



# A systems thinking approach to risk reduction and mitigation for improving disaster management

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This Doctoral Thesis, A systems thinking approach to risk reduction and mitigation  
for improving disaster management, presented by Anshu Shroff,  
and Submitted to the Faculty of The Harvard T.H. Chan School of Public Health  
in Partial Fulfillment of the Requirements for the Degree of Doctor of Public  
Health, has been read and approved by:



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A SYSTEMS THINKING APPROACH TO RISK REDUCTION AND MITIGATION  
FOR IMPROVING DISASTER MANAGEMENT

ANSHU SHROFF

A Doctoral Thesis Submitted to the Faculty of  
The Harvard T.H. Chan School of Public Health  
in Partial Fulfillment of the Requirements  
for the Degree of *Doctor of Public Health*

Harvard University

Boston, Massachusetts.

May 2021

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FOR IMPROVING DISASTER MANAGEMENT

**Abstract**

Disasters negatively impact lives and livelihoods, and over the last two decades of 2000 to 2019, they have cost the global economy approximately US\$3 trillion (CRED (Centre for Research on the Epidemiology of Disasters) & UNDRR (United Nations Office for Disaster Risk Reduction), 2020). The field of disaster management has grown over this same period. Still, efforts towards improving long-term aspects of disaster management like mitigation and recovery have been relatively limited. These aspects of disaster management necessitate a holistic view and long-lasting foresight into ways in which the interconnectedness of diverse components of the system, including climate change, inequity, capabilities, training, and economic volatility, could influence the overall system, its outcomes, and the eventual impact on communities.

Disasters strain the already under-resourced public health systems, along with other essential public services like public safety, public education, public transport, public utilities, and infrastructure, among others. To closely understand the nuances of the interconnectedness of efforts in preparation for and during disasters, I undertook a case study at a mid-sized United States city-county public health department. The case study, while not generalizable or representative of the entire country, was indicative of how systems-based thinking and approaches can be used for efficient and effective disaster management.

The study validated the complex interconnected and dynamic nature of inter-and intra-organizational work, highlighting the need for robust collaboration, relationship-building, and communication plans to be in place and functional much in advance of any crisis and the inherent systemic biases that need to be overcome to make such efforts successful.

The Iceberg Model, a systems thinking tool, was used to understand disaster management. It enabled the identification of the mental models or systemic barriers that are the root causes of the underlying structures and patterns of events seen over and over during different crises. Experts have advised lessons on the importance of cross-sectoral collaboration, information sharing, and capacity-building for out-of-the-box scenario planning for decades. Yet, it is by understanding and addressing the complex mental models that influence explicit and implicit structures that might enable these lessons to be implemented. Furthermore, even such deeper dives should not be siloed analyses. Stakeholders should be careful not to identify root causes within their respective areas and presume that addressing those alone will change outcomes. To understand the full extent of the issues and fully manage them, they will need to work as a part of a bigger system, and efforts will need to be made across the spectrum.

**Keywords:** Systems thinking, Disaster Management, Crisis leadership, Emergency Management, Preparedness, Mitigation, Resilience, Risk Reduction, Pandemic, Collaboration, Coordination, Communication, Leadership, Management, Innovation, Public Health Systems Research, inter-disciplinary, inter-sectoral, cross-sectoral, organizational behavior

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## Abbreviations and Acronyms

<b>AARS</b>	After Action Reports
<b>CDC</b>	U.S. Centers for Disease Control and Prevention
<b>CRED</b>	Centre for Research on the Epidemiology of Disasters
<b>DRM</b>	Disaster Risk Management
<b>DRR</b>	Disaster Risk Reduction
<b>EM-DAT</b>	CRED's Emergency Events Database FEMA - Federal Emergency Management Agency
<b>FCAC</b>	Fragile and conflict-affected contexts
<b>HHS</b>	US Department of Health and Human Services
<b>HSR</b>	Health Services Research
<b>IOM</b>	Institute of Medicine (National Academies of Science, Engineering, and Medicine)
<b>NRF</b>	National Response Framework
<b>OEM</b>	Office of Emergency Management
<b>PERLCS</b>	Preparedness and Emergency Response Learning Centers
<b>PERRCS</b>	Preparedness and Emergency Response Research Centers
<b>PHD</b>	Public Health Department
<b>PHEP</b>	Public Health Emergency Preparedness
<b>PHEPR</b>	Public Health Emergency Preparedness and Response
<b>PHPR</b>	Public Health Preparedness and Response
<b>PHS</b>	Public Health Systems
<b>PHSR</b>	Public Health Systems Research
<b>PHSSR</b>	Public Health Services and Systems Research
<b>RCA</b>	Root Cause Analysis
<b>UNDRR</b>	United Nations Office of Disaster Risk Reduction
<b>WHO</b>	World Health Organization

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*“Vidya Dadaati Vinayam...”* [Hitopadeśa, Verse 6]

This Sanskrit verse from an ancient text translates as “Knowledge bestows humility.” I write to humbly acknowledge the immense gratitude that I feel towards all those who made it possible and contributed to my journey of knowledge assimilation. I bow to the higher power for taking care of everything that was beyond my means. Three people planted the idea of doing a doctoral degree in my mind and continued to nurture it – my godfather, Swami Avdheshanand Giri; my mother-in-another-land, Dr. Hana Totary-Jain; and my husband, Dr. Aditya Tulsyan – to them my gratitude.

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For my parents, Anju and Surendra Shroff

## **1 Introduction**

While the largest disaster experienced in our lifetimes, the global COVID-19 pandemic, continues to unfold at the time of writing this thesis, it has already claimed 2.8 million lives as of 30 March 2021 (*COVID-19 Map*, n.d.). Despite the many difficulties of this time, it also provides an opportunity to understand, document, and learn from the disaster risk management efforts and challenges in order to be better prepared for future disasters.

Disasters and the process of responding to them not only hinder efforts towards the development or advancement of a community; in most instances, disasters set the development efforts several steps back. A lot of effort is undone or ruined. By strengthening disaster risk mitigation, adaptation, and resilience in advance of disasters, we do not just respond well; we also protect what we have already built and can recover, rebuild, and rehabilitate better and more quickly.

Disasters can be defined as being beyond the expected and, hence, novel in their presentation and the extent of their impact. Preparing for and responding to such events requires creativity and innovation. It requires an inter-disciplinary and holistic systems thinking approach.

Disasters also strain the already under-resourced public health systems, along with other essential public services like public safety, public education, public transport, public utilities, and infrastructures, among others. On the other hand, implementing a public health systems-based approach to mitigate the effects of disasters can reduce the overall adverse impact of disasters, including on public health systems themselves.

As the frequency and impact of disasters continue to grow rapidly (Figure 1 below), it is prudent that we address disaster risks using innovative approaches and in a systematic manner.



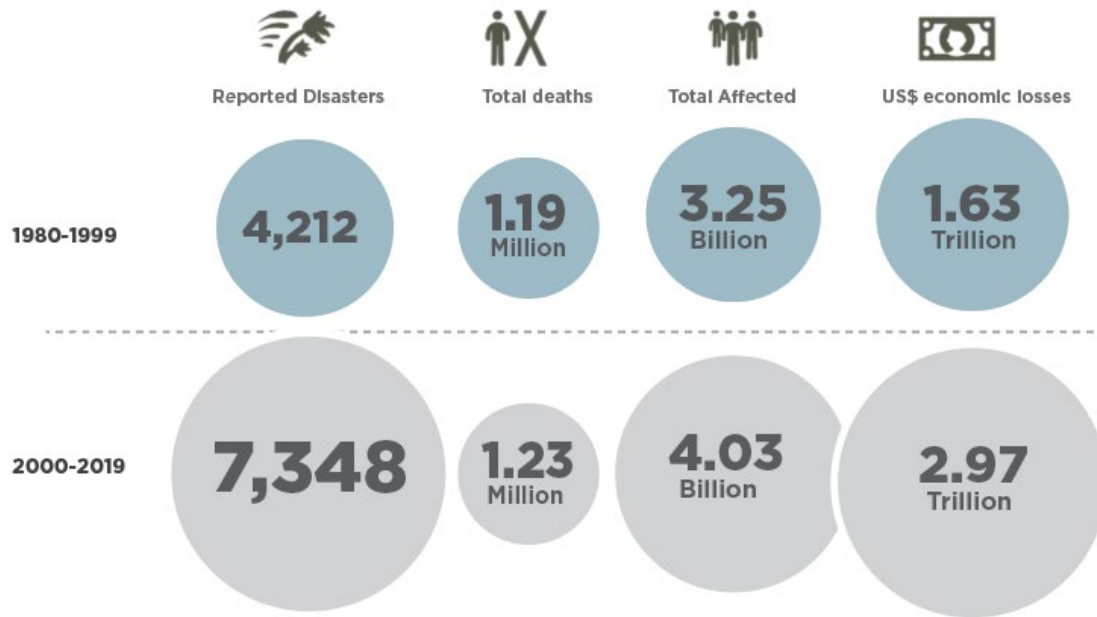


Figure 1: Comparison of Impact over 20-year periods. Data Source: CRED - UNDRR 2020

## 1.1 Defining and classifying disasters

**Disasters** or crises are novel large-scale events that disrupt lives, livelihoods, and resources. Disasters can be natural or human-made. Their response needs innovation and improvisation. The United Nations Office of Disaster Risk Reduction (UNDRR, 2009) defines a disaster as:

... a serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

The World Health Organization (WHO, 2002) describes disasters similarly:

A disaster is an occurrence disrupting the normal conditions of existence and causing a level of suffering that exceeds the capacity of adjustment of the affected community.

Ciottone (2016) further explains that any event that overwhelms existing societal systems is a disaster. Other experts define a disaster as one whose response requires taking exceptional measures and concerted efforts to manage the wide-scope unfavorable situation (Carter, 1992; Perry & Lindell, 2006; Quarantelli, 2000). Each of the above definitions emphasizes the phenomenon of "exceeding" a community's ability to respond. Disasters in the form of epidemics have been known to cause mass casualties for hundreds of years (Ciottone, 2016). Some hazards that cause natural disasters include earthquakes, hurricanes, tornadoes, wildfires, volcanic eruptions, pandemics, famines, droughts. Human-made disasters include bioterrorism, chemical warfare, other humanitarian crises caused by socio-political factors. Figure 2 shows a classification of hazards that lead to disasters. Globalization and the ease of travel have certainly made the transmission of pathogens and the spread of epidemics much easier (Howitt et al., 2017) – as we have witnessed with the COVID-19 pandemic.

### HAZARDS AND DISASTERS: CLASSIFICATION

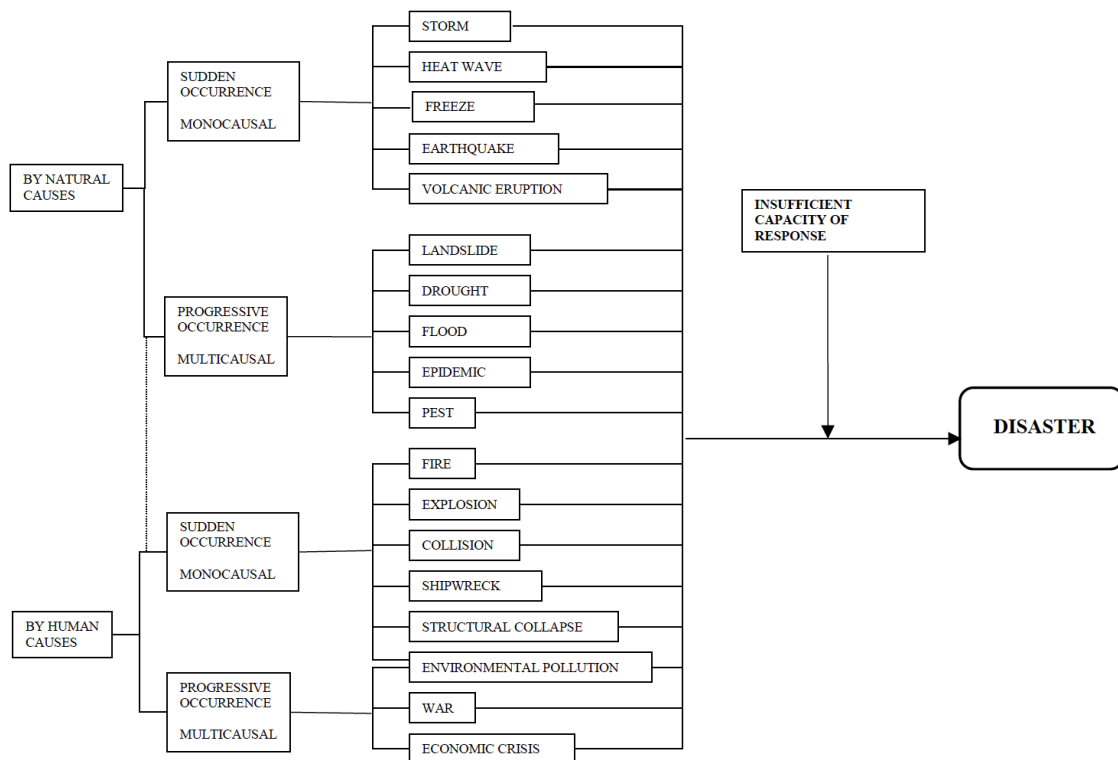


Figure 2: Classification of hazards that cause disasters. Source: WHO, 2002

Disaster Risk is generally defined as a function of hazard, vulnerability, and the capacity to respond (Wisner et al., 2004). **Vulnerability** is defined as the characteristics and circumstances of a community, system, or asset that make it susceptible to the damaging effects of a hazard; some factors that affect vulnerability include wealth, age, gender, health and disability status, race, ethnicity, caste, power structure, training and education, the fragility of infrastructure, economy, location, etc. **Hazards** are natural or human-made trigger events or phenomena mentioned above that can adversely affect lives, properties, or environment, and cause a disaster. **Resilience** is the ability of a system, community, or society to resist, absorb, and recover from a hazard's effects in a timely and efficient manner. The resilience of a community with respect to a potentially hazardous event is determined by the degree to which the community has the necessary resources and can organize itself both before and during times of need. (UNDRR, 2009).

The Center for Research on the Epidemiology of Disaster (CRED) is one of the world's leading agencies for the study of public health during mass emergencies, including natural-hazard-related, technological disasters, and human conflicts. As per data collected by CRED's Emergency Events Database (EM-DAT), the world's most comprehensive database on the occurrence and effects of disasters from 1900 to the present day, the deadliest disasters in the last 20 years (2000-2019) include: the 2004 Indian Ocean Tsunami and Earthquake (226,408); the 2010 Haiti Earthquake (222,570); the 2008 Myanmar Storm (138,366); the 2008 China Earthquake (87,476); the 2005 Pakistan Earthquake (73,338); the 2003 European Heat Wave (72,210); the 2010 Russia Heatwave (55,736); the 2003 Iran Earthquake (26,716); 2001 India Earthquake (20,005) and the 2010 Somalia Drought (20,000) (CRED (Centre for Research on the Epidemiology of Disasters) & UNDRR (United Nations Office for Disaster Risk Reduction), 2020).

Millions more were injured, went missing, were displaced, or had their lives threatened. Added to this was the colossal damage to infrastructure, livelihood, and health of those that survived. The direct economic impact on disaster-hit countries between 1978 and 2017 is estimated to be US\$4,221 billion (United Nations Office for Disaster Risk Reduction (UNDRR), 2018). There exist huge data gaps in the economic losses reported.

As per CRED, only 35% of all disaster events reported any economic losses. African countries reported economic losses for only 13% of their disaster occurrences, and South Asia reported economic losses for only 23% of their events. Despite the under-reporting, Figure 3 below demonstrates the breakdown of the reported economic losses in US\$ for the 20 years (2000-2019).

It should be noted that while not calculable, other intangible losses like the ecological impact and socio-cultural aspects of a society that has been completely wiped out or displaced due to a disaster also contribute to invaluable losses.

