period, including lockdown of Wuhan and Hubei, as well as travel-focused control actions such as pre-screening before departure/landing, QR code tracking through Alipay Health Code app (green status moves freely; red or yellow are required to report to authorities), and multiple checks for health status.

Stage II: Initial Progress in Containing the Virus (January 20–February 20, 2020)

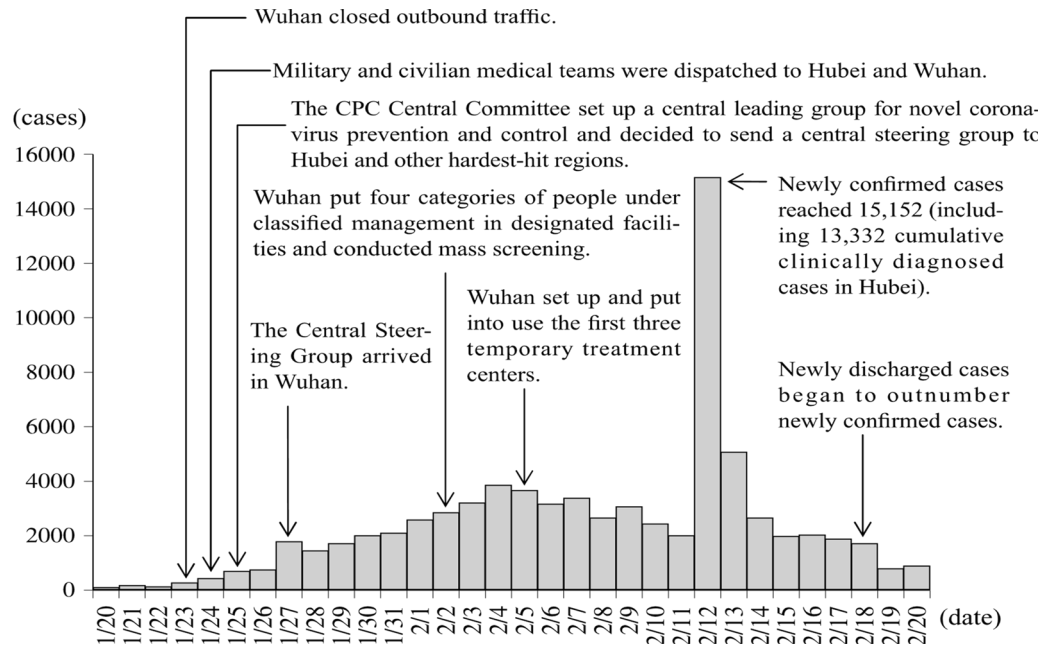

Figure 21. Daily Figures for Newly Confirmed Cases on the Chinese Mainland. (Sources: SUPER and IAEM China)

In an attempt to control the disease, the Chinese government implemented significant lockdowns, shutting down large sectors of the economy (Figure 21). These solutions had significant socioeconomic impacts, but from data of confirmed cases and death rate, they were considered effective in controlling the disease.

Stage III: Newly Confirmed Domestic Cases on the Chinese Mainland Drop to Single Digits (February 21–March 17, 2020)

China had made significant progress: The rapid spread of the virus had been contained in Wuhan and the rest of Hubei Province, the situation in other parts on the mainland had stabilized, and the daily figure for new cases had fallen significantly through mid-March. As the situation evolved, the Communist Party of China (CPC) Central Committee decided to coordinate epidemic control with economic and social development and organize an orderly return to normal work and daily life (Figure 22).

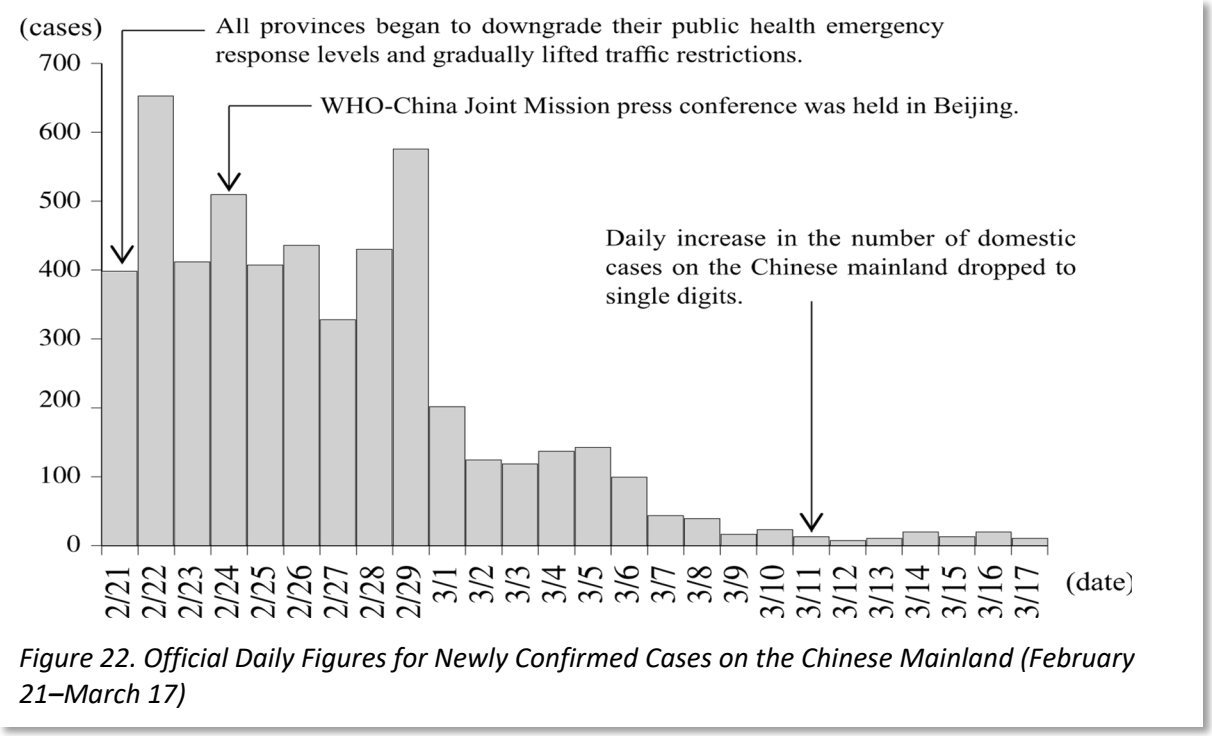

Figure 22. Official Daily Figures for Newly Confirmed Cases on the Chinese Mainland (February 21–March 17)

Stage IV: Wuhan and Hubei—An Initial Victory in a Critical Battle (March 18–April 28, 2020)

The spread of COVID-19 on the mainland was initially halted by lockdown of communities (cities near Wuhan, and even the province of Hubei), in addition to mandatory face mask requirements and limits on movement by QR code tracking. Finally, restrictions on outbound traffic from Wuhan City and Hubei Province were lifted, and all COVID-19 patients in Wuhan hospitals were discharged. China won a critical battle in defending Wuhan and Hubei against COVID-19, which was a major step forward in the nationwide virus control effort.

During this period, sporadic cases were reported, and more infections were caused by inbound arrivals carrying the virus, which continued to spread overseas. In response to the evolving COVID-19 dynamics, the CPC Central Committee adopted an approach to prevent the coronavirus from entering the country and to stem its domestic resurgence. Efforts were made to consolidate

gains in virus control, promptly treat cluster cases, and get the country back to work sector by sector. Care and support were also given to Chinese citizens abroad (Figure 23).

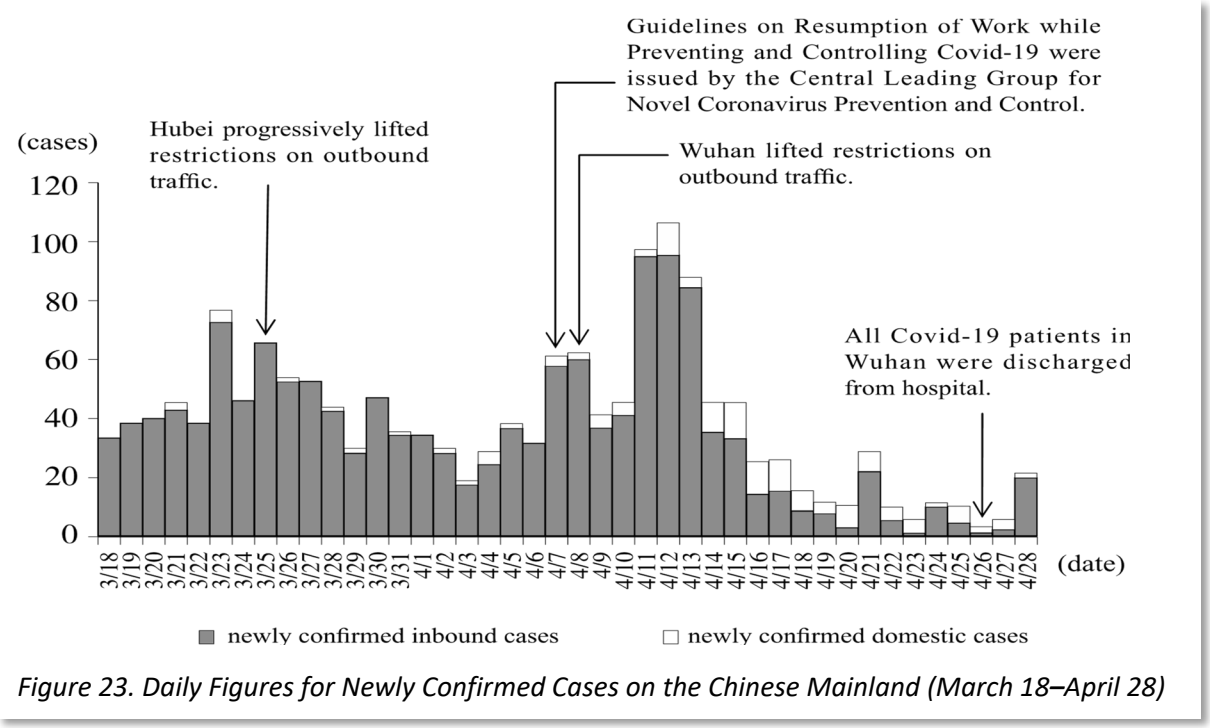

Figure 23. Daily Figures for Newly Confirmed Cases on the Chinese Mainland (March 18–April 28)

Stage V: Ongoing Prevention and Control (Since April 29, 2020)

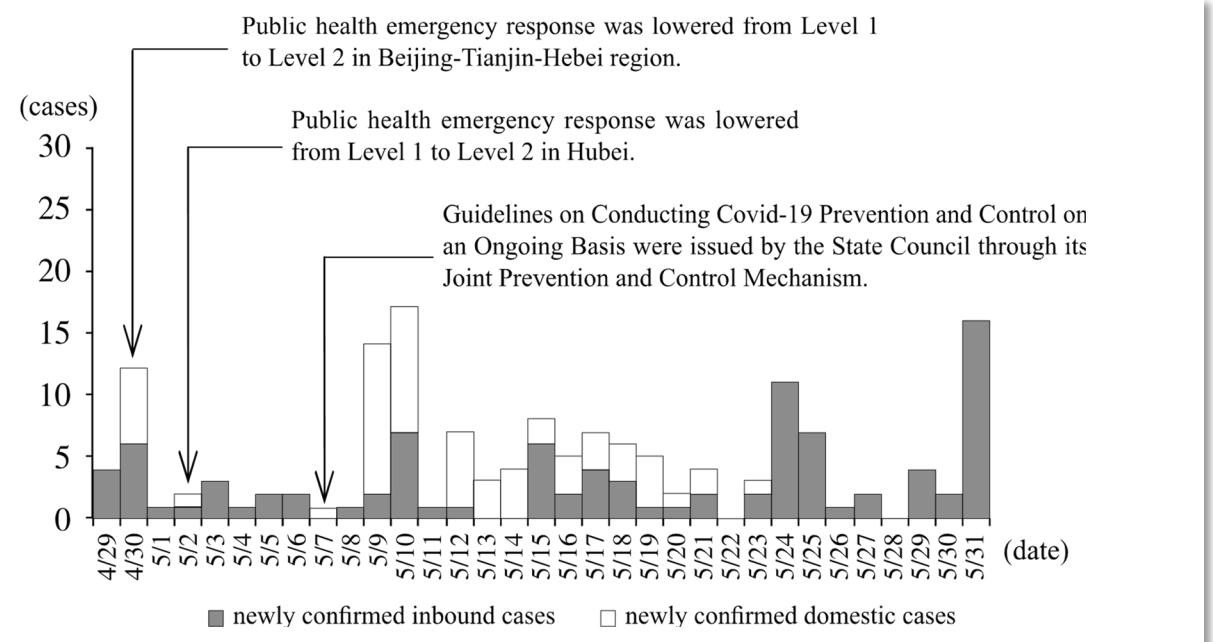

Figure 24. Daily Figures for Newly Confirmed Cases on the Chinese Mainland (April 29–May 31)

Sporadic cases continued to be reported on the mainland, resulting in case clusters in some locations. Inbound cases were generally under control. The positive momentum in COVID-19 control had been locked in, and nationwide virus control at this point was conducted on an ongoing basis. China made vigorous efforts to resume work and reopen schools. The ongoing control measures passed the test of peak travel during the Labour Day (May Day) holiday week (Figure 24).