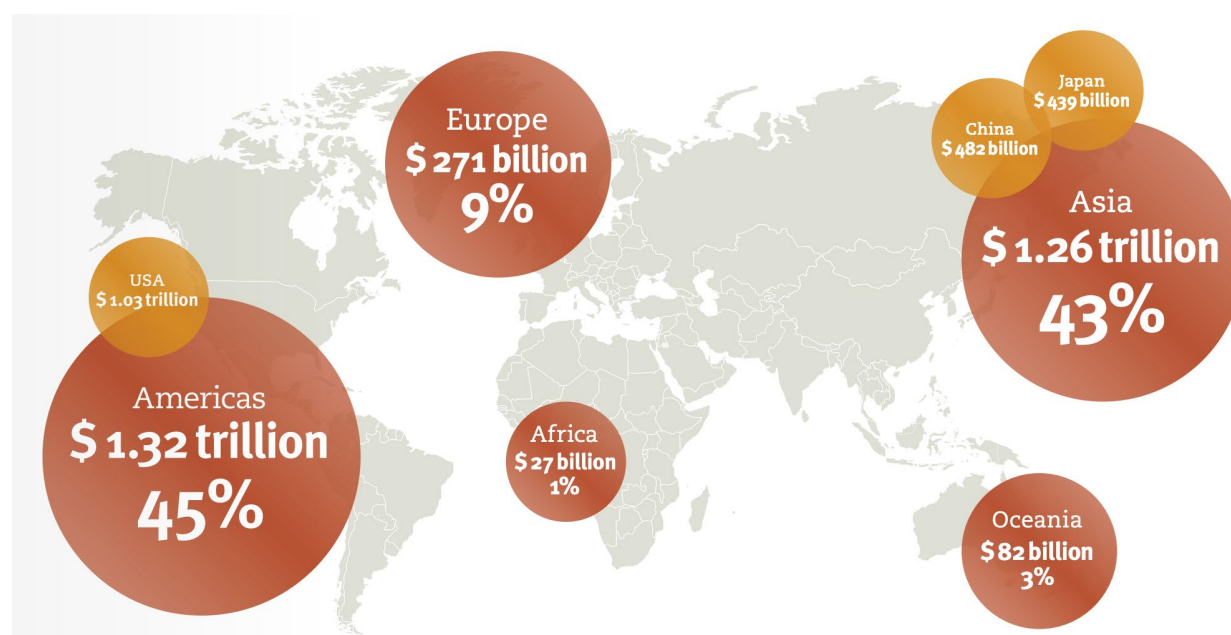


Figure 3: Recorded economic losses (2000-2019) Source: CRED, UNDRR 2020

**Disaster Management**, as defined by Carter (1992, p. xix), is a dynamic process that encompasses management functions of planning, organizing, staffing, leading, and controlling. He notes that it requires the involvement of many organizations that must work together to prevent, mitigate, prepare for, respond to, and recover from the effects of a disaster. Disaster management is, thus,

An applied science which seeks, by the systematic observation and analysis of disasters, to improve measures relating to prevention, mitigation, preparedness, emergency response, and recovery.

## 1.2 Differences between Emergency and Disaster, Emergency Management and Disaster Management

While this thesis will elaborate on the aspects of disaster management, it is essential to mention that various definitions differentiate disasters from emergencies, and therefore, disaster management from emergency management. Although disasters require innovative and hence distinctive responses compared to emergencies, the principles of the two overlap.

Howitt et al. (2017, p. 13) differentiate a routine emergency from a disaster or crisis based on "novelty." A novel characteristic that has not been experienced during an emergency can arise from three sources – the scale of the event exceeds anything planned for; the event is truly unique and unprecedented; or a combination of emergencies occur together and have cascading impacts that weren't planned for.

Some other experts differentiate between emergencies and disasters in that an emergency is an unforeseen state that requires extraordinary measures but can be responded to with available resources and known procedures. Emergencies occur more frequently and can be anticipated and managed by local emergency services, hospital systems, fire and police departments. Some emergencies, if not averted, can become disasters.

However, the fields of "Emergency Management" and "Disaster Management" have often been used interchangeably in the literature, especially in the context of biological and technical hazards, as well as for health emergencies. It should also be noted here that more recently, some experts refer to this field as Disaster Risk Management (DRM) and not Disaster Management because they believe that disasters as such cannot be managed, but it is the risks of disasters that are managed at various stages. For the development of this thesis, the research included both terms, emergency management, and disaster management, and has not been differentiated as such.

### 1.3 Public Health Crises

While public health systems are adversely impacted by any kind of disaster, public health crises primarily involve biological disasters, which include epidemics, bioterrorism, novel infectious diseases, and insect infestations, among others (Table 1). They are caused by exposure to living organisms (bacteria, viruses, parasites), their toxins, or vector-borne diseases they carry. Some recent examples include the Ebola outbreak, West Nile Virus Outbreak, H1N1 Influenza A (swine flu), MERS (Middle East Respiratory Syndrome), and the current COVID-19 (Severe Acute Respiratory Syndrome Coronavirus Disease SARS-CoV-2) pandemic.

NATURAL HAZARDS RELATED DISASTERS					
GEOPHYSICAL	METEOROLOGICAL	HYDROLOGICAL	CLIMATOLOGICAL	BIOLOGICAL	EXTRATERRESTRIAL
EARTHQUAKE	EXTREME TEMPERATURE	FLOOD	DROUGHT	EPIDEMIC	IMPACT
MASS MOVEMENT (DRY)	FOG	LANDSLIDE	GLACIAL LAKE OUTBURST	INSECT INFESTATION	SPACE WEATHER
VOLCANIC ACTIVITY	STORM	WAVE ACTION	WILDFIRE	ANIMAL ACCIDENT	

TECHNOLOGICAL DISASTERS		
INDUSTRIAL ACCIDENT	TRANSPORT ACCIDENT	MISCELLANEOUS ACCIDENT
CHEMICAL SPILL	AIR	COLLAPSE
COLLAPSE	ROAD	EXPLOSION
EXPLOSION	RAIL	FIRE
FIRE	WATER	OTHER
GAS LEAK		
POISONING		
RADIATION		
OIL SPILL		
OTHER		

Table 1: CRED Classification of Disasters based on hazards

Emergent infectious diseases have been a leading cause of mortality and morbidity for centuries (Larsen, 2018; Morens et al., 2004). In recent history, the world has been exposed to several infectious disease epidemics: the 1918-1919 Spanish influenza pandemic (Spanish Flu) killed at least 50 million people worldwide (Morens et al., 2004);

the HIV/AIDS pandemic has claimed 33 million lives and an estimated 38 million live with HIV as of 2019 (WHO, 2020); the 2014 Ebola outbreak recorded 28,638 cases and 11,316 deaths (Nii-Trebi, 2017); and the influenza A (H1N1) virus caused more than 18,400 deaths in 191 countries since its first confirmed case in the USA in April 2009.

In his article "Emerging Infectious Diseases: A real public health crisis?" Osterholm (1996) warned that emerging infectious diseases portended a growing concern of public health crisis. Multiple factors can be attributed to the emergence of new infectious diseases (Becker et al., 2006; Nii-Trebi, 2017). Some of them include microbial mutation and adaptation, changes in virulence and toxicity of pathogens, antimicrobial resistance, and genetic changes in organisms. Other examples of societal and human behavioral factors include exposure to new animal vectors, travel and commerce leading to the ability of diseases to spread to new geographical locations, environmental changes like deforestation, global warming, globalization of food supplies and production, and healthcare activities like widespread use of antibiotics. Societal disruptions, war, and other natural disasters have often been followed by an increase in infectious disease and outbreaks due to inadequate living conditions and unavailability of clean water and sanitation facilities (Kouadio et al., 2012; Suk et al., 2020; Watson et al., 2007). Cholera outbreaks in humanitarian settings and malaria outbreaks after flooding are common examples.

Such biological infectious disease outbreaks are considerably different from other natural hazard-related disasters like geophysical, meteorological, hydrological, climatological, and extraterrestrial hazards. People who experience infectious diseases might have long-term health consequences due to effects on their immune systems (Larsen, 2018). Historically, a strong association has been found between infectious disease and mortality (Larsen, 2018). The invisibility of the organism to the naked eye makes it difficult to detect or trace them, also making their transmission easier across communities and globally. Unlike other hazard events, which can last from a few seconds in the case of an earthquake to a few days or weeks (wildfires), biological outbreaks can continue to spread over an extended period of time (the COVID-19 pandemic has lasted for over a year now) (Howitt, 2020b). Even though disasters are characteristically novel, emergent infectious diseases

make the disaster response even more challenging as scientific expertise, and time-consuming research is needed to understand the emergent infectious disease and their genetic makeup. The new organism's origin, structure and transmissibility, and risk factors have to be analyzed. Responding to an infectious disease outbreak also involves surveillance, contact tracing, laboratory testing, quarantining measures, understanding community spread, and clinical management of cases. Developing countermeasures like vaccines and regulations around the response based on scientific evidence is time and resource heavy. All of the above require specialized skills, clinical capacity, and training to contain the crisis and respond to it. As more time passes, such crises are exacerbated and wreak havoc in the socio-economic aspects of the society at large. Evolving scientific evidence about an outbreak and accordingly changing regulations and policy guidelines create uncertainty and communication challenges about the situation and action required by the public. (Lee et al., 2013). The COVID-19 pandemic has demonstrated that managing such crises and averting global impact requires a multidisciplinary effort.

### 1.3.1 Public Health Emergency Preparedness (PHEP)

Public health systems play an essential role in the complex dynamics of preparing for and responding to disasters. Public health agencies lead the preparedness and response for infectious disease outbreaks but also need to be prepared to coordinate and collaborate for other types of disasters that inevitably require health system support. Public health emergency preparedness and response capacities at local, state, and federal levels, therefore, need to be robust.

The three elements of Public Health Emergency Preparedness (PHEP) are a public health crisis, what its preparedness entails, and who is involved. Using these elements and an all-hazards approach to preparedness, PHEP has been defined as:

Public health emergency preparedness (PHEP) is the capability of the public health and health care systems, communities, and individuals, to prevent, protect against, quickly respond to, and recover from health emergencies, particularly those whose scale, timing, or unpredictability threatens to overwhelm routine capabilities. (Nelson et al., 2007)



At the heart of this definition are the public health and related systems and their ability to coordinate and continuously improve their responses, on which this study focused. The National Academy of Sciences uses the term **public health emergency preparedness and response (PHEPR)** when referring to this field. They define PHEPR as:

A practice broadly as a type of process, structure, or intervention whose implementation is intended to mitigate the adverse effects of a public health emergency on the population as a whole or a particular subgroup within the population. (National Academies of Sciences, 2020, pp. 1–9)

In 2011 the Centers for Disease Control and Prevention (CDC) presented a national capability-based framework in the form of 15 interrelated standards, as listed in CDC's *Public Health Emergency Preparedness and Response Capabilities: National Standards for State, Local, Tribal, and Territorial Public* (CDC, 2019). In the absence of a well-defined agenda or even a standardized definition of PHEP, these standards provided jurisdictions with a structure to plan and operationalize emergency preparedness functions with which to protect against, prepare for, respond to, and recover from emergencies.

CDC's capability standards and the PHEP cooperative agreement program also support the Federal Emergency Management's (FEMA) National Preparedness System's operational goals "to prevent, protect against, mitigate, respond to, and recover from the threats and hazards that pose the greatest risk" to the nation.

The CDC enumerates 15 capabilities under the five functional areas: Planning Framework, Common Terminology, Public Health Role, Collaboration Tools, and Evaluation Planning (Figure 4). The 15 capabilities are grouped under six domains and two tiers. The domains are: Community Resilience; Incident Management; Information Management; Countermeasures and Mitigation; Surge Management; and Biosurveillance. Tier 1 capacities are foundational to PHEP, and Tier 2 capacities are dependent on Tier 1 capacities standards. Tier 2 capacities are also more cross-cutting (Table 2).



Figure 4: PHEP Functional Areas. Source- US CDC [www.cdc.gov/cpr/readiness](http://www.cdc.gov/cpr/readiness)

Domain	Capability and Tier
Community Resilience	Community Preparedness (Tier 1)
	Community Recovery (Tier 2)
Incident Management	Emergency Operations Coordination (Tier 1)
Information Management	Emergency Public Information and Warning (Tier 1)
	Information Sharing (Tier 1)
Countermeasures and Mitigation	Medical Countermeasure Dispensing and Administration (Tier 1)
	Medical Materiel Management and Distribution (Tier 1)
	Nonpharmaceutical Interventions (Tier 2)
	Responder Safety and Health (Tier 1)
Surge Management	Fatality Management (Tier 2)
	Mass Care (Tier 2)
	Medical Surge (Tier 2)
	Volunteer Management (Tier 2)
Bio surveillance	Public Health Laboratory Testing (Tier 1)
	Public Health Surveillance and Epidemiological Investigation (Tier 1)

Table 2: CDC's 15 Capability Standards for PHEP

## 1.4 Disaster management cycle framework

The disaster management cycle consists of four phases: **Mitigation, Preparedness, Response, and Recovery**. The four phases of disaster risk management encompass the work done pre-, during, and post-disasters. These four phases do not occur in isolation; they overlap one another, and their durations can vary with contexts (Figure 5).



*Figure 5. The Disaster Management Cycle*

Over time, other terms used in disaster risk management have been added by various experts to modify the cycle. Examples include prevention, protection, rehabilitation, reconstruction, etc. For the purpose of this thesis, the fundamental disaster risk management cycle is used, which encompasses phases like prevention and protection in the mitigation phase and rehabilitation and reconstruction in the recovery phase.

**Mitigation** is defined as the phase for minimizing the causes and adverse effects of a hazard and associated disaster in anticipation of it (other terms for this phase include prevention, risk reduction, and hazard mitigation). Activities in this phase include those that prevent a crisis, reduce the likelihood of its occurrence, or reduce the risks or damaging effects of unavoidable hazards. More specifically, prevention refers to the complete avoidance of the impact of a disaster. Most often, it is not feasible to avoid a

hazard altogether. Mitigation measures try to reduce the scale or severity of the adverse impacts. Mitigation activities must be undertaken long before a disaster emergency. They include engineering techniques, hazard-resistant infrastructure, environmental policies, and as well as intangible measures that will be discussed in more detail later. The term mitigation is defined differently in climate change policy and implies the reduction of greenhouse gas emissions that cause climate change.

Further details on the challenges of mitigation are discussed in the sections following the disaster risk management cycle.

**Preparedness** includes planning, knowledge, and capacity-building to face disaster events. It involves governments, professional response and recovery organizations, and communities getting ready to face an imminent or current hazard. The quality of preparedness is dependent on the robustness of risk assessments, early warning systems, emergency stockpiles of supplies and equipment, training and coordination, public information dissemination, etc.

Preparedness and Response phases are highly dependent on plans, especially action plans or operations plans which provide directionality. Plans can be prepared at the national, state, and local levels, all the way down to the organizational level. Because of each disaster's novelty, these plans should be flexible and focused on processes, responsibilities, coordination mechanisms, and usability. Plans should be regularly updated and remain relevant to the times. Inadequate organizational structure or planning can create challenges for preparedness (Carter, 1992).

Disaster preparedness is a dynamic process and involves several aspects, along with having a clear policy directive and organizational structure in place. Preparedness involves identifying and monitoring threats, estimating the impact of the impending disaster in terms of casualties, damage to property and services, and other economic losses, and assessing the capabilities needed to respond to the disaster. Preparedness measures also include an up-to-date inventory of all available resources, organizations, roles, and responsibilities. Systems and facilities needed for response should be readied and operational, including communication systems, equipment, supplies, warning

systems, emergency operations centers, emergency relief arrangements, health systems, etc. Preparedness also includes training, public communication, and liaising for support and coordination. All such preparedness measures should be included in the planning documents. Similar to the above institutional preparedness measures, community preparedness consists of training and mobilizing the communities to prepare for local response mechanisms to prepare for and respond to disasters at the community level (*Disaster Preparedness Tools - IFRC, n.d.*).

**Response** occurs during a disaster and in its immediate aftermath. The focus is on saving as many lives and as much property as possible, reducing health impacts, ensuring public safety, and meeting the basic subsistence needs of the people affected in the short-term (it also includes the rescue phase or the disaster relief phase).

Successful response efforts are dependent on good preparedness, and effective response, in turn, impacts recovery (Carter, 1992). Effective response relies on accurate information and resources. Response efforts are dependent on the type and severity of disasters, and consequently, the early warnings and detection to act timely. Effective response phase leads to a direct impact on reducing disruption of life and property as well as fewer casualties.

Along with the understanding of the organizational capabilities and depending on the type of disaster, response includes activating response plans, coordinating and communicating actions, rescue operations, hospitalizations, clinical treatment, evacuations and sheltering, providing food and other subsistence, managing the health and sanitation, taking policy decisions to prevent further impact, and communication to the public on the situation. In case of a biological disaster, it would also involve understanding the microorganism, disease surveillance and transmissibility, understanding risk factors, developing vaccines, increasing healthcare capacity, implementing vaccine supply chain mechanisms, and forming regulations around these efforts and other response measures, as were discussed in the previous section.

Response is a particularly challenging phase of disaster management because it involves operating in disrupted environments that present a unique and complex set of problems.

A hazard leading to a crisis might damage vital response infrastructure and resources like emergency operations centers, medical centers, power supply and transportation, communication systems, logistics, etc. It might also affect key personnel like essential workers and health system workers critical to responding to the crisis. Misinformation related to a crisis can also affect public behavior and attitudes, thereby exacerbating the crisis and impeding response efforts (Eysenbach, 2020; Tangcharoensathien et al., 2020). Inadequate or outdated plans, lack of readiness in terms of resources, including warning and surveillance systems, uncoordinated organizational structures, and lack of timely public communication and awareness-raising are some of the major problems seen in ineffective and delayed response efforts. Poor information management within organizations and with the public, shortage of trained personnel to respond, shortage of essential supplies or logistical challenges, and underestimating the disaster impact are other known problems in response (Carter, 1992).

**Recovery** involves rebuilding, restoring, and improving facilities, livelihoods, and living conditions of disaster-affected communities to bring life back to normalcy after a disaster (other terms for this phase include rebuilding, rehabilitation, reconstruction).

Recovery involves infrastructure restoration and rebuilding, economic recovery to generate livelihood and job security, environment recovery from the ecological impact, as well as helping communities recover from trauma, health issues, displacement, and loss of socio-cultural aspects of their lives (Sena & Woldemichael, 2006). Planning for recovery should involve community participation to understand local needs and challenges.

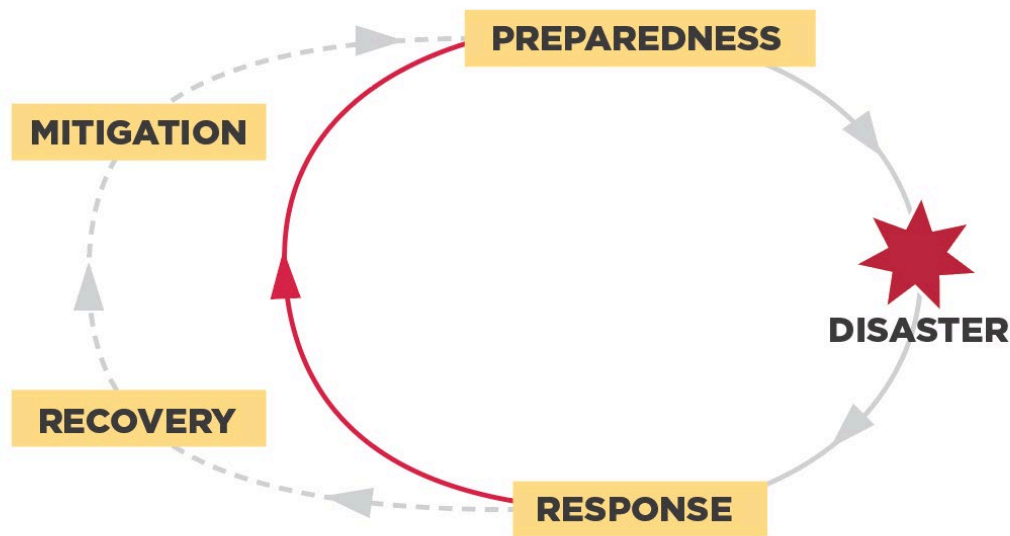
Recovery poses its own constraints, and its goals often compete; examples of such aspects include: rebuilding faster, rebuilding safer, rebuilding better, rebuilding equitably, and rebuilding cheaper (Howitt, 2020a). Building consensus and making decisions on such competing priorities often delay the formulation of recovery programs and their implementation. Recovery can also be delayed due to cascading impacts of disasters that may lead to consequences from which recovery was not initially planned.

Like mitigation, recovery is a long-term process that should be based on pre-existing strategies and policies to facilitate clear institutional responsibilities for recovery actions. As per UNDRR, recovery programs that include public participation through increased public awareness and engagement after a disaster can provide a valuable opportunity to develop and implement disaster risk reduction measures. Sadly, similar to mitigation, long-term recovery is often neglected and results in increased susceptibility to future hazards.

### 1.5 Disaster mitigation – Important but neglected

The Sendai Framework for Disaster Risk Reduction 2015–2030 (Sendai Framework) was adopted by 187 Member States at the 3rd United Nations World Conference on Disaster Risk Reduction. The emphasis of the framework is on the mitigation aspect of the disaster management cycle, specifically on disaster risk management to build resilience and reduce risks using an all-hazards approach.

Very often, attention and resources are focused on the preparedness and response phases of the disaster continuum. Mitigation and recovery, although very important, are often ignored. As in any system with interlinked parts and cyclical processes, weaker links can adversely impact the other links. The lack of a smooth and efficient disaster feedback loop can be a hurdle to progress (Figure 6). By strengthening disaster mitigation, adaptation, and resilience in advance of disasters, we do not just respond well – we also protect what we have built along the way and are able to recover, rebuild and rehabilitate better and more quickly. Understanding mitigation as one of the weaker links, and its importance to the field of disaster management, this thesis has been developed with a focus on mitigation.

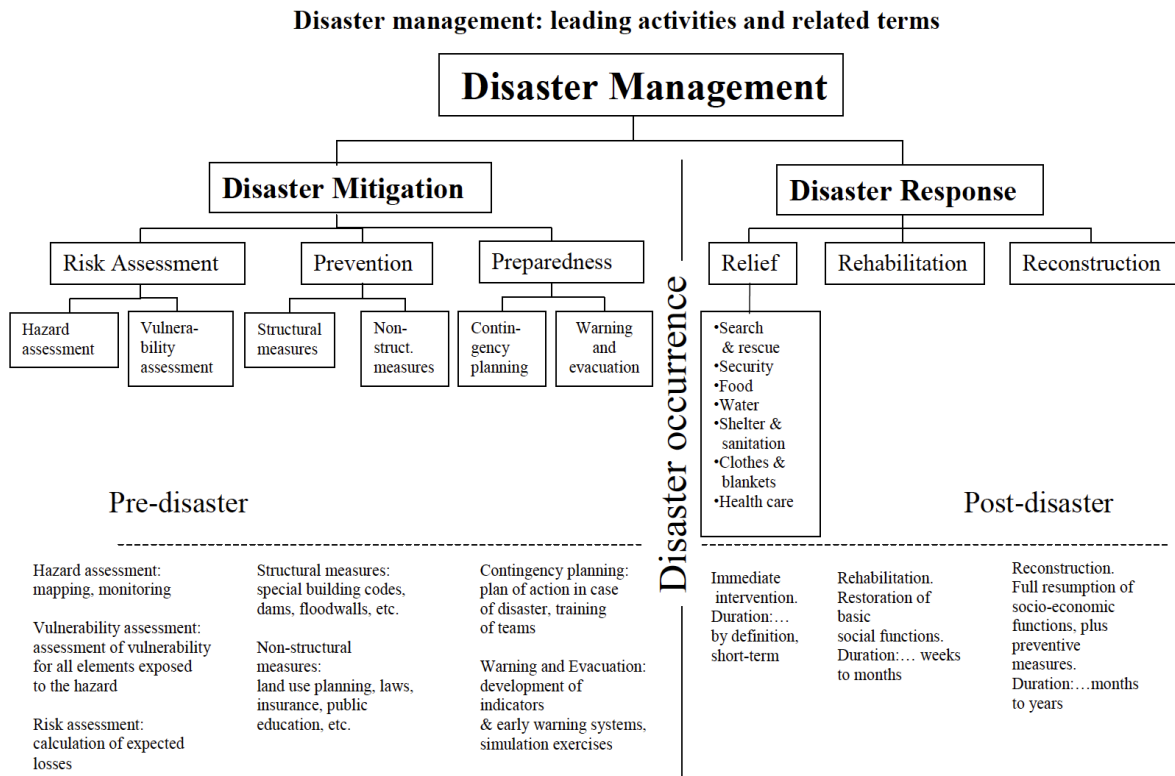


*Figure 6: Disaster Management Cycle Challenge, Source: Shroff, A*

Mitigation, as defined earlier, is the phase of the disaster management continuum that tries to anticipate and minimize the causes and effects of a disaster. Standard mitigation or risk reduction measures include risk assessments for hazards and vulnerability that help to gauge estimates of possible losses and recommend structural and non-structural measures like applying building codes, building dams and levees, developing policies, providing guidance, and spreading information among the public.

Some disaster mitigation activities as defined by WHO and shown in the Figure 7 include a risk assessment to calculate expected losses, hazard assessment to map and monitor hazards like hurricanes, and, most importantly, vulnerability assessment to understand the hazard-exposed population's vulnerabilities. Social disparities, health and living conditions, other socio-economic conditions, education, age, and other factors can increase the impact of the hazard. Other preventative mitigation measures include structural measures like dams, floodgates, levees, buildings and facilities, utilities, transportation, and telecommunications infrastructure, and non-structural measures like laws, plans, policies, and checklists.





*Figure 7: Disaster Mitigation activities as per the WHO*

In order to make countries and communities more resilient, Priority 4 of the Sendai Framework Disaster Risk Reduction recommends countries integrate disaster risk reduction or mitigation into their development efforts (UNISDR, 2015).

In a multi-case study conducted in Europe, small, medium, and large-scale investments in infrastructure and protection measures were reported after each disaster. Infrastructure measures included reforestation, updates in technology, better surveillance, adding emergency exits, flood protection building measures, and flood-proofing of public buildings. Existing emergency plans, rescue plans, and checklists were also updated after every disaster. In some cases, new working groups and units were created, policies were reevaluated, and some resources were invested into further research on specific hazards (Lorenzoni et al., 2020).

Most recommendations on mitigation focus on structural and non-structural improvements, but not on other more intangible measures that can help to integrate these improvements.

#### 1.5.1 Challenges and barriers to disaster mitigation

Mitigation efforts and building resilience involve long-term efforts. The success of these efforts is dependent on the economy, the political incentives, governance structures, social inequalities, the historical context, and health outcomes, in addition to the nature of the hazard and geography of the region.

Various factors and the interaction between the stakeholders can enable or deter efforts of disaster mitigation. In some instances, lack of political incentives might deter preparedness; in other cases, it could be lack of money, technical know-how, or prior experiences with disaster. Underlying political and economic structures in developing countries have a substantial impact on how natural disasters are managed and how they affect different strata of people. Neumayer, Plümper, & Barthel (2014) argue that the propensity (frequency and intensity) of a natural disaster determines actions by governments and private parties. Strömberg (2007) suggests that people in low-income countries are 12 times more likely to die from natural disasters and more likely to suffer economic consequences. Furthermore, a natural hazard becomes a disaster only when it strikes those who are vulnerable to it (Cannon, 1994).

#### Stakeholder roles in disaster mitigation

Efficient working of any part of the disaster continuum requires coordination and collaboration across the different phases as well as among the various stakeholders. It is, therefore, necessary to know about the roles and the investment of the people involved. Stakeholders include: populations and disaster survivors; responders; local communities; aid-providing agencies; private sector; non-governmental organizations; inter-governmental organizations; local and national governments; regulatory bodies that authorize finances for prevention, preparedness, response, and recovery; legislative bodies that make regulations for prevention; urban planning and public works offices;

health services and emergency health management authorities; medical supply-chain; disaster relief authorities; environmental, geological, scientific, technical and local experts; donors and international partners; among many others.

#### A political perspective on mitigation

Governments can help build resilience by regulating the use of risk-prone areas to prevent disasters, and by passing stringent building codes in high-risk areas (Kenny, 2009; United Nations & World Bank, 2010), or undertake large protection measures like building dams and early warning systems. Unfortunately, many do not prioritize doing so (Neumayer et al., 2014). Neumayer et al. posit that governments exert more influence and gain political support by acting on post-disaster response than by working towards prevention. They avoid politically unpopular decisions of stringent regulations and long-term preparedness despite understanding the benefits. The government's ability to act on prevention is only incentivized when a country starts facing frequent and high-intensity natural hazards, and taxpayers believe that it is worth the expenditure.

Cohen & Werker's (2008) political model of disaster suggests that governments are less risk-averse than populations (who are quite risk-averse themselves), and hence spend much less on prevention and insurance, and are more willing to spend on the response when a disaster occurs.

Moreover, in the case of natural hazards, individuals can mitigate disasters by either not living in or doing commerce in high-risk areas, or by constructing robust structures that minimize the chances of damage. Both of these options are not popular (Neumayer et al., 2014). Extreme natural hazards are rare, and their occurrences are unpredictable so, similar to governments, populations tend to ignore risks. Secondly, robust infrastructures are expensive and still do not provide certainty that they might withstand a severe natural hazard. Moreover, purchasing insurance that will cover any costs of damages further disincentivizes individuals from making their infrastructure more resilient, making it a moral hazard issue.

## Socio-economic vulnerabilities

It is not sufficient to prepare for and mitigate hazards from a technical perspective without considering the social-economic situations which make people vulnerable and risk-prone to disasters (Cannon, 1994; Wisner et al., 2004; Wisner & Luce, 1993). The socio-economic and political space within which people exist defines their vulnerabilities and hence contributes to the risks they face. Figure 8 illustrates "The Social Causation of Disasters" framework posited by Wisner et al., first in 1994 (Wisner et al., 2004). The framework below depicts that people have different opportunities, resources, and exposure to hazards. At the same time, economic, political, and social factors play significant roles in determining who is most at risk from hazards and their level of protection and preparedness for a disaster. The disaster risk faced by people is dependent on their vulnerabilities, which in turn depends on social systems and power relations. To manage the risk of disaster, the political economy that operates at large scales needs to be understood and taken into consideration.

For example, an earthquake of similar magnitude has different impacts on people in different countries and even in different social strata within the same country. Some people are able to avoid the impact, others not. Unequal exposure to risks results from social and economic systems and is a function of power that is affected by race, gender, ethnicity, and age, among other measures.

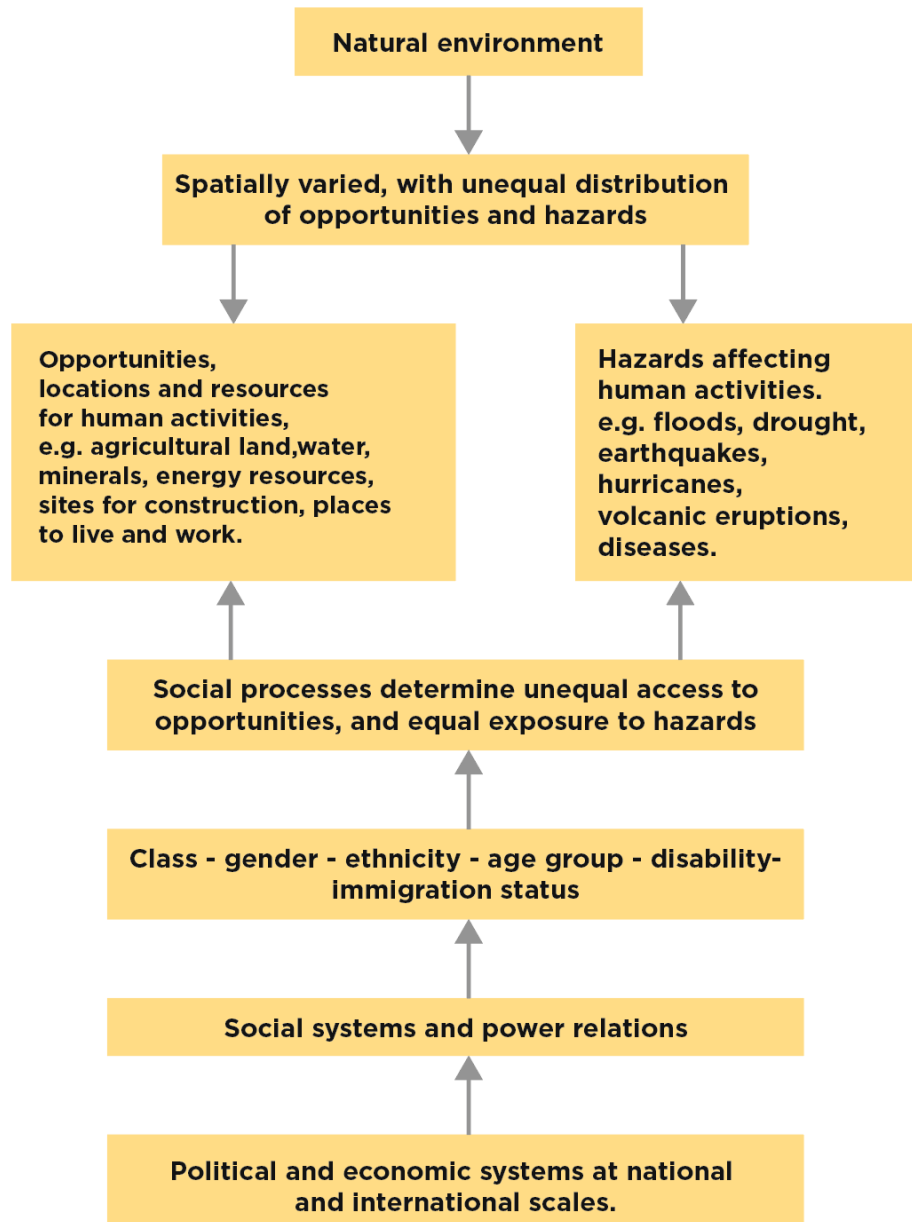


Figure 8: *The Social Causation of Disasters* (Wisner et al., 2004)

Furthermore, natural hazards themselves are sometimes a result of economic and political growth, aspirations, or greed. Deforestation, fracking, and famines in war-torn regions are well-known examples. Hence, economic and political factors can potentially cause natural hazards and turn natural hazards into disasters. Figure 9 illustrates how national and international political economy leads to power and control of natural resources and can affect environmental degradation to a point where natural hazards and, eventually, disasters become inevitable.