Table 6. Chronology of Situation and Reaction in China

Date	Event
1 Dec 2019	First confirmed case, according to *The Lancet*; hospitals in Wuhan receive patients with symptoms
Stage I: Immediate Response to the Public Health Emergency (December 27, 2019–January 19, 2020)	
27 December 2019	**Wuhan Yu Fu Hospital receives the third patient from the year-round South China seafood market; 29 people transferred to Gold and Silver Beach Hospital after diagnosis** **Dr. Zhang Jixian first reports a suspicious outbreak to the Jianghan District CDC**
30 December 2019	Hubei Province and Wuhan City launch investigations and case searches
31 December 2019	**China notifies WHO of "pneumonia of unknown cause" report in Wuhan** **Wuhan Concord Hospital sets up a respiratory infectious disease quarantine area**
1 January 2020	South China Seafood Wholesale Market closed
3 January 2020	**China begins regular briefings with WHO** **China notifies the WHO, United States, and neighboring countries of the outbreak with the gene sequencing prepared**
10 January 2020	Spring Festival travel begins China announces the genetic sequence
11 January 2020	Wuhan reports no medical staff are infected and no evidence of human transmission CDC China provides PCR testing reagents to Wuhan
19 January 2020	Nine nurses from Wuhan Concord Hospital are diagnosed on the same day The National Health Commission sets up a leading group for the response to the pneumonia epidemic
Stage II: Initial Progress in Containing the Virus (January 20–February 20, 2020)	
20 January 2020	Total number of confirmed cases in Hubei is 198; cases are confirmed in other provinces and cities **Respected Chinese doctor Zhong Nanshan publicly announces that "human-to-human" transmission is occurring** Agent is listed in Class B infectious diseases, with control measures for Class A infectious diseases put into effect
21 January 2020	Hubei Province holds a Spring Festival group meeting Establishment of a joint prevention and control mechanism; WHO sends a team to Wuhan
23 January 2020	First fatality outside of Hubei Province **Wuhan city lockdown; Hainan Provincial Committee sets up a provincial leadership group**
24 January 2020	Hainan Level 2 emergency response
27 January 2020	**Hainan EOC is set up**
30 January 2020	Cross-border trains in and out of Hong Kong are suspended China requests emergency production of medical supplies
3 February 2020	22 national emergency medical teams mobilized to build a temporary hospital in Wuhan

Date	Event
7 February 2020	Disease tentatively named new coronavirus pneumonia (NCP)
Stage III: Newly Confirmed Domestic Cases on the Chinese Mainland Drop to Single Digits (February 21–March 17, 2020)	
22 February 2020	**An international team of experts led by WHO travels to Wuhan** NCP name is revised to COVID-19, aligned with the WHO
26 February 2020	433 new confirmed cases and 29 new deaths Hainan Province stands down emergency to Level 3; response level is lowered in 13 provinces and cities across the country
29 February 2020	Beijing adds two new cases of imported new coronavirus pneumonia from abroad China–WHO COVID-19 Joint Study Report released
12 March 2020	**China's current epidemic peak is passed**
16 March 2020	First batch of aid from China arrives in Serbia **New coronavirus vaccine approved to start clinical trials**
Stage IV: Wuhan and Hubei—An Initial Victory in a Critical Battle (March 18–April 28, 2020)	
26 March 2020	China announces entry of foreigners on valid visas will be suspended effective March 28th **All persons coming to Shanghai are under quarantine and health observation for a period of 14 days**
27 March 2020	Wuhan Rail Transit partially resumes operations
28 March 2020	**All allowed entry if showing a green code and normal body temperature** Domestic passenger flights resume from other airports in Hubei Province, except Wuhan Tianhe Airport
29 March 2020	Dalian city adds two new confirmed cases of imported new coronavirus pneumonia, and reports a total of seven confirmed cases of overseas imported new coronavirus pneumonia China informed the spread of local outbreaks has been blocked; should continue to guard against imported cases from abroad
2 April 2020	108 people complete the new vaccine test
8 April 2020	**Hubei Province informed they have no high-risk cities; Wuhan is unsealed**
27 April 2020	The number of confirmed cases of new coronavirus pneumonia exceeds 300,000 worldwide China's fourth new coronavirus vaccine approved to start clinical trials
Stage V: Ongoing Prevention and Control (Since April 29, 2020)	
2 May 2020	Emergency response level is stood down in Hubei
7 May 2020	**All high-risk areas in the country are cleared**
19 May 2020	Jilin city active screening confirms one case Clinical trials are conducted in China on four inactivated-virus vaccines
17 June 2020	Beijing reports 21 new locally confirmed cases; Beijing outbreak rebounds
22 November 2020	New local cases in Zhangjiang town in Pudong, Shanghai
24 December 2020	China suspends round-trip flights between China and the U.K.
31 December 2020	**87,071 cumulative cases (.006% of population) with 4,636 deaths reported**
1 Jan 2021	**Vaccination begins with China's first new coronavirus vaccine**

China's Emergency Management Organization

Behind all these actions, we can study how China's emergency management system works. The "whole-of-government" model is one significant character of China's emergency management system handling COVID-19, as well as other emergencies.

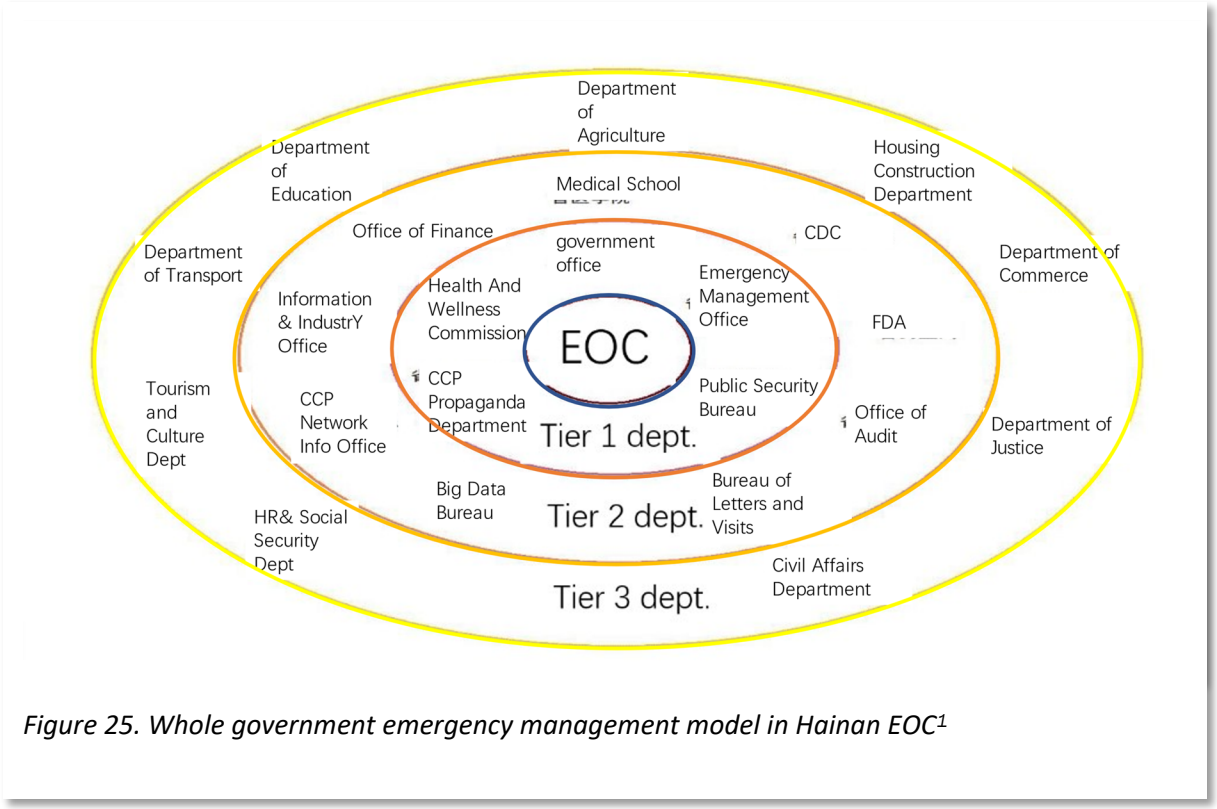

Figure 25. Whole government emergency management model in Hainan EOC[1]

The model in Figure 25 clarifies responsibilities among the central, departmental, and local governments and promotes an integrated disaster administration management system, namely before, during, and after a disaster to promote the integration of disaster preparedness, emergency, recovery, and reconstruction. From the perspective of the relevant disaster departments, it emphasizes the harmonization of governments, enterprises, and communities to promote the integration of disaster capacity construction, insurance, and relief. The three types of integration mentioned above are the core content of China's integrated disaster risk governance.

In other words, this model emphasizes that, under the guidance of scientific solutions and in terms of the dynamic and non-dynamic actions in the emergency process, it is essential to construct the system, mechanism, and legislation for integrated risk governance. The objective is to unite the governments, enterprises, and communities as organic entities during the whole emergency response process and achieve the emergency management goal.

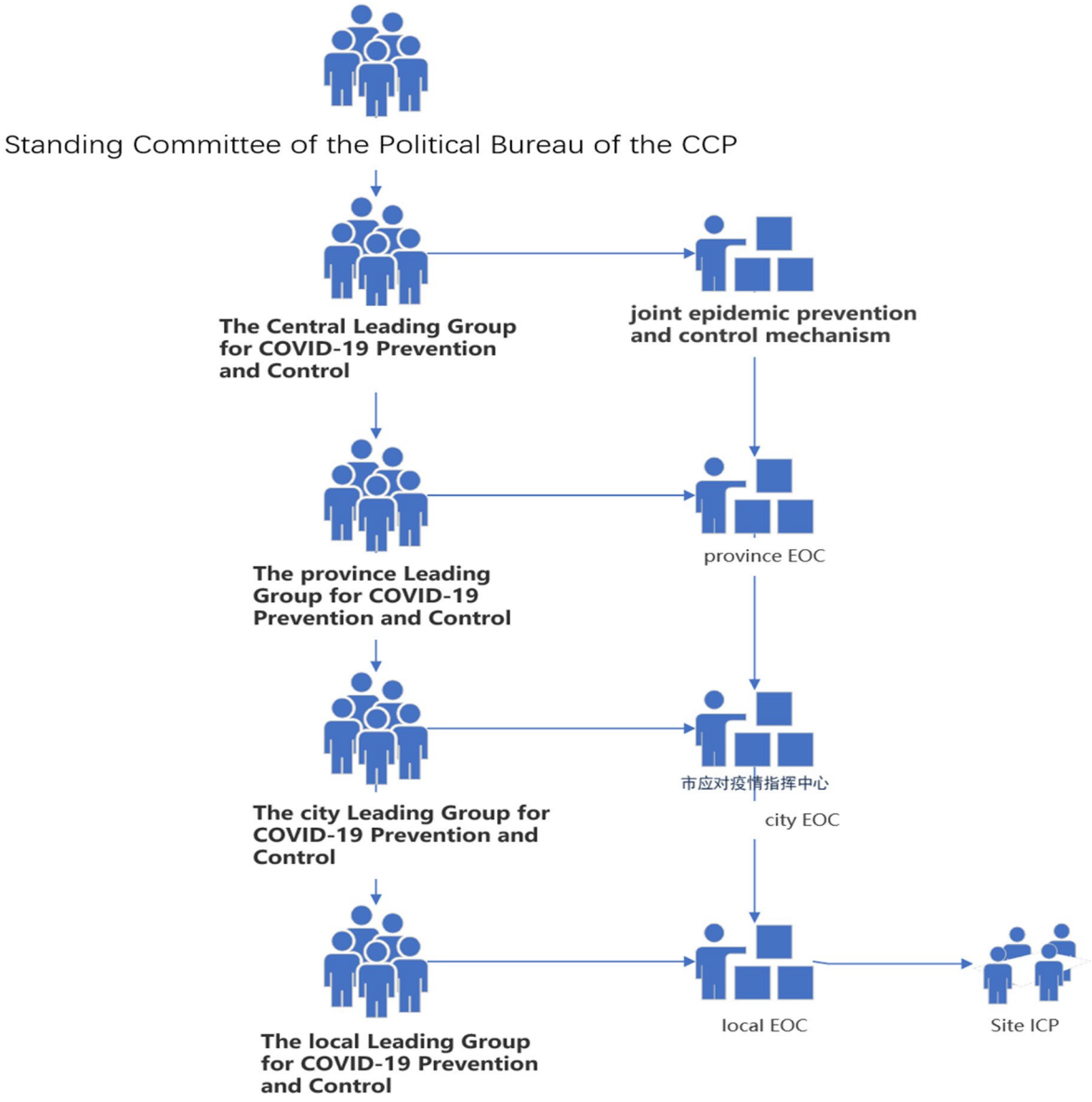

Figure 26. China's Integrated Emergency Management Structure with the Party Leadership

Integrated Emergency Management Model. China's government established one big emergency management organization for COVID-19. This comprehensive emergency management structure is using a system similar to the Incident Management System (IMS) used internationally, but with models adapted to the Chinese context.

From the beginning, the response to COVID-19 was a top-down initiative, triggered by the central government from Beijing. Like other disaster response organization methods, it implemented two command lines working in parallel: one command chain from the Chinese Communist Party and the other from the state council (Figure 26). However, when this command structure goes down

to the city level, these two command lines are merged into one to speed up operations. For example, in Haikou city, the capital of Hainan Province, the Party Secretary of the city was giving a brief to the city as the EOC director (a role usually played by city government), while the city mayor took the deputy role inside the party leader group. Therefore, the party leadership is merged with the city EOC to run daily operations. On the EOC schedule, there is only one big briefing session with the party and municipal officers joined together, but at the province level and above, there are two briefing sessions: the first briefing is for party leaders, and then information from that session is passed to the province EOC in its session.

In Hainan Province, the EOC system has five layers, from the province level down to the village level. Each layer has a director and a party secretary leading together or merged into one person. This operational structure is called "FF," which stands for the five levels of secretaries fighting the pandemic. The party members considers themselves pioneers in the fight against COVID-19.

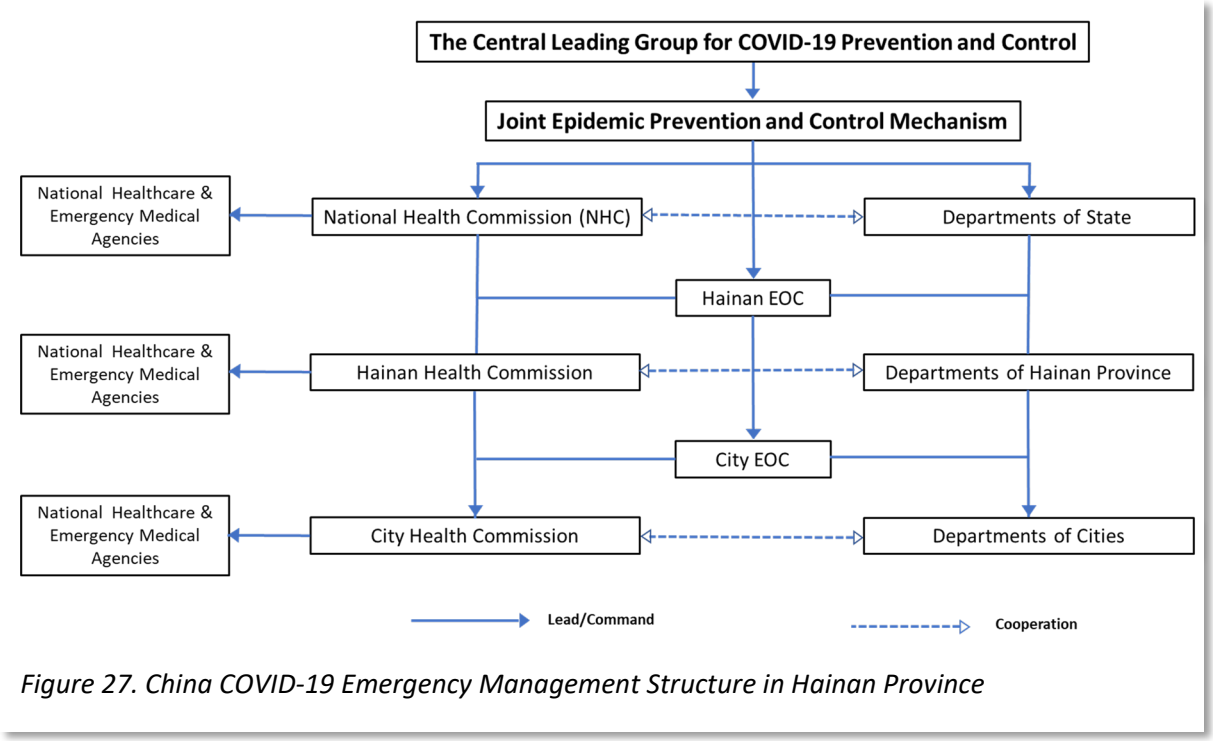

Figure 27. China COVID-19 Emergency Management Structure in Hainan Province

Analysis and Conclusions

To enhance emergency management and implement the government's functions entirely, the new Ministry of Emergency Management at the national level was established in April 2018. It works as an operation nexus, taking charge of the daily operations of national emergency management, responding to public safety incidents, collecting real-time information, and harmonizing the related departments. Since its establishment, like FEMA in the 1970s, the new department has gone through the Tuckman Model's organizational stages: forming, storming, norming, and, finally, performing. This section will discuss current management approaches, particularly as adapted in Hainan Province, and recommend enhancements that would improve China's response capabilities if adopted more broadly.

Hainan EOC. In China, most of the pandemic EOCs are led at all levels by the National Health Committee. Hainan Province is the only jurisdictional EOC led by the Provincial Department of Emergency Management. The Hainan EOC was formed during the Chinese New Year of 2020, and unlike other provinces, not only was its formation initiated by the emergency management department, but it also has adapted the IMS standard for emergency operations. Figure 28 shows the Hainan Pandemic EOC organization chart in February 2020, which has similar elements to an EOC structure in FEMA, though it is customized for the Chinese context. This model has more than the four sections used in ICS, with different titles, and a flatter organizational structure with a larger span of control. It includes Public Information Officer functions (Media, Social Management), a Logistics section, and Emergency Support Functions (e.g., Medical, CDC).

This model is unique in China, and is referred to as China EM HN Model. This HN Model has two concepts: (1) H is an operational process during emergency status, which covers response and recovery phases of the emergency management cycle; (2) N is a complete comprehensive emergency management life cycle that covers all four phases, include mitigation and readiness. The HN Model integrates EOCs at the provincial level, and several regional operation centers (ROCs) distributed in the province at pre-defined locations. There are also many department operation centers (DOCs) such as 119 for fire rescue, and 120 for emergency medical, etc.

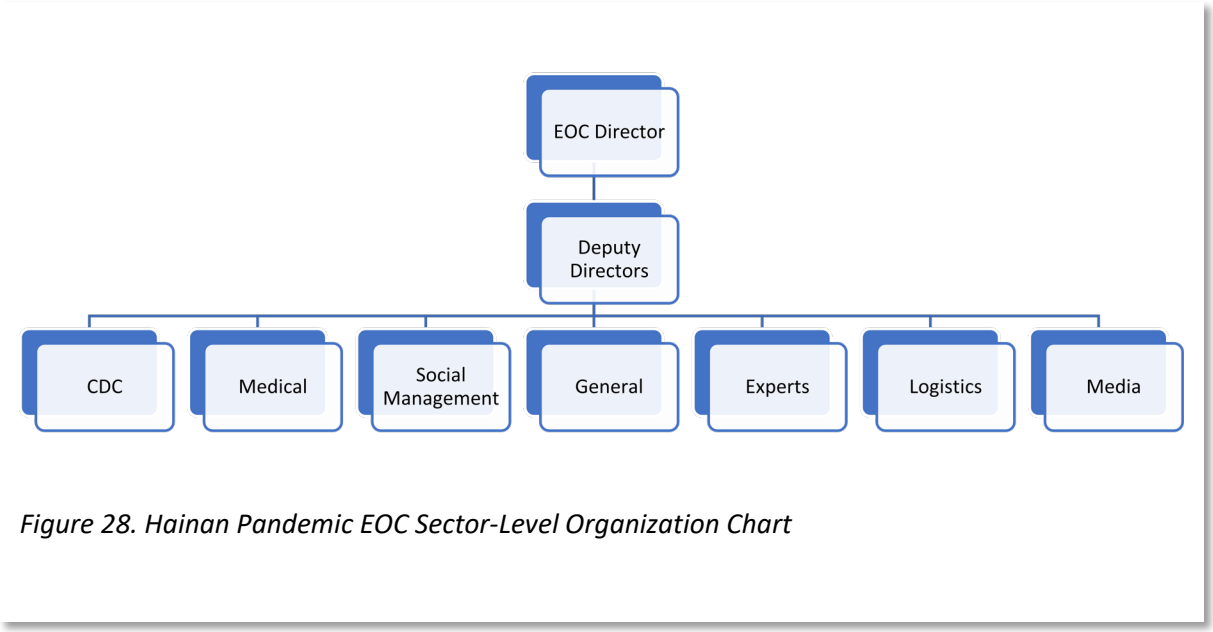

Figure 28. Hainan Pandemic EOC Sector-Level Organization Chart

H Model. The Incident Management System/ICS uses a P model for emergency operations; this has been adapted into the H model in Hainan (Figure 29). As explained earlier, China has one integrated emergency management system flowing top-down from the central government to the provincial level, which is used to handle a nationwide emergency like COVID-19. Therefore, the Hainan EOC Director does not feel like a final decision maker even though he is the secretary-general or governor of the province. In the adaptation from the P model, direction from above on the upper-left side of the H model is an important resource to integrate the whole operation with the larger response effort. Hainan EOC also does not have an integrated online EOC operation

system like WebEOC (or other similar tools) in the United States; therefore, the dispatch function takes place in a different facility. EOC leadership has won key support from a local big data center to leverage its command center for dispatch, using their video conference system. The H model has two information chains on the right side to pass down information (top right) and to get feedback (bottom right) from the regional and district operations centers (ROC and DOC). Future EOC system enhancements may improve these information chains to achieve higher efficiency; however, this model captures how information is shared and actions coordinated currently.