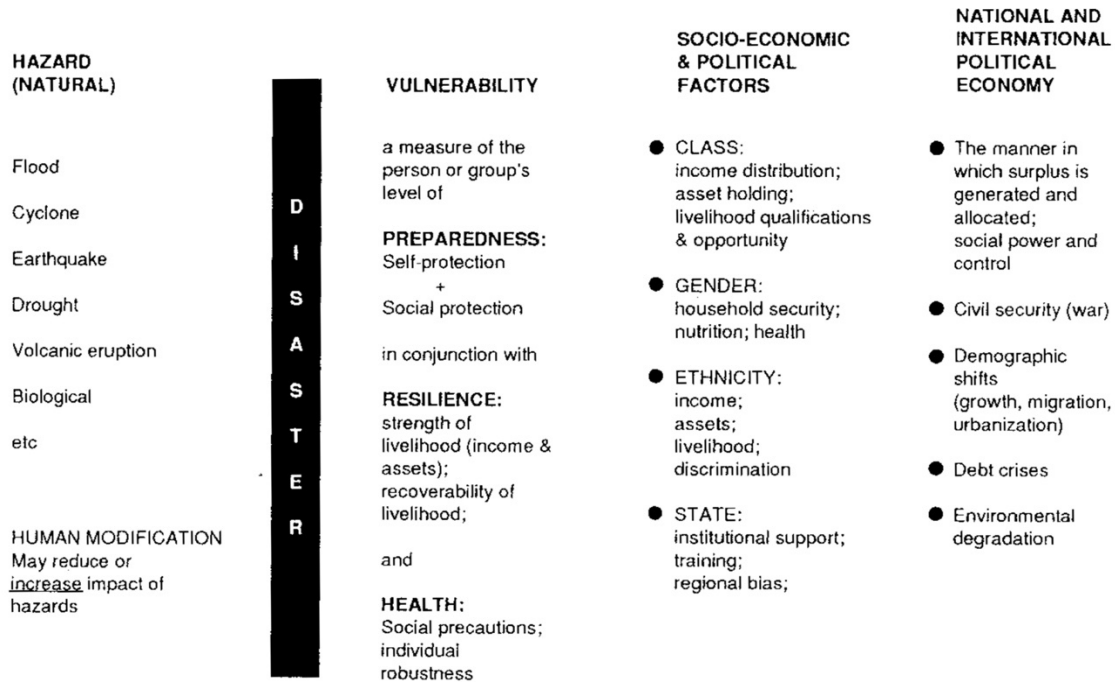


Figure 9: Model Illustrating the relationship between hazard and vulnerability and its root causes.  
Source: (Cannon, 1994)

Economic conditions of people can be some of the most significant barriers to mitigating disaster. The low-waged, marginalized populations live in flood-prone regions of Bangladesh or unstable slopes of Rio de Janeiro because of the system that they are a part of. Their ability to protect themselves and recover from a disaster is negligible. Their lifestyle and livelihood also become the cause of further environmental degradation (Kafiluddin, 1991, p. 199). Social protection provided by the government or NGOs is also dependent on the prevalent inequities, people's position in society, and their access to resources.

#### The propensity of events and risk perception

When the propensity, i.e., frequency and intensity of events, is high, governments and individuals tend to focus on preparedness. When such events are rare and infrequent, attention and resources tend not to be focused on prevention (Ismail-Zadeh & Takeuchi, 2007; Neumayer et al., 2014).

Superstorm Sandy hit New York City in 2012 and inundated the city. The city infrastructure could not handle the storm surges, flooding the subway system and causing widespread damages. While the city had been aware of flooding risks, none of the recent natural events brought the city to a halt; hence, preparation for a disaster as infrequent as the superstorm was not a priority even for a city as important as New York. Post-Sandy, efforts are underway to make the city resilient enough to withstand future extreme events. Storm-surge barriers, flood gates, upgraded electric equipment, and expansion of alert systems were implemented only because of the disaster and the anticipation of similar ones in the future.

Psychological research suggests that recent experiences and emotions associated with a disaster increase people's risk perception. Studies have found that losses and shocks due to experienced disasters affect people's perceptions about the severity of future disasters and thus their attitudes, behavior, and investment patterns over time. For instance, a study conducted in a village on the island of Java in Indonesia, a country prone to natural disasters, found that in villages that were affected by earthquakes or floods in the last three years, people were more risk-averse as compared to those in the villages further away from the epicenter of large earthquakes (Cameron & Shah, 2015).

#### Disasters and Fragile and conflict-affected contexts

While there is scant data on how disasters interact with fragile and conflict-affected contexts (FCAC), there exists empirical evidence that they frequently intersect (Peters, 2017; Siddiqi & Peters, 2019; Walch, 2018). As per an Overseas Development Institute (ODI) report, between 2004 and 2014, 58% of deaths due to natural disasters occurred in the 30 most fragile and conflict-affected contexts (Peters, 2017). Despite the available data, these countries receive assistance after the fact to respond to disasters rather than towards building their adaptive capacity and resilience. Ismail-Zadeh & Takeuchi (2007) point out that disaster risk reduction can become a priority only in times of peace. Researchers have highlighted the adverse effects of conflict in East Africa on their drought management. In South Sudan, conflicts and subsequent famines, despite their fertile lands, expose the increase in vulnerability (Walch, 2018). At the same time, there is

growing literature, although, without consensus, that natural disasters could catalyze conflict and violence (Burke et al., 2009; Hsiang et al., 2013; Von Uexkull et al., 2016).

Disaster risks for populations result from exposure to natural or human-made hazards coupled with the population's coping capacity to deal with the conditions. In fragile and conflict situations, this coping capacity is minimized, and their vulnerability is increased. Resources that could be used for disaster risk reduction (DRR) and response are often diverted in times of conflict. Armed conflicts lead to population displacement, expose them to hazards, increase their vulnerability, and even obstruct response and recovery provisions (Walch, 2018; Wisner et al., 2004). Wars can also destroy infrastructure like dams and levees and expose populations to more hazardous situations. However, depending on the context, DRR interventions could differ and even be sustainable in some contexts (Siddiqi & Peters, 2019; Walch, 2018). More recently, international agencies and policymakers are working to understand the dynamics and develop DRR programs in fragile contexts (Hewitt, 2014; Neaverson et al., 2019; Siddiqi & Peters, 2019).



## **2 Systems Thinking and Public Health Services & Systems Research**

### **1.1 Defining a System**

An interrelationship exists between all elements and constituents of society. The essential factors in public problems, issues, policies, and programs must always be considered and evaluated as interdependent components of a total system. (Manning, 1967)

Anderson and Johnson (1997) define a system as a group of "interacting, interrelated, or interdependent components that form a complex whole." A system includes tangible and intangible elements. Tangible components include equipment, people, property, financial resources, among other things. Intangible elements consist of processes, policies, information flow structures, relationships, interpersonal interactions, and even underlying sets of beliefs and values systems.

Systems are differentiated from a collection in that the specific interconnectedness of all the components of a system is needed to ensure that the system functions optimally. Systems have sub-systems, and they all interact with each other to stabilize and optimize the system. Because of the dynamic relationship, a change in one sub-system may or may not affect another sub-system, the system itself, or a yet larger system of which the system is a part. Systems rely on feedback, which involves the transmission and receipt of information that has been processed through other parts of the system. Feedback is critical to any system because it helps it recalibrate and adjust itself to optimize its output.

Russ Ackoff, a pioneer in the field of operations research, systems thinking, and management science, explains that systems thinking can be used to recognize not just the fact that a part of the system is not working but also why it is not working.

### **2.1 Systems Thinking**

Peter Senge, in his book, *The Fifth Discipline* (2006), defines systems thinking as:

... a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static snapshots. It is a set of general principles distilled over the course of the twentieth century, spanning fields as diverse as the physical and social sciences, engineering, and management... During the last thirty years, these tools have been applied to understand a wide range of corporate, urban, regional, economic, political, ecological, and even psychological systems. And systems thinking is a sensibility - for the subtle interconnectedness that gives living systems their unique character. Today systems thinking is needed more than ever because we are becoming overwhelmed by complexity.

Systems thinking has been defined as a framework, a perspective, a skill set, a language as well as a set of tools (V. Anderson & Johnson, 1997; Arnold & Wade, 2015; Bosch et al., 2007; Monat & Gannon, 2015, p. 17; Sterman, 2002). Systems thinking has been and can be applied to many disciplines; therefore, there exist many schools of systems thinking and various interpretations of its definition. Regardless of the interpretations, there is consensus on the importance of taking a holistic view of an interconnected system and that systems thinking is critical for understanding the root causes of complex problems.

Barry Richmond (1994), credited with coining the term "systems thinking," defined it as "the art and science of making reliable inferences about *behavior* by developing an increasingly deep understanding of the underlying *structure*." Systems thinking posits that **"everything and everyone is interconnected in an infinitely complex network of systems"** (V. Anderson & Johnson, 1997, p. vii). Systems thinking can offer a very valuable perspective on persistent and complex organizational challenges that we encounter and which we are unable to solve through conventional thinking. It zooms out from the current *event* further beyond examining the *pattern* of events to a higher level of understanding of what *structures* might be in place that are causing these patterns of events (V. Anderson & Johnson, 1997, pp. 5–9).

**The Iceberg Model** (Hall, 1976) is often used to understand systems thinking (Figure 10). The model posits that underneath every event that can be perceived, there are patterns, systemic structures, and mental models that are hidden. Interconnecting events

can help us understand the patterns underneath. At the next systemic structural level are organizational and social hierarchy; relationships; rules and procedures; levels of authority; process flows; incentives, goals, and metrics; attitudes; reactions and the incentives and fears that cause them; corporate culture; feedback loops and delays in the system dynamics; and underlying forces that exist in an organization (Monat & Gannon, 2015). Understanding these systemic structures can help us understand the mental models that cause them.

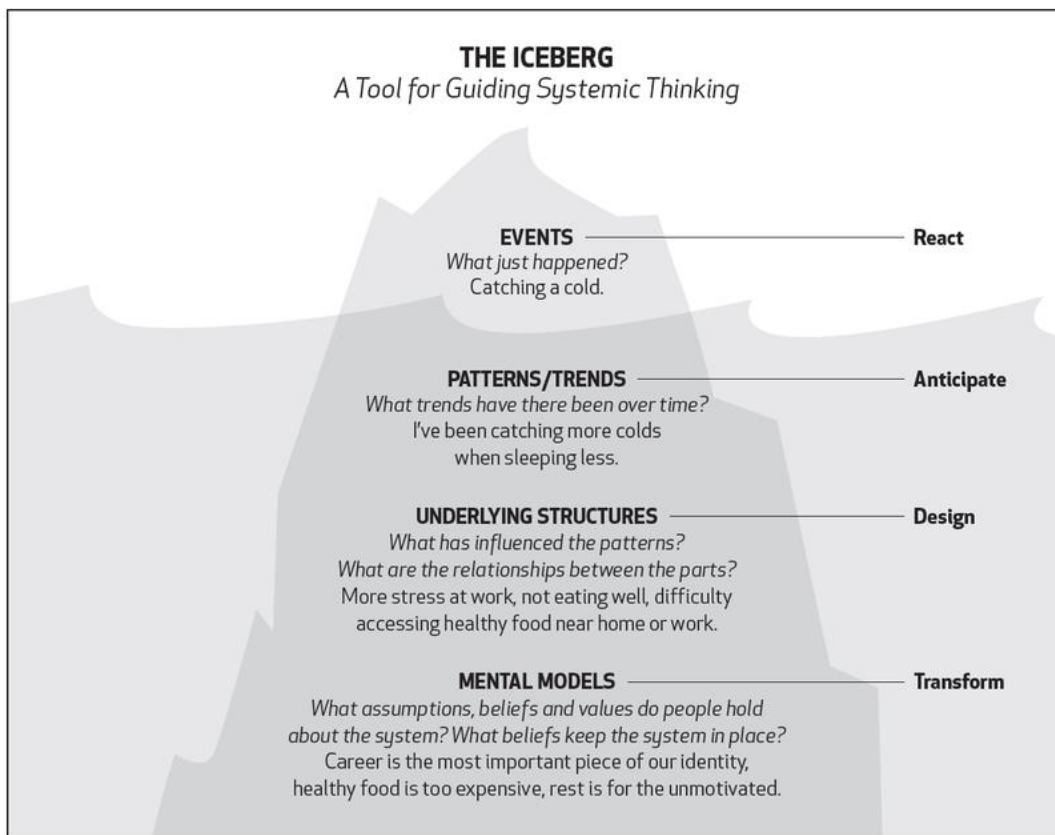


Figure 10: The Iceberg Model. Source:(Iceberg Model, n.d.)

The **Heifetz' Adaptive Leadership framework** recommends continuously perceiving, observing, and intervening by moving between the metaphoric dance floor and balcony (R. A. Heifetz et al., 2009). The balcony view gives perspective and helps make observations, but then one also needs to get down to the dance floor to make interventions. Getting on the balcony for a holistic view of complex adaptive challenges is similar to systems thinking, which is based on the principle of widening the focus to

understand a problem as a part of a more extensive system in order to find an effective solution. Another principle of systems thinking involves analyzing potential short-term and long-term impacts of a strategy before making a decision, without assuming that one will lead to a positive effect on the other. At the foundation of systems thinking is the interconnected and dynamic nature of everything and, as a result, complexity and interdependence. Finally, systems thinking encourages considering the immeasurable, unseen, intangible aspects of systems, which nonetheless affect the workings of any system. Some intangible elements that affect systems include unintended consequences, assumptions, values, and beliefs.

As globalization increases and the world becomes more interconnected, it faces greater complexity, and systems thinking becomes an even more critical approach that should be mainstreamed (Arnold & Wade, 2015). Some experts strongly argue that people in decision-making roles should have a sound understanding of systems thinking (Arnold & Wade, 2015; Senge, 2006).

Don Berwick, one of the nation's leading authorities and innovators of quality and improvement in the US healthcare system, a Harvard professor and former administrator of Centers for Medicare & Medicaid Services (CMS), stated, "the systems thinker is a perpetually curious person..." The value of systems thinking and research to public health can be well understood by recognizing the influence that the dynamics, complexity, and relationships in public health systems can have on a population's health (Thomas et al., 2015).

Disaster management fits the requirements for identifying a systemic problem that requires systems thinking analysis (V. Anderson & Johnson, 1997):

- The disaster management problem is chronic and recurring
- It has been around for a long time
- People have been trying to solve it without success
- An apparent reason for such a pattern over time is yet to be identified

- Various aspects of disasters follow classic patterns of problem behavior like sharp ups and downs in resources, the oscillating frequency of specific natural disasters, no evident change in resilience-building after disasters, etc.

## 2.2 Systems Thinking and Disaster Management

Using the systems thinking approach, disaster management issues can be better understood, prioritized, and adjustments can be made to the organizational approach to disaster management issues. Systems thinking emphasizes the dynamic nature of processes, and in line with findings from the case study, this thesis highlights the need for organizations to work on long-term mitigation efforts continuously. Additionally, robust communications with the stakeholders and various sub-systems can further their individual goals and the disaster management system's overall objectives. It should be noted that the environment is a part of the system and should always be considered in decision-making, policy development, and implementation.

As with any agenda, buy-in and ownership of leadership at the highest level remains necessary. However, it is not sufficient. Managers at all levels need to understand their own and their department's role in the disaster management system. By clearly highlighting their values and perhaps the eventual effect of disasters on their departments due to the interconnectedness of systems, support can be gained in changing the most deep-rooted mental models, behaviors, and ultimately structures and patterns seen in the organization.

## 2.3 Public Health Services & Systems Research

Lack of information on organizing, financing, and implementing public health activities—and lack of knowledge on what constitutes adequate public health practice and its precise definition—have been argued to be barriers to the improvement of public health practice (Lenaway et al., 2006; Mays et al., 2003; Thomas et al., 2015). Although the study of public health services delivery is not new, the rapidly growing health risks, including infectious diseases, bioterrorism, natural disasters, and terrorism, especially the terrorist

attack in 2001, led to more attention and resources becoming available (Harris et al., 2012; Scutchfield et al., 2009). Albeit still insufficient, resources diverted towards public health policy and practice enable prevention, preparation, and response to public health threats. A recommendation to guide public health policy and practice was made by the Institute of Medicine (IOM), a part of the National Academy of Sciences, Engineering and Medicine (Institute of Medicine, 2009), in its 1988 and 2002 seminal reports (Institute of Medicine (US), 2002; Lenaway et al., 2006). Further, in 2010, the US Department of Health and Human Services articulated the need to strengthen the national public health infrastructure to deal with public health threats through a systematic approach (DHHS, 2010).

Based on the IOM recommendation, the Centers for Disease Control and Prevention (CDC) was tasked to convene a consensus-based collaboration among representatives from national, state, and local organizations, academia, foundations, and research institutes to set a national public health systems research agenda. The agenda has 14 overarching priority research themes that stimulate and guide research to improve the country's public health systems. Of these 14 priorities, the top two priority areas are (Harris et al., 2012; Lenaway et al., 2006):

1. Determine how public health agency structure affects performance.
2. Define and quantify dimensions of public health systems, including inter-organizational relationships (including the agency's role within the public health system).

These priorities involve causal relationships that are fundamental to any systems research.

Furthermore, emergency preparedness was listed among the essential public health system topics of inquiry. Other topics included social determinants of health, partnerships, standards, accreditation, and policy (Thomas et al., 2015).

This thesis responds to some aspects of the top two priority areas of the Public Health Systems Research Agenda as well as their direct application to emergency preparedness as the field of inquiry.

#### 2.4 Public Health System (PHS) and Public Health Services and Systems Research (PHSSR)

The Institute of Medicine (IOM) report '*The Future of the Public's Health in the 21st Century*' (Institute of Medicine (US), 2002) conceptualizes **a public health system** as "a complex network of individuals and organizations that have the potential to play critical roles in creating the conditions for health." Mays et al. (2003) define a public health system as comprising entities that contribute to the delivery of public health services undertaken to protect and improve health at the population level for a given population, including governmental public health agencies, private and voluntary organizations.

Improving a public's health can only be achieved through the collaborative efforts of different entities that directly or indirectly work in that direction through access to public safety, education, food, shelter, healthcare, and so on. Figure 11 (*CDC - Public Health System and the 10 Essential Public Health Services - OSTLTS, 2020*) illustrates a public health system's dynamics. Each of these elements within the system is, in turn, dependent on additional external stakeholders, especially federal and state agencies as well as non-governmental organizations, for funding.

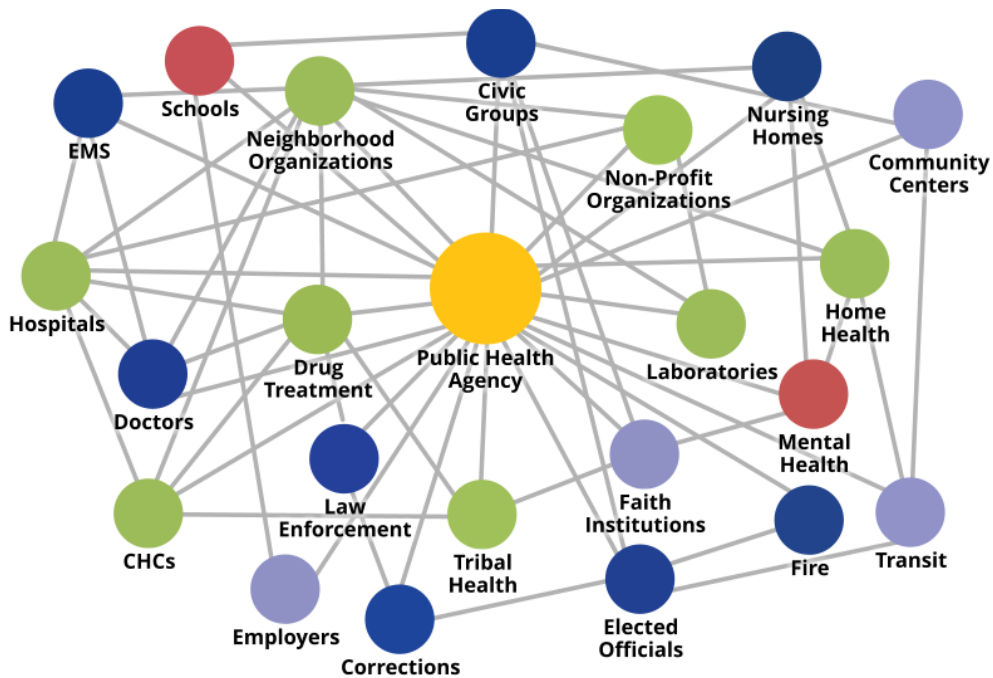
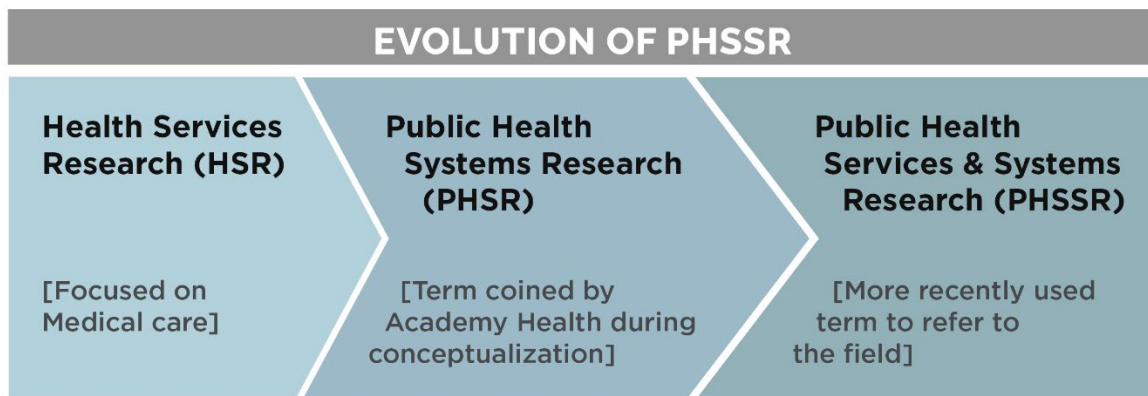


Figure 11: Public Health System (Source: CDC - Public Health System and the 10 Essential Public Health Services - OSTLTS, 2020)

**Public health services and systems research (PHSSR)** is a multidisciplinary field of scientific inquiry that examines the dynamic organization and working of the components of public health systems and their impact on the overall health of the population. As is valid with any systems-based approach, PHSR is a multidisciplinary endeavor that comprises studies from various theoretical and methodological perspectives, including epidemiology, biostatistics, economics, sociology, psychology, political science, information science, and operations research. It studies the organization, financing, and delivery of public health services within communities to inform stakeholders and decision-makers on ways to improve the effectiveness and efficiency of public health systems at local, state, and national levels (Harris et al., 2011; Lenaway et al., 2006; Mays et al., 2003; Scutchfield & Ingram, 2013; Thomas et al., 2015).

PHSSR is also referred to as **Public health systems research (PHSR)** by some organizations like AcademyHealth, as it was the initially used term at the time of its inception.





*Figure 12: Evolution of PHSSR*

Public Health Systems Research emerged out of the field of health services research (HSR). They are different in that HSR focuses on medical care specifically and focuses on the cost, quality of care, and access to medical care. PHSR, on the other hand, arose out of the need to understand the diversity of functions and stakeholders at federal, state, and local levels, as well as to provide insight into improving public health systems performance to positively affect population health outcomes. PHSSR is well-positioned to gather evidence on how biomedical and behavioral discoveries can be incorporated into public health practices and be used for effective prevention strategies (Scutchfield et al., 2009).

The growing need for efficiency and accountability, coupled with the increasing attention on public health, means that evidence from PHSR will be vital for public health policymakers and practitioners to help them advance their efforts of improved population health.

Relevant and translatable findings from PHSSR are needed for implementation in public health practice. The concepts of systems, relationships, and collaborations can provide insights and opportunities. It will require inclusion and strong engagement from the public health practitioners, researchers, and the communities.

Through various tools like causal loop diagrams, social network analyses, comparative effectiveness analyses, the systems-approach can be applied to complex public health

problems and health services delivery. As Thomas et al. (2015) state, PHSSR provides insight and value to improving public health practice by building evidence on factors influencing population health. Understanding the dynamics and interdependence among components of the public health system can help highlight their influence on organizational performance, practice, and health outcomes. Furthermore, this evidence-based research then needs to be translated into practice in the field. Systems research helps identify the implementation challenges and catalysts to then be utilized for effective practice. Beyond influencing better performance at the practice level, PHSSR provides leaders and policy-makers evidence for better decision-making. It is imperative for them to identify how interventions in the dynamic nature of complex public health systems can have unintended positive or negative consequences. The holistic view of systems thinking enables long-term foresight into ways in which the dynamics of diverse components of the system (like climate change, inequity, economic volatility) could influence the overall system, its outcomes, and the eventual impact of communities.

### **3 Public Health Systems Approach in Disaster Preparedness and Response**

Strengthening the United States' preparedness to prevent, protect against, respond to, and recover from threatened or actual terrorist attacks, major disasters, and other emergencies is a shared responsibility of public and private organizations. The Centers for Disease Control and Prevention (CDC) plays a leading role in preparedness and response activities as well as building and strengthening our national health security. CDC's Office of Public Health Preparedness and Response (OPHPR) works with state, tribal, local, territorial, national, and international public health partners to create the expertise, information, training, and tools that public health practitioners, people in communities, and partner organizations need to protect their health from natural and human-made threats (Leinhos et al., 2014).

The Pandemic and All-Hazards Preparedness Act of 2006 (PAHPA) mandated that research be conducted to identify knowledge gaps to improve federal, state, local, and tribal public health preparedness and response (PHPR) systems (Inglesby & Sosin, 2012; Kelliher, 2018). On the request of the CDC to meet the PAHPA requirements, the Institute of Medicine (IOM), in its letter report (IOM & Committee on Research Priorities in Emergency Preparedness and Response for Public Health Systems, 2008), identified four priority areas to strengthen or improve preparedness and response at federal, state, local and tribal levels. The priority research areas (Qari et al., 2014; Savoia et al., 2017) were to:

- Enhance the usefulness of training
- Improve communications in preparedness and response
- Create and maintain sustainable preparedness and response systems
- Generate criteria and metrics to measure public health effectiveness and efficiency

Based on their recommendations, the CDC funded nine Prepared and Emergency Response Research Centers (PERRCs) and 14 Preparedness and Emergency Response

Learning Centers (PERLCs) in academic institutions throughout the United States (Qari et al., 2018). Public health services and systems research is a relatively new approach to improve complex public health preparedness and response that is being used by these research centers. Furthermore, PERRCs were the first and only US Department of Health and Human Services program to use a public health systems research approach to investigate and improve the complex and rapidly changing preparedness and response systems (Leinhos et al., 2014; Qari et al., 2014). The goal of the PERRCs was to conduct public health systems research on preparedness and response capabilities at the various levels using a "multidisciplinary approach to examine the structure, capabilities, and performance of public health systems" (Inglesby & Sosin, 2012). The objective of the PERLC program was to improve workforce readiness and competence through the development, delivery, and evaluation of targeted learning programs designed to meet specific requirements of state, tribal, and local partners (*Preparedness and Emergency Response Learning Centers* | CDC, 2020).

Figure 13 shows the main components of a Public Health Emergency Preparedness System, as depicted by IOM in its letter report of 2008 to the CDC. The filled areas represent the key actors, and the empty circles represent the overlap between the key factors, as well as the many less obvious actors that play a significant role in integrating the public health preparedness system. The field of public health preparedness and response uses the holistic PHSSR approach to improve its strategies, capacity, and performance in preparing for and responding to all potential threats and hazards.



*Figure 13: Main components of the Public Health Emergency Preparedness System (Source: IOM 2008)*

Using PHSSR, the PERRCS have developed methods to study preparedness using data from actual events; methodically examined public health system organization, performance capabilities, effectiveness, and social determinants of system outcomes; evaluated emergency preparedness trainings and their applicability; investigated organizational and structural characteristics that influence a public health system's preparedness; and, identified ways to assess a population's knowledge, attitudes, and practices concerning emergency communication efforts among other contributions (Savoia et al., 2018).

## **4 Case Study of a mid-sized United States city during the COVID-19 pandemic**

### **4.1 Case study purpose and description**

I conducted a case study as a part of the doctoral project and as an opportunity to contribute my skills to a local public health department during the COVID-19 pandemic. For the purposes of the thesis and on the request of the department, the city has been anonymized (referred to as “the city” henceforth), as have the interviewee credentials. My time with the city's Public Health Department (PHD) enabled me to have a closer look at the nuances and operations of a public health department, especially during a crisis. The project, more specifically, aimed to understand the inter- and intra-departmental collaboration of efforts that enabled the success of the COVID-19 pandemic response so far while also drawing on the lessons learned from the current pandemic regarding coordination and mitigation efforts in the future. Since coordination and relationship-building are long-term processes and intangible, the study intended to be a timely exercise in analyzing efforts that may not have been explicitly listed for pandemic mitigation and preparedness purposes but may have been found to be significant during the response. The study intended to identify actionable best practices and challenges of the PHD before and during the pandemic. This chapter elaborates on my findings.

The Public Health Emergency Preparedness (PHEP) team of the city's PHD, along with other staff members of the city-county government, have been responding to the COVID-19 pandemic since March 2020. Similar to what can be seen worldwide, they have had to address multiple emergency response challenges, tackle additional roles and responsibilities, along with ad-hoc creative improvisation for many stopgap measures. It has required internal coordination of efforts within the department's many bureaus and externally across the many departments of the city-county public services, including the Office of Emergency Management (OEM), mayor's office, Police, Fire, Community Health, donors, federal and state grants funders, transportation, state government, hospitals, and long-term care facilities, shelters, other public, private, and academic entities.

## 4.2 Background

The case study was conducted in a mid-sized US city with a city-county metropolitan government that covers urban, suburban, and rural areas.

The idea of local government-led public health systems in the United States has evolved since the late 18<sup>th</sup> century when epidemics like yellow fever, smallpox, and cholera engulfed the country. Almost two and a half centuries later, amid the global COVID-19 pandemic, the local public health systems are strained to capacity and are once again at an inflection point.

In the United States, public health governance structures vary from state to state. Broadly, the governance structure can be centralized under the state; decentralized or led by local governments; mixed or not with a single predominating structure; or have shared structures between the state and local government. This city's Public Health Department (PHD) is a part of this consolidated city-county government. It serves a population of approximately 500,000 – 1,000,000 residents. The workforce comprises over 500 employees with a budget of about \$70 million. The Public Health Department offers preventive health services, behavioral health programs, dental care, and disease screening to children and adults on a sliding payment scale basis, along with other programs on smoking cessation and food-related needs.

Most recently, the city was inundated by a natural disaster which was followed by the first confirmed case of COVID-19 less than a week later. With little to no time at hand, local governments had to respond to multi-layered disasters with cascading impacts.

## 4.3 Stakeholders

Stakeholders in the work of the Public Health Department include, foremost, the public (including the various vulnerable populations), the community healthcare organizations, healthcare systems and their workers, local, tribal, and county officials, the City Health Board and Council. It also includes non-profit organizations, partnering organizations and universities. At the federal and state levels, the federal public health agencies and

fundings located within the Department of Health and Human Services (DHHS) (National Institutes of Health (NIH), the Health Resources and Services Administration (HRSA), CDC, the Substance Abuse and Mental Health Services Administration (SAMHSA), and the Agency for Healthcare Research and Quality (AHRQ)), state government and public health agencies. Non-governmental fundings, including private foundations and philanthropies are also important stakeholders.

#### 4.4 Current State of Public Health Challenges

Based on community health assessment surveys and community health improvement plans of 2015-2020, the PHD's priorities included: advancing health equity, supporting mental and emotional health, and maximizing built and natural environments to improve health. Other pressing public health challenges of the city include very high rates of obesity, vaping among young adults, and hypertension. The city also faces risks of natural disasters like tornadoes, floods, thunderstorms, fires, extreme heat, and earthquakes. Other emergencies that the public health department needs to be prepared for include infectious diseases, biological, chemical, nuclear, and radiological events.

##### 4.4.1 Demographics and socioeconomic status

The county's population has been increasing steadily for the last decade. With a median age of 34 years, the population is relatively younger than the national median of 38 years in 2018. Twelve percent of the population is older than 65+ years old. Racial and ethnic diversity is distributed as 56% White, 28% Black, 10% Hispanic, 3.7% Asian, and 2.3% more than one race. The city has 12% foreign-born residents. The racial and ethnic diversity is higher compared to the state and the country average (*US Census Bureau QuickFacts*, n.d.).

Poverty is a critical indicator of future health and well-being as it creates barriers to access food, health services, and other necessities on which the health and well-being of a person depend. Seventeen percent of the population lives in poverty. The percentage of children living in poverty has been increasing since 2016 and is at 25.4% as of 2018, higher than



the national average (16%). The highest rates of poverty are found among single female householders with children.

#### 4.4.2 Social determinants of health

As per the US Census Bureau in 2018, 38.5% of the residents had a bachelor's degree or higher, but 12.2% of people above 25 years do not have a high school diploma; this includes 9.8% Whites compared to 14.4% African Americans who do not have a high school diploma. The unemployment rate has been declining and is relatively lower than the state and national average; 17.3% of the population has difficulty accessing or affording food, and 18% of residents have housing problems due to affordability and have been forced to move to the periphery of the city.

#### 4.4.3 Political Context

Similar to social determinants of health, political ideologies inform health priorities and health policies, resulting in increased funding or defunding of particular programs. In turn, these circumstances impact population health and health inequalities (Borrell et al., 2007; Cinaroglu, 2019; Greer et al., 2017). Different ideologies at the state and city-county levels have led to varying priorities in public and private funding for various health outcomes and have caused certain laws and restrictions to be in conflict. This became more apparent during the COVID-19 pandemic when the city wanted more stringent lockdown policies while the neighboring counties under state jurisdiction followed more lenient policies, to the utter dismay and disapproval among residents and businesses in the city who were required to follow different rules while living a block across from each other.