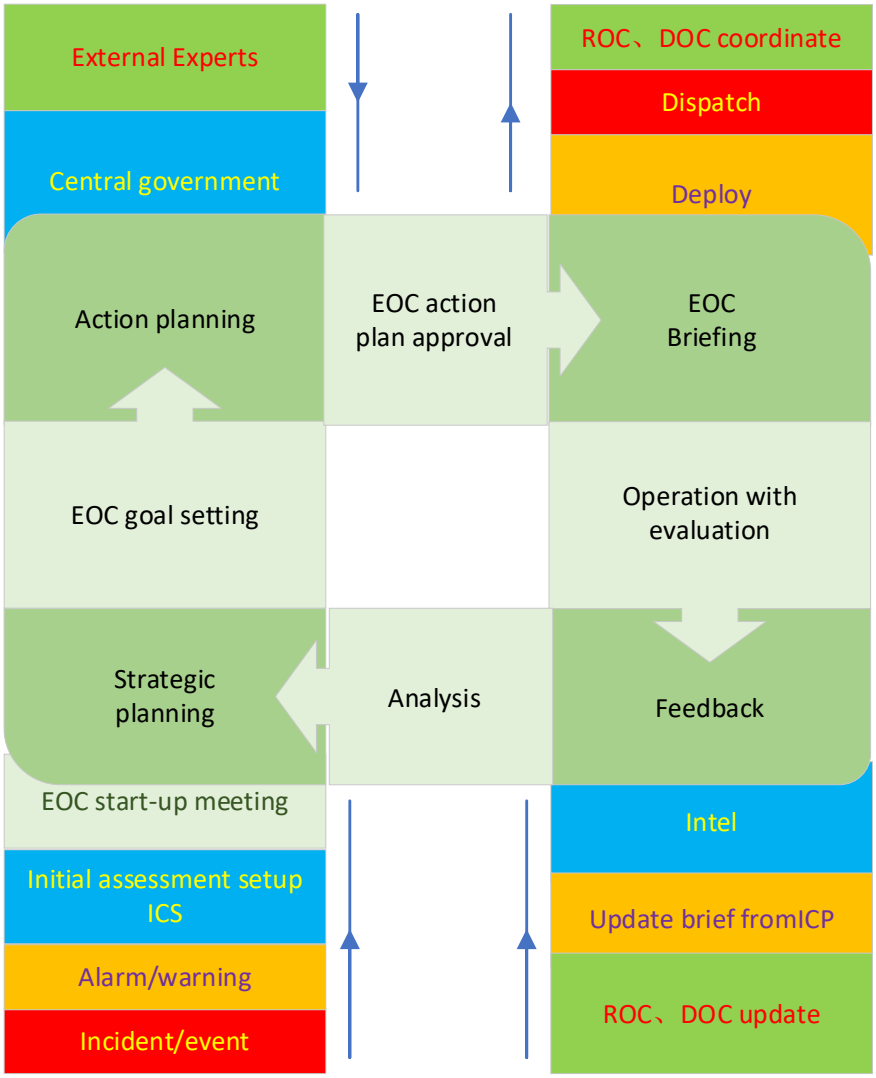

Figure 29. The H Model Replaces the P Model of ICS, adapting it for the Chinese context.[268]

N Model. Before November 1, 2007, there were 35 laws and 37 regulations published in China covering various areas from the environment to safety, health, and security. However, these laws were limited in scope, unable to become one systematic emergency management program. Therefore, it is said that the real emergency management system in China started after the SARS epidemic in 2003. Using the lessons learned from the SARS response, the Chinese government modified public hygiene and many related tactical regulations. On May 12, 2003, the *Regulation on the Urgent Handling of Public Health Emergencies* was published. This regulation put together everything needed to handle SARS and similar situations. It has become fundamental for the subsequent development of detailed emergency plans in different tactical fields. It was a key milestone to have a general law with top-down authority for emergency management of medical response and public hygiene.

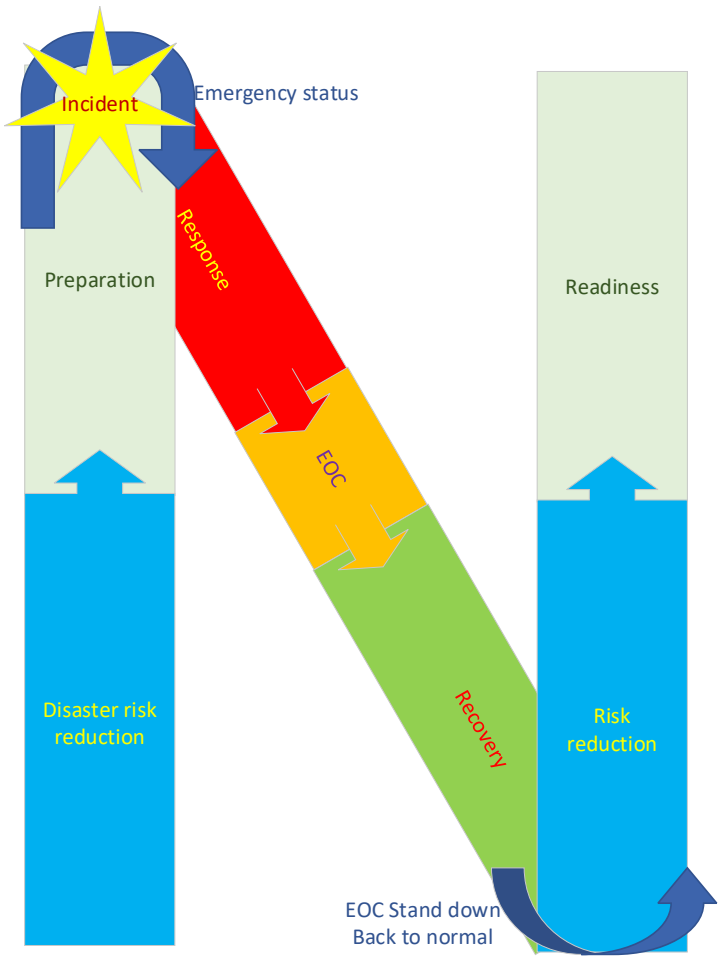

Figure 28. The N Model Covers Four Phases of Emergency Management: Risk Reduction, Preparation/Readiness, Response, and Recovery

In November 2003, the "Emergency Law" was initiated but it was not published. Instead, an amendment to the Constitution in March 2004 changed the terminology of martial law to emergency law, thereby giving support to the law of the emergency state. A short time later, in December 2005, China established an Emergency Management Office (EMO) and started to build a new emergency management system for China. Following that, the State Council issued a *Master State Plan for Rapid Response to Public Emergencies* in January 2006. Started as a draft

on May 31, 2006, the legislation was finally passed as *The Law of the People's Republic of China on Emergency Responses* on August 30, 2007, and came into effect on November 1, 2007. This law is the foundation of systemic emergency management in China. By this law, emergency management in China obtained legal support from all levels of authority from central government to local, and through the master state plan, the emergency management system established its framework of emergency planning. Based on this framework emergency plans were developed in China, with 51 national-level emergency plans developed for the country by March 2009. Additionally, 138 nationally owned corporations and all mine- and chemical-related corporations developed emergency plans as well.

However, one weakness to all these laws and plans is that they do not clearly define "emergency status." The emergency management system continues to have the same authority as normal status—just expedited for rapid response. Hainan Province made a "leap" in addressing this shortfall in 2020. At the beginning of 2020, while the Hainan COVID-19 EOC was about to initiate operations, the Hainan Provincial People's Congress passed a series of proposals to give legal authority to empower the EOC for COVID-19. Essentially, emergency status was declared, and the government in subsequent official statements used the term "war-time status." Throughout 2020 there has been normal time, war-time/emergency status, and new normal, which follow the three lines of the N model. China still does not have an emergency status defined by law or the emergency authority system, so the terminology "war-time" refers to emergency status.

The N model shows the Hainan emergency management program as one continuous improvement process covering four phases—mitigation (risk reduction), readiness, response, and recovery—starting from the left for disaster risk reduction and preparedness. When there is an emergency trigger, the whole government model will turn into "war-time status," meaning the emergency response and recovery phases. During this period, the EOC is set up and operational, running the H model continuously until the end of the emergency status, when operations transition into a new normal status and proceed to the next level of mitigation and preparation.

During COVID-19, the Hainan government's activation of the five levels fighting COVID-19 ("FF") represented the transition from normal status into "war-time status," which is shown in the upper-left point of the N model (Figure 30). The EOC is then active throughout the response and recovery phase. In the middle of 2020, the domestic situation had improved and the majority of the effort was focused on preventing imported cases. The government then started to resume business and focused recovery on socioeconomic goals. This signified they had reached the U-turn on the lower-right point of the N model, which was officially called a "new normal" by the government.

Conclusion

The COVID-19 pandemic will be remembered as a cataclysm that affected the general population and their socioeconomic well-being. Adequate protection and wise allocation of resources were very important during this period. The Health Emergency Management System, created in part from the lessons learned during the SARS pandemic, has proven to be a valid model in the management of pandemics. Use of the IMS with all government engagement and the whole-of-government model should be continued, even when the new normal comes. An integrated emergency management system using the HN model will continue improving China's emergency management system, because it combines advantages from China and the international community. Continuous international surveillance, cooperation, coordination, and communication to effectively respond to the COVID-19 pandemic are crucial because future EOCs could face similar issues. Adapting and improving responses based on lessons learned will

leave China better prepared to deal with the COVID-19 pandemic and other epidemics that arise. China's emergency management system is unique, growing fast, and evolving toward an international standard.

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[265] Shi 2007
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[267] State Council Information Office of the People's Republic of China, 2020
[268] Bater, et al. 2020

Conclusion

The case studies in this publication describe several examples of how countries' experiences during the SARS pandemic shaped preparedness efforts during the 17 years that passed before its cousin, SARS-CoV-2, emerged, causing a new pandemic of COVID-19. This concluding section will revisit the Iceberg Model in view of the case studies, highlight themes that emerged, and, where possible, compare and contrast how different SARS experiences and responses drove different outcomes. Information from the case studies is synthesized, along with additional supporting data, to reflect on each of the four levels. Although these reflections stem from the case studies presented, they can only represent a starting point for understanding the root causes and underlying dynamics that produced either wildly divergent or similar and sustained outcomes. Many of the discussions below have their own bodies of literature that can be explored for comparative purposes, with the understanding that this paper represents only six countries and yet every nation on earth was affected by COVID-19.

Iceberg Model Synthesis

In this section, we return to the Iceberg Model framework discussed in the introduction to the case studies. Key questions include:

- Which patterns, structures, and mental models enabled effective response?
- Which patterns, structures, and mental models hindered response?
- How were these shaped by lessons learned from SARS, either positively or negatively?
- What are the limits of lessons learned? Where does leverage from SARS begin to wane?
- How can we use the knowledge gained through this analysis to improve COVID-19 response in the near term, pandemic response in the future, or any other problem sets that require significant behavior changes to address?