#### 4.4.4 Health Priorities

The most common diseases in the city include: cancer (higher than the national average); obesity (36% of children are obese); diabetes (11.4% compared to the national average of 9.4%); heart disease (372 per 100,000, which is higher than the national rate of 327); addiction (alcohol, opioids, marijuana); and smoking/youth vaping (90% smokers start

before the age of 18). One in five people experiences mental illness, and 7% experience major depression. Suicide among youth is on the rise.

## 4.5 Approach & Methodology

### 4.5.1 Data Collection and Analysis

The primary methodology employed was semi-structured in-depth interviews (IDIs) with staff and contingent workers at the Public Health Department, including those from the Public Health Emergency Preparedness team, the Community Health Bureau, and the Policy and Legislation team. Questions were broad, included sub-questions, followed by probes to understand the issues at hand more deeply. The interviews were conducted between November and December 2020, using the interview guide as a tool. They were all conducted in English. The interviewer and all interviewees were fluent in English. The protocol and semi-structured interview guide are appended to the thesis.

The IDIs of 60 minutes each were conducted using Cisco WebEx video conferencing. The eight qualitative interviews totaling about 10 hours were recorded and transcribed using Microsoft Office transcription. NVivo version 12 and Microsoft Excel were used to clean, code, and systematically analyze themes and trends of the qualitative data. The Framework Method was used to manage and analyze qualitative data. Developed in the 1980s for large-scale policy research, the framework method is now widely used in multi-disciplinary health research. It is a systematic and flexible approach that requires reflexivity, rigor, and quality. It allows for non-interview data to be integrated with the matrix structure. Since this approach is not aligned with a particular theoretical viewpoint, it can be used for inductive or deductive analysis or a combination of the two.

Secondary data from a desk review was conducted using publicly available data. The search queries included emergency preparedness, emergency management, disaster preparedness, office of emergency management, public health emergency preparedness, infectious disease preparedness, planning, public health systems research, along with the city, county, and state details. Best practices from academic centers and other cities were also referenced.

#### 4.5.2 Reflexivity

Reflexivity refers to how the research was done and how it affected the findings. While individual subjectiveness cannot be eliminated entirely, it can be understood and recognized. As a researcher looking at qualitative data, I am bound to my subjective lens developed through my individual and shared experiences and, hence, bring along my implicit biases. My research could accordingly reflect relativism as my version of ideas interwoven to create a story or a theory; it could also be attributed to social constructionism, in that the ideas have come about through interactions with the world.

Similarly, it is important also to state that the interviewees' perceptions of me as an interviewer might have also played a significant role in this work. Significant differences in race, culture, ethnicity, age, accent, nationality, the status of carrying the tag of a prestigious university, along with being an outsider to the system trying to ask deep questions and expecting honest responses were a significant number of factors that could have influenced the study.

#### 4.6 Limitations

There were several limitations to the study. First, it is reasonably challenging to get access to public health workers who are in the midst of responding to the largest pandemic seen in one's lifetime. Hence, access to the many requested interviews was denied with an interview request response rate of 53%. It is possible, although unknown, that this low response rate resulted in a selection bias of participants.

The literature review for this study was based on publicly available data only, except for one response plan that was made available by the department. Requests were made for other guidance notes, toolkits, plans, standard operating procedures, protocols, and structure for emergency preparedness, and COVID-19 meeting minutes for the department and state-level meetings but were not fulfilled.

While the study's intent has been purely forward-looking, to capture best practices and challenges as they unfold during the pandemic response from an unbiased external

perspective, the study faced skepticism and hurdles due to internal bureaucratic struggles in the Department of Public Health.

The case study was dependent on the data collected from interviews that reflect only what the interviewees were willing to share, with a possibility of an unconscious social desirability bias.

Furthermore, it should be noted here that while utmost precaution was taken, a researcher's confirmation bias is known to be the most pervasive type of bias and may have influenced my interpretation of data.

As described earlier, emergency preparedness and response require collaboration and systemic efforts across bureaus, departments, and agencies. It is essential to gain the perspectives of all stakeholders. While this case study was able to capture the views of most PHEP team members and a couple of bureau directors, it was not able to capture the perspectives of other bureaus, which might have also contributed to the response efforts. More importantly, time permitting, the case study could have captured the perspectives of external stakeholders, like the Mayor's Office, Office of Emergency Management, COVID-19 assessment centers, schools, hospitals, long-term care facilities, public health schools, shelters, fire and police departments, local communities, disparity populations, among others, all of whom are essential to depicting the entire preparedness and response efforts to any large-scale emergency.

#### 4.7 Findings

As per its mandates, a PHEP team in the public health department plans and prepares for large-scale what-if emergency scenarios. The COVID-19 pandemic tested their readiness and response efforts. The response efforts span far and wide. The PHD response includes contact tracing and monitoring; coordinating with assessment centers; providing guidance to the public; collecting, analyzing and presenting COVID-19 data to the public and policymakers to inform decisions; working with case managers at the hospitals and developing their discharge protocols; working with and advising group homes, long-term care facilities, schools, and daycare centers; helping homeless care providers and shelter



15). It should be noted that this map is not all-encompassing in that it only includes partnerships among those who were interviewed.

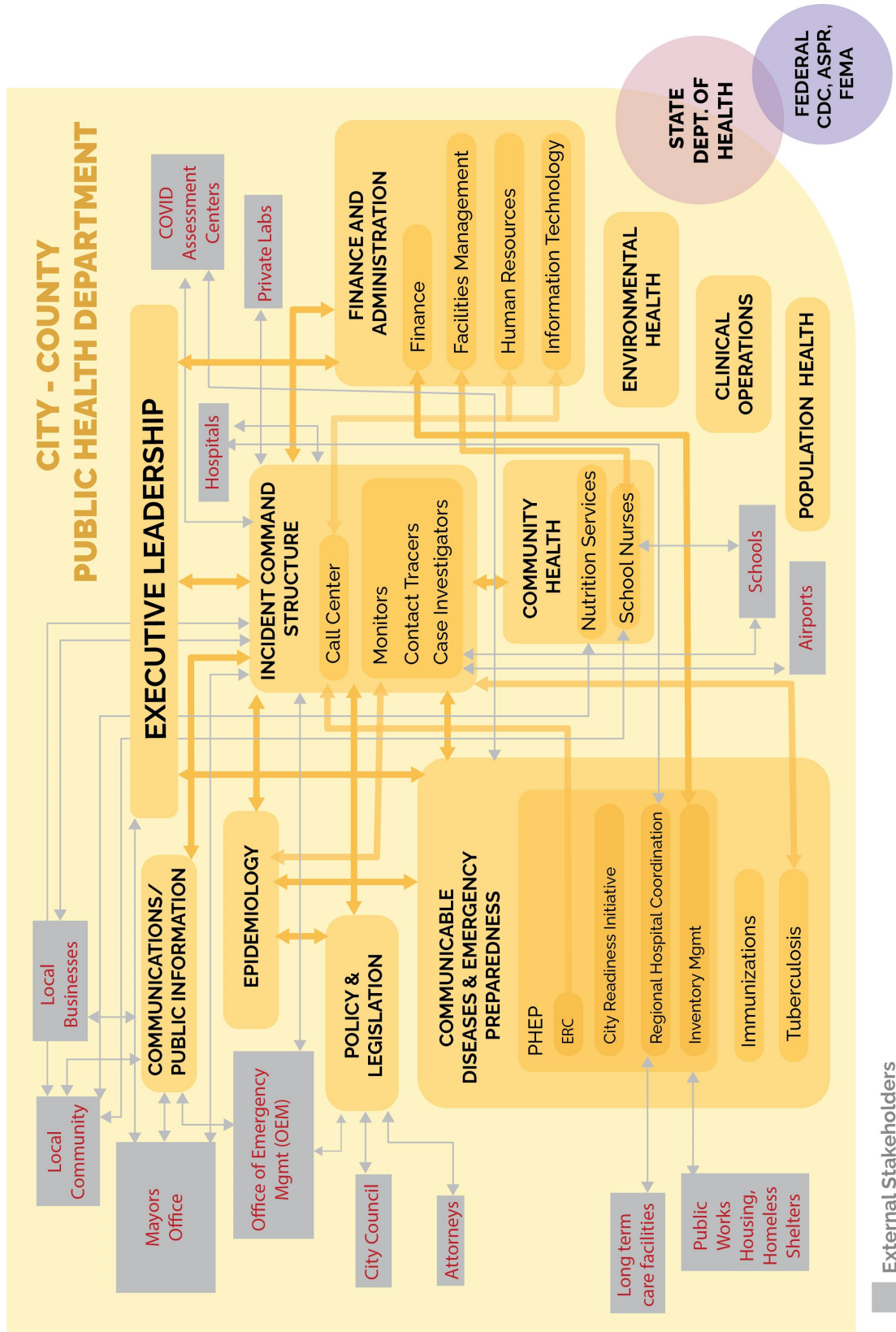


Figure 15: Stakeholder Mapping of interviewees. (Source: Shroff, A)

Based on the data collected, the findings were categorized into three thematic areas:

- Planning and Response Coordination
- Leadership, supervision, collaboration, and teamwork
- Community expectations and information management

#### 4.7.1 Planning and Response Coordination

The PHD set up an incident command center early on in the pandemic and established a basic information pipeline as they started receiving a lot of calls from the public and businesses. They tried to mirror the state department's format of answering questions. They coordinated with their counterparts at the local level, broke down the tasks and what needed to be accomplished, realizing that they would need a lot of volunteers to support them.

Previously built good relations greatly facilitated response efforts – planning and response are not in the moment processes but involve long-term efforts.

All the interviewees who had been associated with the PHD for a long time were able to attest to the value of relations they had built over the years in responding to the pandemic. The people they "already knew were easiest to work with." Interviewees reported that in the middle of trying to tackle such big problems, it was harder to communicate when they did not know each other, and "people accidentally get left [out of a communication] because we don't know each other."

Previously built relations also made it easier to communicate issues and help the other parties understand their department's nuances better:

The ones that know me, they understand a little bit more about the health department. They got an issue, they called me. The [number] that I don't know, whatever it is that I don't know as well, they're all over the place.



Long-term relations gave stakeholders the access and flexibility to reach out when the pandemic hit. They didn't have to waste time to think it through; they could just pick up the phone and call for help. However, such relations already existed and were established, and they "were not built overnight." In the midst of an emergency, it is what and who you know that one has to make use of in order to respond expeditiously. An interviewee went on to suggest,

The relationships that I had before-hand helped me find the relationships that I needed, so we already had a lot of great relationships among colleagues in the Health Department and so, and then I didn't have any trouble calling someone.

Good relationships are not only meaningful within a department and with other government organizations, "you really need good connections with trusted members of the community and especially the subsections of your community." When the team at the PHD identified a COVID-19 hot spot at a meatpacking plant, they quickly realized that it was not the conditions at the plant but the commute of the workers—many members of a community who worked at the plant car-pooled together for long hours. Because the department had good connections to representatives of that community, they could reach out to explain how the community could mitigate the risks.

Most of these relationships were built by working together on various projects overtime. Multiple communications and long-term associations built trust, comfort and mutual understanding of each other's capabilities. Some relationships existed as a result of being a part of specific sections of the community or having built trustworthy relationships with them overtime. Such relationships also enabled interviewees to reach out to individuals or groups and discuss challenges without worrying about trust and acceptance.

The pandemic has also broken silos for many in the department, who otherwise did not know each other or work with each other. An interviewee commented, "but there are a lot of people in the Department I know much better now. [I have] a great appreciation for the skills and the work that they do."

From the outside, emergency response may look like an after or during the emergency action, but it indeed involves efforts from the outset.

Emergency response without systemic, cross-sectoral effort and lacking the active participation of all stakeholders cannot be very effective.

A public health system includes organizations and individuals as stakeholders of the community's health and wellbeing (Novick & Mays, 2005). It is essential to understand the need and potential of synergistic impact when responding to emergencies. Depending on a situation, in addition to a community's own public health system, the federal government (e.g., Federal Emergency Management Agency and HHS), and the state government (e.g., state health department and state emergency management) can be involved. At the local level, local and county level governments, public and private sectors, faith- and community-based organizations, and non-government organizations are other important actors(Qari et al., 2014).

The city had a mask mandate in place starting early in the pandemic, but the surrounding areas did not. They "are not an island," they are surrounded by people following different guidance. A city or a group of cities cannot solve something that is worldwide, "you need a national response, if not a worldwide response." An interviewee expressed that a consistent national strategy would have helped. "It is very difficult when you're dealing with a disease. It does not respect any kind of border." It has been challenging to implement rules in a county or parts of a city when the surrounding areas of the same state are asked to follow more lenient recommendations. Based on the interviews conducted, it was evident that the COVID-19 pandemic response required systemic, cross-sectoral effort.

Stakeholders with expertise in their respective areas should be tasked to play the leading role of advising the decision-making authority. However, one respondent suggested that the Mayor's Office went ahead and created a COVID-19 Task Force with a roadmap instead of asking the public health department to be the primary advisor on responding

to what is clearly a public health crisis. This created a tangential approach to orders being sent out by the public health department.

Inconsistency of processes across different initiatives providing similar services to similar subgroups caused distress during the pandemic. A primary homeless shelter had more lenient standards, while another had stricter rules like no alcohol or drugs on the premise or not allowing entry if the client arrived incapacitated by them, and time-limits on arrival. It became a challenge to evenly distribute people at the homeless shelters despite availability because people had their individual preferences about which shelter they would like to go to.

Cross-sectoral efforts also help get the attention of people through other departments who might yield more substantial authority. "We've got the beer board to help us. They have a much bigger stick than we do. They'll pull a beer license, and that really gets some restaurants' attention in a big hurry. We've got other agencies that have some sort of regulatory authority." For construction site disease clusters, the PHD reached out to the Codes Department that issues citations for violations so they could ask the general contractor to have his site workers wear masks as per the city orders.

Staff had access to response plans and continuity of operations plan, but they weren't significant parts of their response efforts. They built protocols, training manuals, flowcharts from scratch as they found the need for it.

Most respondents had not accessed the response plan for their response. The response plan was old and had not been recently updated; interviewees did not find it to be of any value to them in the midst of the pandemic response. Comments included, "we were pulling it off the shelf for the first time in a while;" "there were elements of the plan that hadn't been touched in a while;" "we probably needed to have this little bit more up-to-date and ready to go, and at least just the Operational Structure." As the only document provided by the PHD for this study, the Pandemic Respiratory Illness Response Plan review revealed that some data, including the Crisis Communication Plan, essential

phone numbers, Mass disaster/Mass fatality policies, and procedures, was last updated in March 2007.

Even though each disaster is unique, and its preparation and response require innovation and contextualization, maintaining plans have proven to be instrumental in effective disaster management. Plans can be useful in that they provide processes and approaches to deal with disasters. They can provide structure and coordination mechanisms, roles and responsibilities, assessment of capabilities, trainings and resources that should be prepared in advance. Plans are developed based on previous lessons learnt and in coordination with all relevant stakeholders. At the time of crises, updated plans, if readily available, can be valuable in providing the basic structure, which can be quickly improvised to meet the specific needs of the disaster.

No interviewee involved with the direct response could refer to any actionable tools, checklists, or other plans that helped them with their tasks, other than what was being created by them specifically during this pandemic. An interviewee in charge of getting homeless cases discharged from hospitals reported, "I wrote it down and made that the protocol." "My leadership, the Office of Emergency Management, and then the hospitals were just grateful to have some guidance to lean on."

Strategies, systems, and teams were formed organically based on needs rather than updating and contextualizing previously thought-out strategies.

The usefulness of plans depend on context and the expectation is that they can be improvised and built upon for the given circumstances. However, under other circumstances the challenges that present themselves may be substantially different and a completely new strategy may be appropriate.

Several examples throughout the interviews highlighted the lack of aspects of the pandemic response efforts that could have been developed as a part of mitigation efforts for an infectious disease pandemic or even as measures, strategies, recruitment, and training for scaling up to any general large-scale emergency response.

Staff was pulled in to perform various roles as the response needed to be scaled up. There were two epidemiologists in the department, and at the start of the COVID-19 pandemic, [the city] had only four contact tracers. As cases increased, more contact tracers were hired. "It was just, we're bringing people, onboarding. We need to create training materials and figure out what the training session is going to look like."

[...], but I was the one who had to sit down and say, we have these protocols in place that those of us working in the office and working in our operations team know. Now, we need to get them on paper so that the people that we're training have something to go off of. And so, that was one thing that I never knew or had done before. Now going into it, that was going to turn into one of those things that takes a portion of my time. It's like being the person to say we need to have documentation on paper, not only for documentation and records sake, but also for the sake of these hundreds of efforts, 150 temp employees that are working from home and, rather than emailing me 100 questions a day, we can have this training manual that answers their questions.

The response effort "was pretty organic in how it all came about." Interviewees said they would think something is important but then realize that since nobody else was addressing it, they might need to do it. While not everything could be planned for, some anticipation about what an infectious disease epidemic might look like could enable a process to be developed. It can then be honed when an actual epidemic occurred because, during the response, there is not much time to be thorough and thoughtful in developing a complete process.