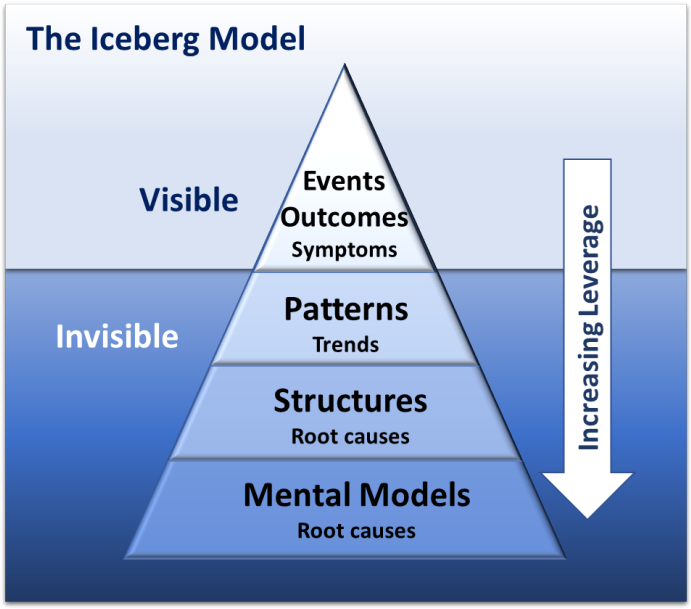


Figure 29. The Iceberg Model provides a systematic method for investigating the trends and behavior patterns that cause the visible outcomes—or symptoms—we see, as well as the underlying structures and mental models that create those behaviors and trends.

Events and Outcomes

One striking observation while reading these case studies is the degree to which the COVID-19 experiences of the countries varied (Figure 30). While concern over the pandemic was a constant throughout the globe, the wide chasm between countries with the lowest caseloads during the first year (e.g., Singapore with 1% of population infected and 29 deaths, Vietnam with .001% infected and no deaths) and those with the highest (United States with 6% infected, 349,000 deaths) highlights how people living in different countries would have wildly divergent experiences of the COVID-19 pandemic. Even though China experienced the first cases, with very high caseloads through February 2020, they were able to go from a significant emergency situation back to a preparedness posture, even as other countries struggled to contain the disease.

This extreme variation in outcomes is reminiscent of the disease itself, which is a shape-shifting collection of symptoms that includes but is not limited to cough, shortness of breath, respiratory distress, fatigue, aches and pains, fever, rash, diarrhea, neurological abnormalities, loss of smell, cardiac changes, and, of course, mild illness or no symptoms at all. Just as doctors and scientists work to decode the mechanisms and causes that lead to such a wide variety of outcomes, we should investigate why some countries had better outcomes than others. Similar to outcomes at the human scale, we can expect many factors came together to create the course of disease. Pre-existing vulnerabilities, genetic differences, initial dose/extent of exposure, treatments and supportive care received, and properties of the viral strain, along with other factors, interact to create patient outcomes. We can likely see corresponding pre-existing strengths or vulnerabilities, levels of exposure, and the methods of treatment chosen by each country's leadership and the public at large. It is difficult to single out key variables in these cases; however, it may be helpful to note trends when investigating root causes.

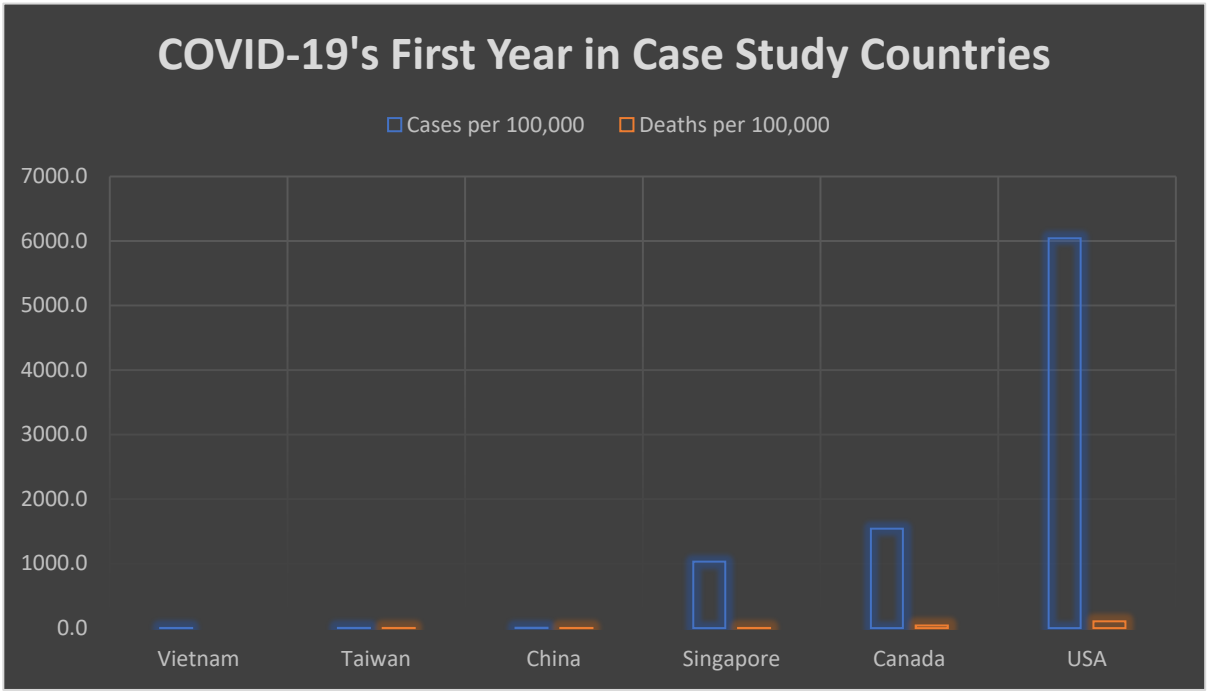
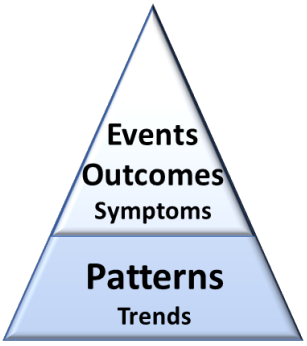


Figure 30. Comparison of Case and Death Rates among the countries reviewed in this publication.

Patterns and Trends Level



When comparing how countries did against SARS to their success fighting COVID-19, one data point comes to the forefront: The United States, which did not experience a single SARS death, was the worst performer of the group reviewed in this series, and also fares poorly in global comparisons of countries' first years of response. This could lead an observer to wonder whether the United States experience with SARS, being so mild, did not lead to as many lessons learned as in the countries with more significant epidemics. China, Taiwan, and Singapore, who had more significant SARS outbreaks (Figure 31), were able to respond effectively to get COVID-19 under control. Vietnam, hailed as a star performer during SARS, was also one of the success cases in immediate response to COVID-19. Canada breaks the trend in terms of countries with significant SARS experiences performing well during COVID-19; however, some of their adverse outcomes may reflect proximity and interconnectedness to the United States, rather than being a true reflection of their lessons learned from SARS.

Other common themes from the case studies where COVID-19 was relatively contained during the first year:

- Early and aggressive prevention activities (Vietnam, Taiwan, Singapore)
- National/widespread mask mandates (Vietnam, Singapore, Taiwan, China)
- Widespread use of GPS/cell phone technologies to manage contact tracing and isolation/quarantine (China, Singapore, Taiwan)
- Isolation/Quarantine enforcement (China, Vietnam, Taiwan, Singapore)

While elements of these success trends may have been present in the United States and Canada, implementation was not as robust. For example, deliberate decisions were made not to prohibit travel early on; mask mandates were locality-based and discretionary; cell phone apps were available but not widely used or compulsory; and isolation and quarantine were largely voluntary, especially in the United States.

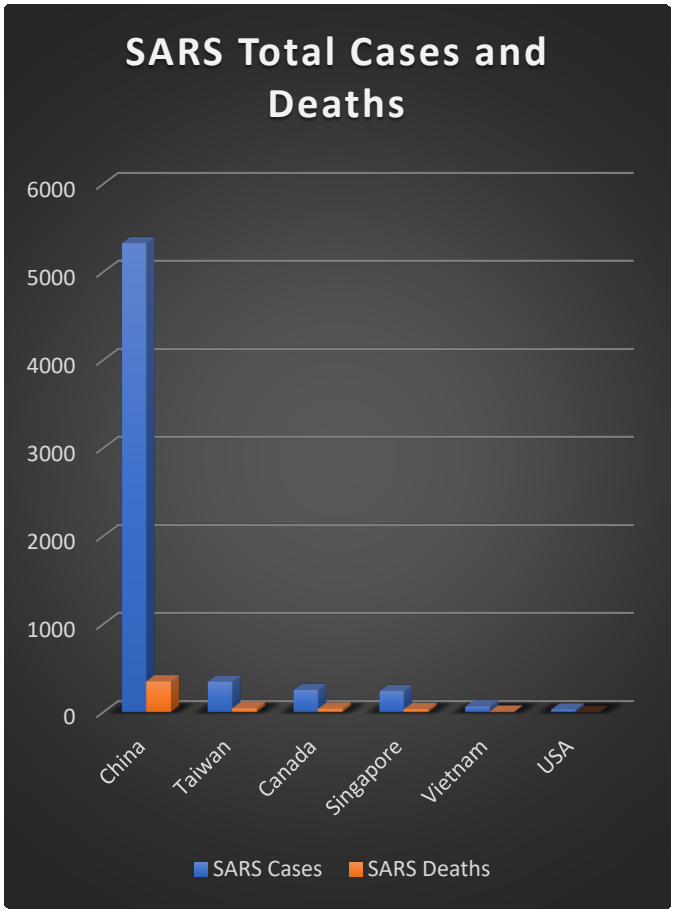
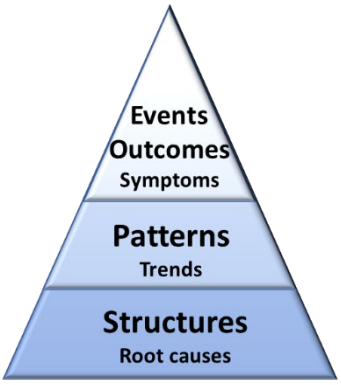


Figure 31. Total Cases and Deaths Due to SARS in Case Study Countries

Structures Level



The structures that enabled the trends discussed above, ultimately shaping outcomes, were a significant focus of post-SARS reform activities reflecting each country's lessons learned.

Legal Structures. In a public health emergency, government health officials require clear legal authorities to conduct basic epidemiological functions that break the chain of transmission (e.g., contact tracing, quarantine, isolation), as well as to require citizens to take measures to prevent community spread (e.g., social distancing, wearing of facemasks, closing high-risk or non-essential businesses). During SARS, public health experts recognized that the variabilities of legal authority across levels of U.S. government (local, tribal, territory, state, and federal) would make coordination particularly challenging. While some states adopted legislation that would help clarify and solidify needed authorities, this legislation did not alleviate litigation challenging governments' authorities to require and enforce mitigation measures during COVID-19, and many such lawsuits were successful.

After SARS, Canada rewrote *The Quarantine Act* in 2005 to clarify and extend the federal government's ability to prevent introduction of dangerous diseases from the borders; however, provinces and territories retain authority over public health response in most other cases. Many countries passed legislation toward the start of the pandemic that helped the countries respond; noticeably missing in the case studies of China, Taiwan, Singapore, and Vietnam were significant challenges to the government's authorities to conduct and mandate measures to prevent spread of COVID-19, even if some measures spurred complaints.

Another area where legal structures come into play is in freedom of expression. As noted in the respective case study, Vietnam took a very aggressive stance against misinformation and disinformation. Conversely, the United States and Canada have significant legal protections for freedom of expression. These protections along with the speed and amplification dynamics of social media, allowed for rapid and mostly unchecked spread of misinformation, undermining public health efforts. A legal system that allows countries to treat misinformation as a significant threat to public health helps governments reduce the harms of such information; however, there is always a potential for abuse in these cases.[269] Government use of this power to improve public health outcomes is beneficial, but crackdowns on journalists, scientists, or others who are informing the public of information unfavorable to the government can constitute human rights violations, and ultimately undermine the public health goal.

Public Health Emergency Management Structures. Many case studies in this publication discussed substantial changes to public health and emergency management structures since SARS, often directly linked to the lessons learned during that time. Canada made significant changes, establishing a new public health agency, led by a Chief Public Health Officer of Canada. The country also invested additional funding in public health at all levels, and strengthened programs for responding to infectious diseases. Similarly, China conducted a significant overhaul of its public health policy and structures, recognizing that insufficient investment in public health had contributed to the gravity of the SARS pandemic—though it still did not have a designated all-hazards emergency management department until 2018. These changes and investments were reinforced by significant public health emergency incidents that took place in the wake of SARS, justifying the need for improvements. Taiwan also made improvements to their public health response systems, moving from a paper-based reporting system to use of information technology

to facilitate public health functions across response areas, including surveillance, contact tracing, isolation and quarantine, health records, and face mask distribution. Vietnam has upgraded their public health infrastructure by adding EOCs at national, regional, and district levels and adopting the Incident Management System, and Singapore learned the importance of having a management structure that separated "line" functions (require domain expertise) and "staff" functions (coordination, administration). They also used information technology to assist with public health functions.

Overall, every country made changes to their public health emergency management structures between SARS and COVID-19. The degree to which these changes were motivated by SARS—and informed by the lessons thereof—roughly corresponds to how severe the SARS pandemic was in that country. China and Canada seemed to respond most strongly to their countries' failures in handling SARS, with China recognizing and rectifying underinvestment in public health, and Canada overhauling its governance structures to create a new public health agency. Singapore and Taiwan also applied lessons learned and improved public health management structures, and Vietnam has invested in improved public health emergency management. The United States is a slight outlier in this group, already having a relatively mature public health infrastructure at the time of SARS. Investments in improved and standardized emergency management in the years following SARS were motivated more by the 9/11 terrorist attacks than the SARS pandemic; however, concerns about pandemics and biological terrorism did help shape preparedness programs like the Hospital Preparedness Program and the Public Health Emergency Preparedness cooperative agreement. Over time, however, U.S. investment in public health preparedness has dwindled as a share of healthcare spending, and public health structures were arguably weakened by the time of COVID-19 and unable to keep up with the requirements, especially as the pandemic spiraled out of control there.

Healthcare Structures. Healthcare structures drive health outcomes in important ways. Although most of those who contract COVID-19 do not require medical intervention, severe cases require very intensive supportive care. A healthcare system should afford its population access to quality medical care; it should also be able to prevent transmission of disease in the hospital setting, both to other patients and its own staff. Changes were made in several of the studied countries to both of these aspects.

Infection prevention and control (IPC) at hospitals is a complex interplay of facility design, development of protocols, staff training and adherence to these protocols, as well as sufficient resources of personal protective equipment (PPE), disinfecting agents, and other equipment. This was a major shortfall of SARS, where hospital-based transmission was widespread across countries experiencing outbreaks.[3] Several countries invested in and improved IPC, including Canada, Taiwan, Vietnam, and Singapore. China recognized the need to improve IPC systems, and created stockpiles of medical resources; however, these stockpiles were maintained in a centralized location, limiting storage capacity and ease of distribution. This led to shortages of medical resources, including PPE, as early as February 2020. Similarly, the United States both encouraged hospitals to maintain stockpiles, and managed its own Strategic National Stockpile of medical resources—and yet shortages in PPE and medical equipment were encountered early and often. Private hospitals and public hospitals on limited budgets had found the "just-in-time" ordering system to be more economical, whereas storage and rotation of stockpiles was a costly expense. The "just-in-time" system, however, is highly vulnerable to the very types of demand surges and supply disruptions experienced during COVID-19, and ultimately undermined hospitals' ability to keep both patients and staff healthy. In Taiwan, this problem was mitigated

[3] Except for the United States, which experienced very little transmission overall.

after the SARS epidemic as government agencies began regulating hospital preparedness and could inspect hospital stockpiles and other resources, and also observe hospital exercises in key aspects of infectious disease response. In this area, we see mixed results across countries, with some learning this lesson better than others. It should be noted, however, that preparing a geographically dispersed country of hundreds of millions (United States) to over a billion people (China) will necessarily be more challenging than a smaller country; furthermore, countries that took aggressive preventive actions that largely succeeded in limiting total cases may have experienced more shortages if their outbreaks had been more widespread, as they were in the United States and Canada.

Law Enforcement. Enforcement of public health measures will work differently in different contexts, but is important everywhere because if measures are not enforced—or enforceable—people will have to comply voluntarily. With good risk communication, the number of people voluntarily complying will increase, but there will always be people who only comply due to the threat of punishment. During SARS, most Canadians complied voluntarily with quarantine orders; however, several written orders were needed, and law enforcement agents were asked to do spot checks or investigate reports of noncompliance. The *Quarantine Act* passed in 2005 enacted very strict penalties for violation of isolation and quarantine orders (from $5,000 CAD fines up to $1,000,000 CAD and/or 3 years imprisonment if breaking orders causes death or serious bodily harm to another person). However, two provinces never adopted a federal act that gives police authority to enforce the *Quarantine Act* provisions, complicating enforcement.[270] The United States has also faced significant issues with enforcement of public health laws, including mask mandates.[271] With states and localities as the primary enactors and enforcers of such measures, the result is a patchwork of different rules and regulations, inconsistent enforcement, and overall lower compliance levels compared to many other nations.

The Asian countries studied in this series enacted more aggressive enforcement strategies; for example, Singapore's COVID-19 Act 2020 and Infectious Diseases Act established the basis for "Safe Distancing Enforcement Officers," who have broad authority to enforce public health laws, and "Safe Distancing Ambassadors," who do not have enforcement powers but nonetheless urge public compliance.[272]

Geography. It should be acknowledged that countries' geographic locations and features play a part in the options available to fight diseases, the extent to which a country can insulate itself from its neighbors, and how quickly the disease is likely to spread once introduced. Vietnam's leadership acknowledged that their proximity and highly trafficked, long land border with China, where SARS emerged, made it likely to be one of the first affected by a similar crisis, as they were with SARS.

Singapore's status as a city-state makes it easier to track, control, and respond to disease outbreaks, owing to a smaller geographic footprint and a flatter governance structure, but their high population density and reliance on imports were both significant concerns. Taiwan acknowledged their status as an island gave them an advantage in controlling initial introduction of the disease, and used the limited entry paths (airports and seaports) to rigorously quarantine all entrants—an option not available to countries with significant land borders and economic dependence on the freedom of movement across them. For example, corresponding peaks and valleys in daily new cases suggest Canada's fate was in part tied to U.S. actions and outcomes (see Figure 32[273]). Although non-essential travel across the borders was banned, essential travel and trade were allowed, and citizens were always able to return to their respective countries. This interconnectedness was not a notable dynamic during SARS, where most of Canada's transmissions were in hospital settings, U.S. cases were mostly imported from Asia, and

community spread was minimal. Additionally, there is little countries can do to change their geographical features, other than make policies that seek to mitigate weaknesses or leverage strengths, as Taiwan did.

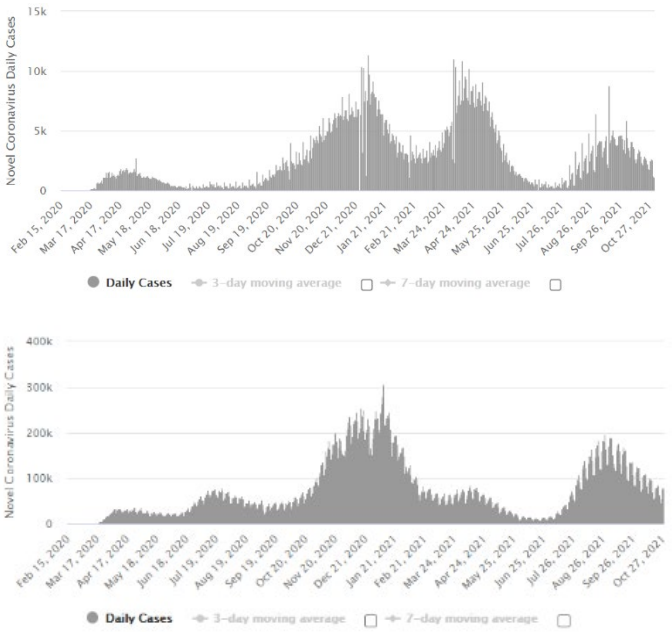


Figure 32. The temporal alignment of the peaks and valleys of Canada (top) and U.S. (bottom) daily new cases highlights how geographic proximity and economic interdependence can influence outbreaks and potentially limit effectiveness of interventions.

Socioeconomic Structures. The Singapore case study highlighted the vulnerability of foreign workers to COVID-19, due to their living conditions in crowded dormitories that fostered rapid spread of the disease. This situation was exacerbated by the government structures that placed regulatory authority for the dormitories under the Ministry of Manpower, not the Ministry of Health. As a result, MOH was not fully aware of the extent of vulnerability of this population, and had not taken adequate steps to mitigate spread in those facilities.

Socioeconomic structures also drove disparate impacts in the United States, where vulnerable populations have borne a greater burden of COVID-19 in terms of both health and economic outcomes.[274] The absence of universal healthcare coverage in the United States exacerbates these inequalities by limiting healthcare access for those with the least ability to pay out-of-pocket expenses.

In both of these cases, SARS did not expose these pre-existing fault lines. In an article published after SARS urging Singaporean officials to consider globalization, socioeconomic realities, and the impacts of marginalization of certain communities, most of the focus was on preventing introduction (e.g. foreign worker quarantine upon arrival), not on identifying and supporting vulnerable populations.[275] Similarly, the lack of community spread in the United States meant that most of those affected were recent travelers from Asia (with the requisite occupations or financial means to travel), their close contacts, and healthcare workers—likely more educated and affluent segments of the population. SARS did not adequately demonstrate the exquisite vulnerability of already-marginalized populations throughout the globe, so this is a lesson that went unlearned. Consequently, the worldwide pattern reflected the socioeconomic structures within the state, as "[s]ocieties with an unequal distribution of power and wealth saw that unequal distribution replicated in the impact of COVID-19."[276]

Political Structures. A full discussion of how political structures shaped pandemic outcomes worldwide is beyond the scope of this publication. However, it is impossible to escape the conclusion that political leadership and pre-existing political structures and attitudes had significant impacts on how countries experienced and responded to COVID-19. Because these structures are deep, enduring, and multi-faceted, they are resistant to change; even when lessons are observed in this arena, they are rarely truly "learned." Accordingly, although legislative changes were made in virtually all the countries reviewed in this document following

SARS and at the start of COVID-19, these did not fundamentally alter the political landscape in terms of regime type, partisan structures, how centralized/decentralized a country is, government accountability and transparency, or other such characteristics. Individuals within political leadership may be blamed for failures, removed, and replaced, as they were in China following the mishandling of the SARS epidemic, and changes may also be made in how information is handled and the incentives political bodies respond to.[277] These changes rarely amount to a complete overhaul of political structures, however, and unlike the Black Death, which is often credited with ending feudalism in Western Europe,[278] wholesale changes to political systems were not observed after SARS.

In these case studies, we saw how federalism complicated many aspects of the United States' and Canada's responses. Decentralization and "home rule," both hallmarks of democratization, amplify people's voices in their own governance but pose significant challenges in coordinating an effective public health response. More centralized governments (e.g., Vietnam, Singapore, China) may face other response challenges, but coordination hurdles and changing authorities from jurisdiction to jurisdiction do not interfere as significantly in their response efforts.