Some ad hoc plans developed during the pandemic were centered around individuals who were leading the effort. All stakeholders were dependent on the same person for many months. The team then met to discuss, "How do we make it to where it's not centered around [that person]?" Stakeholders were then directed to an independent cellphone number, which would be handled by whoever was in charge or backing up this person. But by then, a precedence was set, and most people continued to call the staff on her phone directly. Challenges from such response situations could have been overcome from

the start if initial procedures had incorporated steps of using generic cellphone lines for specific issues' coordination.

For the response efforts, the staff was assigned to multiple roles, and over time they were spread too thin to be available to back up one another, defeating the continuity of operations planning. It also underscored the low level of resources available to public health institutions in ordinary times and the difficulty of scaling up quickly.

Since scaling up quickly is a standard crisis need and challenge, planning for surge capacity of trained personnel is a standard mitigation and preparedness practice as discussed in earlier sections. Some employees were "already juggling multiple roles or at least dual roles." Others found themselves leading huge teams – including two people who were leading 150 people at one point. Some roles had backups, but the "back-ups were overburdened with other tasks" and had limited ability to actually back each other up when needed, which seemed in contradiction with continuity of operations planning.

News reports spoke of departments across the country struggling with the shortage of inventory, but the PHD self-reported smooth and coordinated inventory management.

As per an interviewee who managed inventory, the supply chain during the pandemic was "smooth" and "relatively flawless." "[The city] kept their stockpile of emergency supplies for which they receive funds every year, while others who had shortages were either not buying them when they had to, or donating them, giving them away." They reported, "We were so well-prepared at the beginning that we didn't come at it with our hair on fire [...]. We're not going to be able to work. It wasn't any of that."

The interviewee emphasized that it has been "a great coordination," and they did not have any shortages because they had a head start from the beginning. However, an online search for "[The city] COVID supply shortage" revealed that the [city-county] government

itself had made a public appeal on March 24, 2020, because of a critical shortage of medical and personal protective equipment.

A possible response bias, known as the social-desirability bias, may have led to the interviewee not reporting the problem. It is a common social sciences bias where interviewees answer in a manner that may seem more favorable. It leads to over-reporting of desirable behaviors and under-reporting of undesirable behaviors. Another cause of this contradiction could be individual perception, where the interviewee truly believed that he was doing his job well. Finally, a third possibility, might be that the interviewee did not have insight into the larger supply chain details or strategies as compared to those in the government who made the public appeal. A follow-up with the interviewee could have helped to seek more clarification but was not possible.

#### 4.7.2 Leadership, supervision, collaboration, and teamwork

Overall, staff across the department have been eager to help and have been highly flexible, creative, and adaptive in responding to the pandemic.

Interviewees resonated with the idea that the public health department employees "showed a willingness to help" and "were just all in." Their flexibility and adaptability were crucial to the COVID-19 response efforts. The school nurses were displaced from schools, but they quickly came on board to take call center duties and respond via hotlines to the community. With their medical knowledge, it was appropriate to have them answer calls, do contact tracing, and then manage assessment center duties once those opened up to the public for COVID-19 testing.

Employees have had to pivot quickly, show resilience, and be willing to do different things. "Everybody felt it's kind of like a war effort." "Everybody is trying to figure out how they could pull together, but [...] it was very unifying."

Interviewees felt that the Human Resource and Information Technology departments were very supportive in the expeditious scaling-up activities that the department needed, providing technical support and other resources necessary to set up call-centers.

The PHEP team felt strong camaraderie within the core team and support from their supervisors.

Overall, the PHEP team "felt supported" by each other and reported "a pretty good dynamic." They understood each other's responsibilities, and "at the same time each could do each other's job [...] so, we try to be well rounded, just in this program." They reported that they were able to rely on one another.

An essential aspect of this understanding is that despite the quickly changing, fast-paced environment that they were working in, they managed to keep each other on the same page. If one of them heard something from the leadership, they made sure there was consistent communication among them.

PHEP team members interviewed were also very appreciative of the support and understanding that they received from their supervisors. "I just can't speak highly enough about the people that I work with. But we all have kind of been willing and able to put in the work, and it has been successful," reported one interviewee.

However, as per the interview data collected, that cannot be said to be true across the department.

Clear communication protocols and quick responses from higher-ups were consistently reported to be a challenge. Overlaps and gaps in information communication slowed down efforts and caused confusion.

Several team members acknowledged that communication across the department could be improved. "We have a kind of problem with replying. I guess it is an easy way of putting it." "It's been tough to get a consistent process in place for how information flows upward



through the chain of command." "People were not doing the reply all." "I think that communication could be better across the board."

There's definitely a problem with communication with leadership. Whether things are verbally communicated or communicated with them via email, we don't always get responses. And then on occasions, there will be a problem that arises, and it'll get delegated to six different people because there's no communication and so, it kind of leaves us, the people who are actively working and dedicated to the response, in a bad position because we've got four different people giving guidance. Not saying that they shouldn't give guidance, but maybe more boots on the ground [would be helpful].

In the middle of a resource-constrained situation, employees were sometimes "doing double or triple duty on this one task." They tried to address the problem, but "there's only so much that [they] can do," and many felt that root causes of communication failure needed to be addressed. It may seem minor, "but when it takes an hour or two of your day when you should be responding to something else, it's definitely frustrating."

As discussed in the introduction chapters, effective response relies on timely flow of accurate information. Crisis conditions can make it more challenging for leadership to stay on top of managing their communications. The case study interviewees reported the critical issue of leadership not responding in a timely way or communicating requests through multiple channels causing overlap, confusion, and wastage of crucial time. Simple communication protocols for critical information flow that could be set by the incident management systems were lacking.

At a time when employees need leadership to listen, encourage, and support them, such interaction has been lacking.

No interviewee said they received any communication or encouragement from senior leadership other than their immediate supervisors as they responded to the crisis. "I

didn't really get much from leadership;" "if you're asking if there's been much proactive communication or planning, I'd say it was limited, honestly."

One interviewee did remember communication leadership highlighting the department's priorities, "as I recall, one or two emails going out to everyone, regarding COVID-19 as a priority [...] but that all of the other work that the Department does is also important and vital and needed in our community and it will continue."

More than half the interviewees had joined the department a year or less ago, some very close to the start of the pandemic. It required quickly learning new roles and responsibilities.

More than 50% of the staff interviewed had joined the department about a year ago, some right before the start of the pandemic. They were each entrusted with significant response efforts in areas they were not necessarily experts at and had to learn their "roles and responsibilities quickly without necessarily [being] explained which role [they] would be stepping into, and that also happened organically, which I think has been both rewarding and challenging in trying to figure out."

Some of them were just starting their public health careers because it was their first job out of school. They had to wrestle with the ambiguity, not understanding if that is how things usually were, if they should seek clarification, what their responsibilities were, and when they could speak up and ask. Clearer communication of duties and expectations would have been beneficial to staff who were already stepping up in such situations. These new employees also had to build relationships and social capital across sectors relatively quickly to get their specific tasks done, some through introductions and others on their own based on their assignments.

An interesting insight raised was that all of the core team was in their 20s and early 30s, with limited family responsibilities. They were able to "drop everything and stay at work and figure things out and work on the weekend, come in early [...]." But if they had people that depended on them or people to care for, and if they weren't able to stay late and work,

how would it have impacted the work of the department? Additionally, they lacked the social capital that can be leveraged from long-term professional and community relations.

#### 4.7.3 Community expectations and information management

Most interviewees thought that communication to the public on COVID-19 related data was consistent across different sources and platforms (although as expected of emergent infectious diseases, it changed over time as more scientific information became available). People understood what was being conveyed. However, a few interviewees thought that the department was not consistent in its messaging, and it confused the public.

As per the US CDC and as discussed in earlier chapters, making sure people have information to take action is one of the six domains of public health emergency preparedness. Simultaneously, there also arises a matter of civic responsibility. Some people expressed frustration at the "real lack of civic responsibility. This idea that you can't tell me to wear a mask because I'm American [...]." It was also very challenging to convince the public to overcome the assumption that COVID-19 is like the flu and that they didn't need to worry.

As public health professionals, "we kind of live in this bubble where we know what's going on, and we know the numbers, and we know the protocol. But the general public often doesn't." It becomes vital to walk the public through the steps and keep repeating the same consistent messaging over and over again. However, in case of an emergent infectious disease like COVID-19 the task is challenging because new information and evolving guidance is expected. As scientists learn more about the disease and counter measures, previous guidance might change, and updated information becomes available. It is important to share this new updated information consistently across all platforms, being explicit that this is what is known so far.

A dashboard developed by the city's Public Health Department with COVID-19 related data on case trends, transmission rates, hospital capacities, and testing capacity has been

available to the public from very early on. It also contains other pertinent information on where to get tested, assistance on an event, important phone numbers, and announcements. It is regularly updated. Overall, data communication on COVID has been very consistent through the dashboard.

While data has been presented to the public as accurately and consistently as possible, some interviewees thought that the guidance available to the public has been inconsistent and is an area needing improvement, "There's not a consistent message. Don't confuse people. I mean, that's less than 101 in emergency preparedness. Truthful messaging over and over and over again." Inconsistent messages from professionals have confused the public and made it harder to convince them about who and what should be believed.

Different settings required differing recommendations for prevention and response efforts. There could not be a standard set of rules for daycares, high schools, gyms, construction sites, long-term care facilities, shelters, hospitals, malls, theatres, prison systems, courts, restaurants, and bars (places where people have to take their masks off to eat and drink), and various other businesses. Conveying this to the public has been challenging. A focal point from the department ensures that consistent messages are conveyed by community health workers to the populations and by the contact tracers and investigators to people over the phone.

Some interviewees' perception of public information communication was that the population largely understood the messages being conveyed but what they chose to believe or not believe was up to them.

The City faced challenges because neighboring counties had more lenient and different regulations on gatherings and for businesses. A discrepancy in advisories because of different political orientations and standards being followed created distrust in the public.

The city is surrounded by some of the 80 other counties of the state, which follow regulations set by the state Department of Health, while the city had to follow policies put forth by their quasi-independent city-county government. The city-county government

imposed strong "rules which are out of step with every county around [them]." It put them in a position to being "out of step with people right across the street, literally."

While the city imposed an 11:00 pm close of business, a similar business in an adjacent town was able to stay open without any restrictions. "Literally. On the other side of the street, they can do whatever they want. And that business owner is screaming. Understandably." On their end, the city-county government implemented tight shut-down rules between July and September, but people would go across to other counties, mingle, get sick, and come back.

Flexible response at state and local levels can be valuable in some instances but in the case of a COVID-19 global pandemic that affected the entire country, such response and limited federal leadership did not help to manage the situation better.

Local businesses are hurting badly, and there is no magic bullet to solve the contradictory prescriptions between economy well-being and taking care of public health – both of them being important considerations, but challenging to balance.

A large portion of the city's economy runs on tourism. These tourists come in to enjoy themselves and might not care much about the city's pandemic regulations, particularly if their own cities have not imposed such restrictions. The city's representatives imposed regulations to close businesses by 11:00 pm. "People aren't happy about some of the policies that have been implemented by the city. [...] There [are] lawsuits with bars and restaurants." "People didn't want to adapt and shut down, and there isn't an economic driver for small businesses, and it's hurting them right now when they have to shut down."

To tackle the resistance by businesses and show that there is a real problem with transmission through bars and restaurants, the city decided to share cluster reports with over 10 cases publicly. That led to a further backlash, and many businesses were unwilling to cooperate for fear of ending up on the list and losing more customers. Businesses are refusing to give details of the contacts, which impeded contact tracing efforts. Even

employees at these businesses would not talk to the city officials for fear of getting into trouble with their supervisors.

The best measure from a public health perspective may not be ideal from an economic sustainability perspective. So, there is a constant push and pull between people. This constant challenge of balancing priorities is not unique to the case study city either. Across the world, response to COVID-19 has seen public health, education, economic well-being, and other important sectors having to compete. Ultimately, public health is not and should not be the only voice determining the priorities among these values.

Sometimes, it might not just be about revenues either. Places like construction sites were reported to be reluctant to let anybody inspect compliances with mask mandates because they fear other non-compliant working practices might get exposed.

Sometimes, contract tracers were not trusted when they called up and asked for information.

Most direct communication to the public was done through the case investigators and case monitors over the phone. While some people cooperated in sharing information and details around their activities and business, many were reluctant. There had been instances where people thought that it was a fake call, and random people were trying to get information out of them. The case investigators had to go to great lengths sometimes. If sharing their credentials over the phone did not suffice, they offered to do the interview via email from their government email addresses. Sometimes if that were not possible, they directed the person to the Health Department's front desk, so they could call and confirm the phone number and the person's credentials to be convinced whether the case investigator worked there.

#### 4.8 Recommendations

Based on the findings discussed in the section above, the case study led to the following recommendations (not in any order of significance):

- 1 Plans and protocols need to be updated regularly, at least annually, if not bi-annually.

Toolkits with quick checklists should be developed to make plans more accessible and actionable. More effort is needed in developing response plans for anticipable scenarios, including drills for less likely events.

Despite and actually because a pandemic is a very fast-moving, aggressively changing situation, public health emergency preparedness during ordinary times requires thinking through various use case scenarios.

Questions like: 'What are the key pieces of information we need to get? How can we format that into a script so people who are coming in can do these interviews and get that same information as well?' which were questions staff was thinking about during the pandemic could be thought out sooner and should have required only contextualizing and updating to meet the given circumstances. The likely infectious disease hot spots and clusters (like schools, homeless shelters, long-term care facilities, restaurants, other kinds of public and private gatherings) are known in advance. Plans and strategies to deal with these stakeholders should be updated regularly.

Ideas on how to let the public know when the contract tracing calls are from authorized personnel and processes to use general cellphone lines for different functions, instead of using a particular person's number to make efforts independent of individuals should all be planned out in advance, and not during a pandemic.

A plan should be actionable, and its purpose should not be to simply exist as a tool for media and the public to be assured that "there is a plan." Updating response plans should be a part of annual deliverables, and representatives of all bureaus should be involved. There is a need to develop checklists for different response areas that can be actionable. They are not meant to be all-encompassing; their purpose is to get everyone on the same page and give an overview of the broad tasks at hand, especially to new staff.

Drills to practice response efforts are crucial to emergency preparedness as well. The city had planned to have a tornado response drill in early March when an actual tornado hit. They should also plan to have drills for other uncommon but possible disaster scenarios, even if it is less frequent as compared to drills for the specific natural disasters they face.

Complex dynamics with overlap require clarity in roles and responsibilities, clarity in communication protocols, and efficient coordination mechanisms. As stakeholders, one needs to be aware of spontaneous responses, where people "always think they're in charge." "You'll have a banker, a lawyer, a doctor, have a handful of politicians, maybe an insurance agent or two. Something happens, and they say, what are we going to do?"

- 2 Recently hired employees will need to build long-term connections and relations within and outside of the department to facilitate future response efforts.

As has been evident from the COVID-19 pandemic response, long-term relations have greatly facilitated the response efforts by the PHD. Staff with institutional memory and previous relations should connect the incoming staff with those connections. The pandemic response might have already facilitated some of these connections among newer team members, which might not have been the case in usual circumstances.

- 3 Efforts need to be made to improve consistency in services being provided via different groups.

In order to strike a balance in the distribution of services, efforts need to be made to bring all the service providers together to ensure that they are on the same page. This is important to prevent an imbalance of overcrowding in one location and low utilization of the same service in another. Similar standards and protocols of service enable a balanced distribution of beneficiaries and reduce any distress due to one location being more or less preferred over another. City authorities could facilitate this by working with service providers to ensure standardization of services, especially enforced during emergency declarations. Coalitions could also be used to develop such standards or services.



- 4 Use more creative ways to scale up during an emergency, like training community volunteers in advance who can be used as standby capacity.

The need to scale up quickly in an otherwise low-resourced public health setting is challenging. For standby capacity, the support of community partners can be sought. Community volunteers can be trained on various aspects of preparedness and response, like contact tracing and community awareness-raising. They can be provided with certifications and with some quick refresher training during emergencies, and they can be activated to support the department in improving their outcomes.

- 5 Set predefined protocols of communication in the department.

The findings of communication challenges within the department warrant a set of protocols for information sharing and communication chains that everyone should abide by, like having a 24-to-48-hour response time on emails and doing a 'Reply All' unless acknowledging receipt or thanking someone. Having clearly defined protocols to cc everyone concerned on emails can be a simple yet effective practice of good communication. Sometimes, colleagues sitting close together do not forward emails to one another and prefer just to convey messages verbally. While verbal interaction is meaningful, an email follow-up helps keep track of communication. While these are standard implied practices, an organization facing communication and information flow challenges should make these practices explicitly known and expected of all its employees.

- 6 Effective communication requires consistency and repetition across the board, along with actively addressing misinformation.

What may appear as common sense or general information to professionals may not be as readily understandable or available to the public. Misinformation is as much of a problem as is lack of information or differing information. Changing guidelines have already made it difficult for the people, but it is imperative to address misinformation. Straightforward and easy-to-understand explanations should be provided to the public

on why specific policies have been put in place, so there are more acceptance and less resistance.