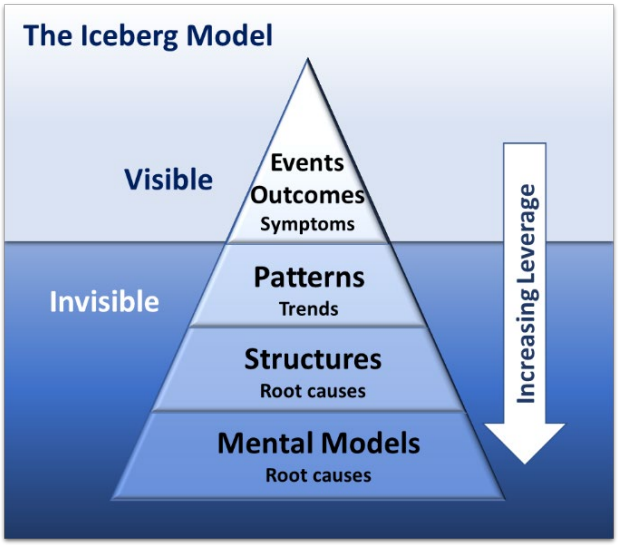
Table 7. Democracy Index rankings from The Economist Intelligence Unit's 2020 report.

Full Democracy	Canada (5) Taiwan (11)
Flawed Democracy	United States (25) Singapore (74)
Authoritarian	Vietnam (137) China (151)

As a consequence of seeing such difficulties with democracies responding to COVID-19, some have suggested that more authoritarian governments fare better during public health emergencies. While it is true that less-democratic governments have more tools for enforcing public health measures (e.g., Vietnam's centralized quarantine facilities; Singapore's Safe Distancing Enforcement Officers), this does not mean democratic countries cannot perform well. Taiwan, a full democracy ranked #11 on the Economist Intelligence Unit's 2020 Democracy Index (out of 167 ranked countries), was able to enact strong preventive measures that minimized harm to its population.[279] Indeed, one of the strongest global performers, New Zealand—though not featured in this publication—is ranked #4 on the same list, with Canada at #5. And while Vietnam, considered to be an authoritarian regime, performed well against COVID-19 during 2020, not all authoritarian states fared as well.

China's SARS response is a cautionary tale for authoritarian regimes, as their initial attempts to avoid or suppress news of the growing atypical pneumonia led not only to the disease spiraling out of control, but also to a significant mistrust of the government.[280] While some had thought the experience would have taught them that "in an era of the Internet and cell phones, a complete information blackout is not only impossible but also counterproductive,"[281] high-profile cases in the COVID-19 era like the detention of Li Wenliang and other doctors for allegedly spreading rumors about an illness circulating in China certainly limited open discussion among other medical professionals.[282] A later Supreme People's Court decision exonerated this doctor; however, the damage had already been done. The court acknowledged, "[i]f society had at the time believed those 'rumors,' and wore masks, used disinfectant, and avoided going to the wildlife market as if there were a SARS outbreak, perhaps it would've meant we could better control the coronavirus today." While China to some extent repeated its missteps from SARS, the lesson to be learned today is that while authoritarian governments may be well positioned to compel or coerce citizens into fully adopting public health measures, they are also susceptible to the temptation to suppress adverse information, which allows infectious diseases to propagate uncontrolled in the information vacuum. It should be noted that Vietnam did learn from SARS that open and transparent communication is important to gaining public trust and compliance, and they made this a cornerstone of their efforts.

Mental Models Level



A *mental model* is a simplified version of some aspect of reality that people hold in their head. People rely on these mental models because the world is complex, and if we had to experience everything anew, we'd be quickly overwhelmed. These simple mental models reflect our values and the way we think the world works. We use them so extensively and effortlessly that we are often blind to our own mental models. We tend to assume other people share the same models and beliefs, and fail to understand why they behave so differently and—to the observer—illogically. Externalizing mental models that drive behavior helps explain why people do what they do, and why they have created the types of structures reviewed above. Several examples of mental model–driven behavior were noted in the case studies, and many more interact with the structures and dynamics already discussed.

Mental Models about Disease Transmission. In order to stop a pandemic, we must understand how the disease is transmitted. This is a very simple rule, but in practice the world found it quite difficult to do this at the outset of COVID-19. While the WHO and CDC focused on surface transmission via droplets, urging handwashing and discouraging mask use except by medical professionals and those who are symptomatic, this guidance may have actually been overly influenced by SARS experiences. The SARS pandemic created a mental model that ***coronaviruses are primarily transmitted by people who are symptomatic, often in hospital settings***.[4] Assuming its cousin, COVID-19, would behave the same way discounted the potential for presymptomatic and asymptomatic transmission, which were later found to be drivers of community spread. Similarly, discouraging mask use by the public planted the unhelpful mental model that ***masks do not protect the wearer***. When evidence for asymptomatic and presymptomatic spread emerged, the logical extension was that ***because we do not know who is infectious at any time, we must all wear masks to stop transmission***. While some were able to adapt their mental models in view of this realization, many others continued to simply believe ***masks do not work*** and that ***handwashing is the best way to prevent COVID-19 transmission***, even as evidence for aerosol-based transmission proliferated. These mental model dynamics seemed less important in the Asian nations studied, whose mental models—also informed by SARS—reflected a blanket understanding that ***masks prevent respiratory illnesses***.

Another important mental model about disease transmission covers *where* people contract the disease. When the prevailing belief holds that ***coronaviruses spread easily in hospital settings***, many will opt to stay home and be cared for by family. However, it is known to the public health community and to anyone who has seen a viral illness attack family members sequentially, that in fact ***home-based care endangers families and increases community transmission***. This mental model supported the centralized quarantine and isolation facilities run by Vietnam, as well as arrangements in other countries to remove exposed and/or ill persons from their residences, sometimes by force. In America, patients were encouraged to ***stay away from hospitals until***

[44] In this section, key mental models are highlighted within the text in ***bold and italics***.

symptoms are severe. Although the U.S. CDC provided guidance for isolating sick family members in the house, effective isolation from those in a dwelling unit is difficult in practice; as a result, COVID-19 often overtook entire families.

Mental Models about the Threat of Infectious Diseases. One of the most important and animating mental models affecting behavior at all levels relates to how seriously a person takes the threat of infectious disease. This may be tied to experiences—for example, with the SARS epidemic of 2003, or with living in densely populated cities where diseases spread rapidly. These situations may create a mental model that ***infectious disease are serious threats***. Conversely, those who live in less densely-populated areas, or in countries or regions that have never experienced serious impacts from infectious diseases, are more likely to feel that ***infectious diseases are not a big deal***, and ***sharing sniffles and colds is just a fact of life that doesn't warrant extra precautions***. Where an individual's perspective lands will depend on culture, personal experience, historical memory, health status, and other factors, but there is little doubt it would greatly influence whether that person will embrace or reject aggressive public health measures. These case studies reflect such a dichotomy; it may not be a coincidence that the United States, with the fewest cases and no deaths from SARS, is a far outlier in terms of COVID-19 performance by a SARS-affected nation.

Mental Models about Mask Wearing. Several case studies made the point that in the early months of any pandemic, we are unlikely to have access to vaccines. Therefore, we must rely on preventing disease spread through a combination of epidemiological efforts (e.g., contact tracing, quarantine, isolation, social distancing) and in-person transmission barriers (e.g., physical distance, hand hygiene, face coverings/masks, other PPE). Although mask wearing was not controversial in much of the world, countries experienced varying levels of compliance with mask-wearing requirements. The Singapore case study noted that the public was puzzled by the initial guidance to not wear masks, and the Taiwan case study indicated the SARS experience in 2003 had helped them cultivate disease prevention habits, like mask wearing and handwashing, as courteous and normal social etiquette. In many Asian countries, ***mask wearing is a normal practice***—in part due to painful experience with SARS, but also to protect against air pollution, allergies, and other germs. In these countries, the public holds many mental models about mask wearing: that it is normal, that ***it prevents disease transmission***, that ***it is courteous***, that ***the government has the authority to enforce mask wearing for the good of the community***, and that ***it is simply not a "big deal."*** These countries were able to shift to mask wearing much more quickly (if they weren't *already* wearing masks regularly in public) because of these mental models. The normalization of masking in these countries also meant masks were more widely available early on in the pandemic.

In other countries that were not accustomed to mask wearing, adoption of this public health measure was not as smooth. When mask wearing is not seen as "normal," ***it is a physical and visual reminder of the stress of the pandemic***. Still, many embraced masks, despite discomfort, because they accepted the premise that ***masks work best when everyone wears them***, and this was the best way to regain some sense of normalcy. Others rejected these concepts, and adopted a very different idea of what a mask represents. Their mental model of a mask became one of ***oppression: a sign that the mask-wearer was afraid***. Many even believe that ***masks are harmful to one's health***, while ***COVID-19 is no worse than a normal flu***—another mental model that influenced behavior. These mask-wearing mental models also intersected with mental models about government authority and civil rights. At best this resulted in people believing ***mask wearing is a personal choice***, but that ***the government does not have the authority to mandate it***. At worst, they believed ***no one should wear a mask at any time***, and harassed people

who did, as well as anyone who tried to get them to put on a mask in public. This in fact resulted in multiple deaths in the United States.

The mental models around mask wearing that developed in the most SARS-affected Asian nations seem to have likely enhanced their ability to prevent person-to-person spread. While masks are not 100 percent effective in all cases, they are a helpful tool in the public health arsenal. In the United States and to a lesser degree in Canada, where mask wearing has not been historically as widespread or normalized, more adverse mental models formed that reduced public compliance, undermining public health efforts.

Mental Models about Prevention. One recurring theme in the case studies centered around the perceived importance of prevention. Vietnam's leadership recognized their healthcare capacity was low—they could not afford to have a major epidemic. Therefore, they prioritized and aggressively pursued prevention, citing lessons learned from SARS as a motivator for their strong government commitment. Taiwan and Singapore echoed these sentiments. In these countries there is a strong mental model about prevention. It echoes the idea that ***public health emergencies are serious***, which, as discussed above, is a mental model fairly lacking in the U.S. population, which is rarely affected by significant infectious disease outbreaks—including SARS, where they saw no deaths. Taiwan, Singapore, and Vietnam also invested heavily early on, believing that ***prevention is cost effective.*** The United States and Canada, by contrast, were hesitant to take drastic measures that might harm the economy. Leadership and the public seemed to agree ***we can't disrupt our lives for a health scare***, probably because there have been no serious ones in recent memory. This also contributed to a feeling that ***not that many people are affected, so it's not a problem***, because they had not personally experienced the exponential growth in cases that Hong Kong, China, Taiwan, and Singapore had seen during SARS and other outbreaks.

While the Singapore case study called out the very cautious nature of their government leaders, who feel it is ***better to overreact than underreact***, caution is not as valued in U.S. culture, where people ***don't want to be seen as an alarmist***. The precautionary principle, summed up as "***it is better to err on the side of caution,***" is often discussed when it comes to public health. In Singapore, Taiwan, and Vietnam, this translated into aggressive action to prevent introduction and transmission of the virus; however, in the United States and Canada, leadership seemed to err on the other side of caution, believing it was ***better to not disrupt the status quo*** (in particular, the economy) before we know more about the impacts of the disease. This may also be related to a fundamental attribution error where people believed ***public health measures are harming the community***, instead of blaming COVID-19 itself for the harm caused. Paradoxically, the more successful prevention is, the more public health measures are blamed for harms because the disease is not as visible. This often results in premature lifting of restrictions and a resurgence of cases. Very strong mental models about prevention and the seriousness of infectious diseases are needed to counter this impulse.

Mental Models about Freedom and Responsibility. In Vietnam's constitution, ***a citizen's rights are inseparable from a citizen's duties***, and the government is specifically empowered to suspend civil rights for the good of the community. This differs from the U.S. mental model of ***individual freedom from government oppression***, which is intertwined with the nation's history and founding documents. Though many would agree in principle with both of these mental models, the details become difficult. *What is an inalienable right? What is a negotiable right? What is your responsibility to others? What is a reasonable duty? What constitutes oppression?* The answers to these questions can be highly context-dependent and, as discussed previously, may differ from person to person in subtle or significant ways we cannot understand without in-depth,

targeted discussions. While the tradeoffs between civil liberties and disease control were raised during and after the SARS pandemic, each country must still find their own "sweet spot" where human rights are respected but disease control is achievable. External observers of COVID-19 may object to how people were treated in Vietnam or China, and these same observers may note the extreme intolerance of some Americans to what are reasonable and customary rules elsewhere. There are still lessons to be learned on both ends of this continuum, but the fundamental mental model to achieve for effective public health emergency response is that ***saving lives is worth some limits on individual freedom***.

Mental Models about Privacy. Epidemiological work is painstaking and labor-intensive, and grows exponentially with each new case. The Taiwan case study noted that during SARS, paper copies were still used for reporting and communication, and that they had automated many of these processes to expedite response during COVID-19. This trend was seen elsewhere and expanded to automation of related tasks via cell phones, apps, GPS trackers, and other technological approaches, which were cited as greatly facilitating response in many nations. These approaches were widely embraced throughout Asia, and not as well received in the United States. Related to the mental models about freedom from government oppression, many feel ***tracking people's movements is a privacy violation***. This is not to say there were no similar issues in the Asian countries discussed; rather, the Singapore case study notes specific privacy concerns about the *TraceTogether* app. Adoption of such automated systems may be broadly accepted when populations think of them as ***more effective ways to prevent transmission***, or as being particularly ***convenient***. Privacy concerns, as well as concerns about whether ***data can be used in court cases***, will need to be addressed for broader acceptance unless the public has ***no expectation of privacy***, as may be the case in some locations.

Mental Models about Risk Communication. The discussion of political structures in the previous section mentioned authoritarian governments' suppression of infectious disease information; however, this instinct is not only seen in such regimes. Political leaders often react instinctually to bad news by covering up or "spinning" information into a more favorable narrative. The mental model here is ***we don't want to look bad, so we can't release embarrassing data***. However, in the long run this approach undermines credibility. Leaders during pandemics need to realize that ***transparency in communication, even when we are delivering bad news, builds trust.*** Moreover, there is a perception that ***the government controls diseases through its actions***. This is not true, however. Viruses cannot be suppressed by controlling and suppressing inconvenient information, or by fiat. Political leaders need to move from a mental model of ***the government can control the disease*** to ***the public is our partner in response***. All risk communication must flow from this idea. Public service advertisements, whole community engagement, and grassroots messaging campaigns mentioned in the Vietnam and Singapore case studies reflect this mental model. On the other hand, leadership in the United States downplayed the risk of the disease and didn't harness the full power of the public to combat it. As a result, instead of responding as a whole, Americans received messages filtered through partisan lenses and competing media outlets. The United States missed out on lessons learned from SARS about how to bring people together to fight disease as a common and elusive enemy.

Another mental model about risk communication that affects outcomes involves ***freedom of speech***. The United States and Canada both guarantee freedom of expression, within reasonable limits. This right allows for open discussion and dialogue without the fear of government retaliation (as was seen in the case of Dr. Li Wenliang in China); however, it also allows for the rampant proliferation of rumors, incorrect information (misinformation), and intentional falsehoods (disinformation). Underlying this dynamic is the mental model that ***people can figure out which information is bad or good***. This differs from the Vietnamese mental model that

misinformation and disinformation pose serious threats to public health, and warrant severe punishment. In fact, health emergencies are known to stimulate specific kinds of false information, including "mischaracterization of the disease or protective measures that are needed; false treatments or medical interventions; scapegoating of groups of people; and conspiracy theories—often about the existence or origin of the pathogen, profiteering, or politics," according to Dr. Tara Kirk Sell, a Senior Scholar at the Johns Hopkins Center for Health Security.[283] Each of these categories of false information is dangerous in its own way, and experience suggests that people do in fact struggle to disentangle good information from bad. While much of this was known by public health and risk communication scholars during and after SARS, that pandemic took place in a different environment—as the internet was still in its adolescence, and social media had not yet taken hold. Current internet platforms hold enormous promise for promoting awareness and explaining what measures will help keep the public safe; however, their potential for quickly spreading rumors—and algorithms that actively promote the most sensational, and likely false, content—cannot be understated. Democracies that actively protect freedom of speech will need to grapple with the problem of whether ***speech that poses a public health threat should be protected***, and develop strategies to counter the impacts of such speech while maintaining important freedoms.

Mental Models about Government Support. During SARS, it became very clear that ***people are more likely to follow isolation and quarantine guidance if it does not affect their livelihoods***. These considerations include external financial support, job protections, and ability to receive life-sustaining food, water, and medicines without leaving their houses. Governments and communities that provided these supports, and other ancillary services, were likely to see higher compliance with public health measures. This lesson was reflected in North American legislation that, among other programs, subsidized payrolls for companies, incentivizing them to retain employees; supplemented and increased access to unemployment insurance; provided direct payments to taxpayers; and placed temporary moratoria on evictions, ensuring vulnerable residents would not lose their homes.[284] Singapore provided grants to workers affected by COVID-19, and Vietnam established rice ATMs, free-of-charge stores, and other supports.[285] Taiwan similarly established assistance for COVID-19–affected workers and businesses,[286] and China, once the initial outbreak was contained, focused recovery on socioeconomic goals, as discussed in the case study. While China's economic assistance focused more on businesses and less on individuals, some have noted that the dynamics of their economy make this assistance helpful to workers, even if it is indirect.[287]

The widespread provision of economic stimulus and individual assistance stands out as a lesson that was generally learned from SARS, even though the pain of the pandemic—especially for the vulnerable communities—can't be fully relieved through such payments and programs. In the United States, workers deemed "essential" were not always given time off to quarantine if exposed, or to isolate if sick, and this precipitated many clusters of infection. Some of this stems from practical demands (e.g., requirements for healthcare professionals, infrastructure workers, an operational food supply chain), but in some instances this approach reflected American mental models about government and individualism. Many still felt ***if you're not sick, you should be working*** or that ***government shouldn't give people money to stay home***. This individualism is also reflected in the idea that ***people will just have to figure out how to make money or get food when quarantined***. This contrasts with other mental models that acknowledge that a ***government's proper role is to provide support and services for the people***. It should also be noted that in other countries outside of those discussed in these case studies, governments have been so corrupt and ruthless that the public would never expect support or services; that is simply not consistent with their mental models of how government works.

Final Thoughts

Reviewing the case studies and using the Iceberg Model framework for investigating underlying root causes has the potential to explain how mental models and structures influence the patterns of behavior that shape visible outcomes. It also allows us to understand how and why certain lessons were learned from SARS, and others weren't. From this synthesis, high-level concepts from each level become clear.

Events/Outcomes. Early, aggressive action is crucial for effective infectious disease response. This means a country needs a big response to what seems like a small problem at the time, or else later they will need an *enormous* response to a very large problem. As a general rule, the response should feel like an overreaction, or else it's not enough. The countries that learned this lesson during SARS invested in prevention and were better able to contain the spread of COVID-19 than countries who were spared in the 2003 pandemic. This is because early, aggressive response to what seems like a minor crisis takes a leap of faith in leadership, and a willingness to potentially look foolish if the forecasted disaster does not materialize. The question here is which is the cautious approach? To overreact, and possibly be accused of overreacting later? Or is it to urge more moderate action and a "wait and see" approach that could be hailed as wise in hindsight if the event is easily contained, or as an abdication of duty if it spirals out of control? Those who have experienced significant epidemics are more likely to see the aggressive approach as cautious, as shown in the case studies. With the benefit of hindsight, we now know it was the right path to take and a lesson learned well in countries with more significant SARS outbreaks. In the moment, though, we often struggle to see the dynamics that underlie the visible events, so we have difficulty determining what is right, and what will produce the best outcomes in the future.

Patterns. Governments can't stop infectious disease through willpower alone; the public is the key partner in behavior changes that will bring infections under control. Viruses don't care who is in charge—they don't care how they impact upcoming elections, or if the current leader will be ousted if they keep replicating. They care about the day-to-day, tiny interactions of normal people. While governments coordinate, and message, and provide resources, it is the people's patterns of behavior that drive or end epidemics. Even when considering well-understood diseases with medical countermeasures like vaccines or antibiotics, people still have to get vaccinated to stop measles, polio, and now COVID-19; people have to take a full long course of antibiotics to stop tuberculosis. Whether people take these actions results from the complex interplay of so many factors—availability, convenience, science literacy, vaccine hesitancy, and more. It turns out that ending epidemics depends on small decisions made by everyday people. *Will I wear a mask? Should I get tested? Should I stay home and have my family care for me while I am ill, or go into isolation? Will I host a large party or wedding as planned?* Messaging, communication, and awareness are important to start this process, but governments and public health officials also have to target the incentive structures and mental models that shape patterns of behavior if they want to have success.

Governments that prioritized messaging, urging, and enforcing desired behavior changes gained better control of COVID-19. Some of these lessons were available after SARS, but many were not since the patterns that dominated SARS (e.g., international travel, hospital-based transmission, symptomatic spread) were different from the patterns that have dominated COVID-19 (e.g., community transmission, pre-symptomatic and asymptomatic spread, higher impact on vulnerable/marginalized populations, widespread public health measures with significant social, emotional, and economic impacts). Some of these patterns could have been anticipated, given a few high-profile cases of community-based SARS transmission, as seen at the Amoy Gardens

complex. The lack of such cases in the United States and Canada in particular may have contributed to a false sense of security and blindness to existing vulnerabilities.

Structures. A system's existing structures can either facilitate or limit response in some way. Sociocultural, political, scientific, logistical, and other considerations all make up a country's response ecosystem, and only some of these factors are within the control of the health emergency response community. A democracy in a public health crisis will not suddenly become an authoritarian regime that can compel its population to act in certain ways, even if those actions would save lives; they have to find other ways to explain and incentivize the desired change. Acknowledging and understanding existing structures, and how they might constrain a country or community trying to put together an effective policy or program, helps planners anticipate context-specific challenges and craft appropriate interventions.

It is important to think about response systems holistically, determine what incentives and resulting behaviors they create, and how they interact with the broader environment. While some of this introspection was done following SARS, there were limits to the changes countries could make to address public health emergencies. Common changes seen after SARS included reorganization of health and response structures, increased investment in health care, and legislative remedies to ensure appropriate authorities. Changes to geographical, political, and socioeconomic structures that also conditioned COVID-19 outcomes were simply not possible.

It should be noted that none of the structures discussed in this publication are determinative—that is, just because a government is structured a certain way, that doesn't mean they will have a successful response. How the structures interact with each other is also very important, and this is why seemingly similar countries can have very different experiences, though trends can certainly emerge. It can be helpful to understand how other countries' structures help or hinder them, so we can more clearly see the strengths and limitations of our own system's structures.

Mental Models. Disaster response is inseparable from politics and culture. Emergency managers and planners put systems in place to assure effective response that can endure and thrive under multiple political administrations, but COVID-19 has shown these systems cannot be fully insulated from the political context, or from decisions made by leadership. Political systems, culture, and the mental models that accompany them affect the options available to countries for responding to infectious diseases, and how effectively these can be implemented. Preparing for the next disaster requires serious reflection on the ways that political systems condition what outcomes are achievable, as well as the ways a society's culture and mental models influence people's behaviors—and their willingness to change them. SARS deeply affected the mental models of leadership and the public in countries with more traumatic experiences. These mental models drove leadership to act with great caution, knowing that epidemics can quickly spiral out of control, and drove their populations to comply quickly and more fully with public health interventions (like masking), because they were already normalized in those cultures. Unfortunately, these mental models were not available in many countries that had not experienced significant infectious disease emergencies, and this had deadly consequences. Mental models are not easily changed, but working with people to externalize and examine how they influence choices is necessary if we wish to be successful in conquering COVID-19 and preventing another serious pandemic. Only by understanding and targeting these root causes of behavior can countries prepare for and solve future outbreaks and pandemics, or any of the other complex challenges societies face.

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ISBN 978-0-578-25712-9