- 7 Conduct brown bags or small meetings to provide a platform for staff to share their efforts and celebrate their contributions.

Interviewees were asked to share an aspect of the COVID response that they were most proud of, and each one came up with various tasks they fulfilled or hurdles they overcame that contributed towards the overall pandemic response. This ranged from overcoming hurdles of data collection reporting to smooth inventory management to helping out the community or daycares. While all the effort is ongoing, a lot of hard work goes unknown among people other than the immediate supervisor. Taking some time out once a month for a 20-minute brown bag where staff can showcase their work to the department would be a huge morale booster when it is much needed and might perhaps help generate more ideas.

## 5 Discussion

Although lessons from past disasters should help us improve our understanding of how to respond effectively to these events, Auf der Heide (2006) correctly points out that we seem to keep repeating the same mistakes without making concrete progress. Savoia et al. (2012) feel that the underlying reason for this lack of progress might be that true organizational and systems-level learning—such as that needed to respond to the complexities of disasters—is extremely challenging, and the required changes that such learning identifies are even more difficult to implement. This discussion elaborates on the gaps identified, the barriers, and ways to overcome them.

The Iceberg Model, a systems thinking tool, can be used to understand disaster management and the findings thus far and to identify the mental models or systemic barriers that are the root causes of the mistakes that occur over and over. Figure 16 illustrates these factors, placing them within the framework of the Iceberg Model.

At the highest level are the visible events, which are disasters and our response to them. These events are evident to everyone but, figuratively, are only the tip of the iceberg, lying above water. Beneath this are patterns and trends that affect that response, but which may or may not be as evident. These tend to be patterns that are only identified over time and often lead to disjointed preparedness and response efforts across sectors. Factors identified in this level include, first, that public health agencies, health care delivery organizations, and other entities tend to work in silos; mitigation and recovery efforts often receive less attention and fewer resources than those spent on preparedness and response, more so they involve different sets of actors even in instances where all the efforts are carried out within the same agency; and third, the same lessons are relearned repeatedly after each disaster.

The model further probes and identifies underlying structures that influence these patterns. It tries to understand who and what influences the trends, the explicit and implicit rules that explain the patterns, and the relationships between the parts. These include difference in priorities and competing interests of stakeholders. Even when agencies might have similar interests, they might differ on their priorities, which in turn,

might lead to conflict. Subsequent negotiations with each other to resolve conflicts may lead to one or more actors finding the status quo preferable to the proposed changes required to cooperate as their Best Alternative to a Negotiated Agreement (BATNA), as described in negotiations theory (Fisher et al., 2011). Pressure and demands to keep up within one's own sector and no obvious incentives lead to lack of long-term relationship-building across sectors during routine times. Leadership and political commitment to address these issues can significantly influence such patterns, but the long duration and resource-intensive nature of mitigation and recovery efforts often lead to a loss of momentum and prioritization during these latter two phases. As discussed earlier, recovery also poses its own constraints due to competing priorities among stakeholders. Building consensus and taking decisions on what aspects to prioritize often adds to the delay in leadership commitments.

Finally, at the deepest level lie the mental models, i.e., the assumptions, deep beliefs, attitudes, and values held by people. These beliefs keep the structures and systems in place. Understanding these is critical to address any change in how a system works. The unpredictability inherent in the next disaster's timing and impact and thinking "It won't happen here" or "It won't happen while I'm in charge" are significant barriers to changing how disaster management is carried out. Despite several disasters in the past decade alone, an attitude of complacency can exist towards efforts for which one might not likely be accountable during their tenure. When a disaster hits and after time and energy are expended on preparedness and response, resources are depleted. Recovery and mitigation efforts that could improve management of the next event get deprioritized.

In addition, in resource-constrained settings of public service, policymakers prioritize issues that are important to their constituents and impact them in their day-to-day lives and immediate future, including education, employment, and housing. Focusing on mitigating disasters whose propensity (likelihood and impact) is unknown is difficult to prioritize and justify even if desirable.

Additionally, there is a gap in formal training, focus, structures, or incentives for inter-sectoral coordination at the leadership level. The emphasis on results-oriented

performance measurement makes it so that each unit is trying to achieve its tangible goals and has no incentive to look at the holistic picture of the system of which they are part. Furthermore, no central responsibility or accountability exists for a coordinated response.

# UNDERSTANDING DISASTER MANAGEMENT USING THE ICEBERG MODEL

## What just happened?

- Disasters and our response to them

## What are the patterns identified over time?

- Disjointed preparedness and response efforts
- Mitigation and Recovery efforts lacking
- Re-learning same lessons over and over

## What and who has influenced the patterns?

### What are the explicit and implicit rules that explain the patterns?

- Difference in priorities and competing interests
- Preferring the status quo as the BATNA
- Lack of long-term relations across sectors
- Lack of leadership and political commitment to address these issues
- Long-term and resource intensive nature of mitigation and recovery efforts

## What are the assumptions, beliefs, and values held by people that keep these structures in place?

- Ambiguity of next occurrence of disaster and its propensity
- After the time and energy expended on preparedness and response, these resources are depleted
- Recovery and mitigation for the next event are deprioritized
- Priority is on immediate challenges of constituents
- Coordination of efforts cannot be easily measured
- Lack of formal training, structures or incentives for inter-sectoral coordination at leadership level
- No central responsibility or accountability for a coordinated response

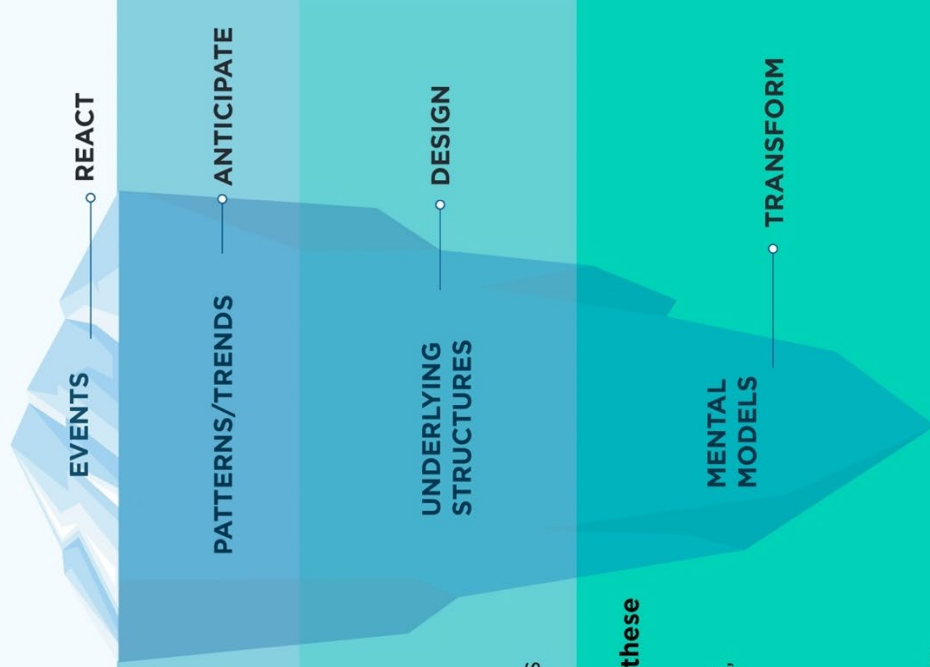


Figure 16: Using the Iceberg Model to understand the challenges of Disaster Management. (Source: Shroff, A)

## 5.1 Another Perspective

As discussed above, the Iceberg Model looks at underlying layers to understand the root-causes of problems. My research posits that to understand the full extent of the issues and fully address them, stakeholders should be careful not to identify root causes within their respective areas alone and assume that addressing those will change outcomes. They are a part of a bigger system, and efforts will need to be made across the spectrum. Figure 17 illustrates this point using the iceberg itself. Individual stakeholders could understand the root causes from their narrow perspective and not see the entire picture until the puzzle is put together.

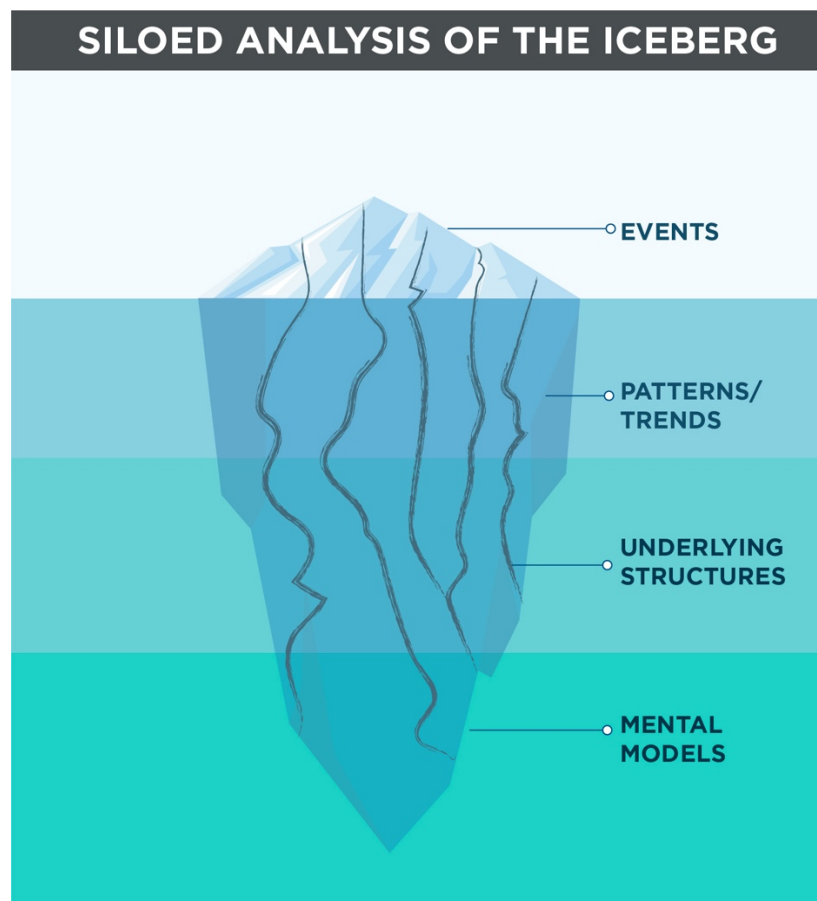


Figure 17: Siloed Analysis of the Iceberg (Source: Shroff, A)

For elaboration, an analysis was conducted by Piltch-Loeb et. al (2018) after the Salmonella outbreak in Alamosa, Colorado. The most challenging aspect of the response,

as the researchers found, was detecting the source of the contamination. The county health department was responsible for responding to outbreaks and believed that salmonella could not be found in the public water supply. Their root cause analysis did not yield any results to lead them to the source of the problem. However, it was the city and not the county that ran the water system, which was aware of some waivers and breaches that could make water supply a potential source of the problem and hence, could point to a deeper root cause. The city and county did not work collaboratively, and it took many more cases and weeks before the real source of the problem could be identified.

In this case study, in an evidently siloed effort, it was observed that the COVID-19 cases continued to rise despite imposing restrictions on the city-county citizens. It was found that the neighboring counties had more lenient guidelines owing to their political ideologies and regulations that informed them. With no coordination of efforts between these counties the cases easily dispersed between them. Interventions by one entity could not solve the problem without addressing those of another.

In another instance, the public health department identified homelessness as a risk of COVID-19 transmission. To address the issue, they coordinated hospital discharges of homeless individuals who were infected and shelter accommodations that followed COVID-19 guidelines. However, the intervention did not show expected results. It was not until the PHD worked with different shelters that they found out the root cause of continued infections – something over which the PHD has no control. Owing to different regulations among shelters, some individuals preferred other shelters over the ones with which the department worked, and it didn't matter if the shelter had enough capacity and followed guidelines to reduce the spread of the virus.

## 5.2 Barriers

Many areas of improvement for PHEP and disaster management are well known, but there remain significant barriers to implementing recommendations. Lack of clear definitions, as discussed earlier, are deterrents to including aspects of PHEP into the planning and execution of steps. Another limitation is the variability and variety of healthcare and public health systems in the United States. Experts at the National



Academies of Sciences argue that the diversity among federal stakeholders alone who fund disaster research makes the system fragmented and complicated, and the coordination among them difficult. (National Academies of Sciences, 2020). Table 3 below shows the diverse and broad list of key federal stakeholders conducting or supporting disaster research.

Federal Stakeholder	Role in Conducting or Supporting Disaster Research
Federal Emergency Management Agency (FEMA)	Whole-community preparedness, personal disaster preparedness, protective actions
Health Resources and Services Administration (HRSA)	Access to health care; enhancing health systems for geographically, economically, and medically vulnerable populations
National Institute for Occupational Safety and Health (NIOSH)	Responder safety and health
National Institute of Standards and Technology (NIST)	Built environment, infrastructure, communities, hazards, standards
National Institutes of Health (NIH)	Environmental health, natural disasters, biodefense
National Oceanic and Atmospheric Administration (NOAA)	Natural disasters
National Science Foundation (NSF)	Social sciences, engineering, natural hazards, built environment
Office of the Assistant Secretary for Preparedness and Response (ASPR)	Regional disaster health response, health security, medical countermeasure enterprise, science preparedness
U.S. Department of Agriculture (USDA)	Food and agriculture safety, antimicrobial resistance, climate change
U.S. Department of Defense (DoD)	Epidemiology, medical countermeasure development, biodefense
U.S. Department of Homeland Security (DHS)	Counterterrorism, homeland security, critical infrastructure, preparedness, and resilience
U.S. Department of Housing and Urban Development (HUD)	Community resilience, housing and community development
U.S. Department of the Interior (DOI)	Natural disasters
U.S. Department of Transportation (DOT)	Emergency medical services safety, innovation, and infrastructure
U.S. Department of Veterans Affairs (VA)	VA facilities and veterans' health affected by disasters
U.S. Food and Drug Administration (FDA)	Medical countermeasure law and science
U.S. Geological Survey (USGS)	Natural hazards, emergency management, environmental health

Table 3: Key Federal Stakeholders conducting or supporting disaster research. Source ((National Academies of Sciences, 2020)

When speaking of barriers, it should yet again be acknowledged that the novel aspects of each disaster magnify the difficulties of effectively preparing and responding.

As much as it is essential to focus on mitigation measures, it is equally prudent to consider scenarios where such measures succumb to the way in which a disaster unfolds. Contingency planning in the event of failures of resilient structures, changes in context, funding, leadership priorities, management structures, and the knowns and unknowns is essential. For instance, in the case of Hurricane Katrina, the city of New Orleans heavily relied on the effectiveness of the levees, which ultimately failed them (Crichton et al., 2009).

De-prioritization on disaster management due to reasons cited earlier often translates to lower human resource allocation. At the case study site, there were four people in the PHEP team at the beginning of the pandemic. Within a few months, they required over 250 people who were temporarily involved in the pandemic response. In larger agencies, effectively managing disasters is also complicated by the fact that the people planning and executing the mitigation and preparedness phases are often different from those involved in the response and recovery. They might have the same mission of reducing the impact of disasters, but they have different immediate goals. The disconnect between the preparation and response could be overcome by sharing information and proactively involving the people in response into the planning phases. Similarly, response and recovery meetings should include mitigation and preparedness representatives to understand each other's responsibilities and the constraints under which they work. Some of the limitations of lessons-learned and recommendations, as noted by Auf der Heide (1989), include the lack of feasibility, usefulness, transferability, and generalizability of responses from one disaster to another.

### 5.3 The focus has been on substantial outcomes, not on the process of mitigation itself

Disaster mitigation efforts are generally interpreted as structural and non-structural outputs that build resilience and reduce the risk of disasters. The focus of mitigation efforts is usually on the outcome, not on the process of planning for disasters or on gaining a shared understanding of perspectives (Crichton et al., 2009). In general, the emphasis is on tangible resources like strengthening infrastructure and making preparedness plans more robust. Leonard and Howitt (2010) in their comprehensive risk management

framework for “Acting in Time” explain that pre-disaster efforts can include prevention and mitigation efforts to reduce impacts, preparedness for response, and advance recovery measures that anticipate recovery efforts and plan for it. The intangible capacity-building efforts like developing strong collaboration and communication plans that are much more challenging to measure have more recently started gaining due attention. A study conducted by the Harvard Kennedy School’s Program on Crisis Leadership after the Boston Marathon Bombing (H. B. “Dutch” Leonard et al., 2014) found that the success of the crisis response efforts could be attributed to substantial multi-dimensional preparedness and planning, especially institutional and personal relationships development among response organizations and key personnel. Regular cross-organizational drills and internalization of operational coordination structures greatly facilitated the response efforts. By working in a coordinated manner on mitigation efforts, the agencies and people involved can develop a mutual understanding of each other's areas of expertise and challenges. Thus, crucial relationships can be built to prepare for and respond to disasters. These mitigation efforts, although somewhat intangible, can be immensely valuable for collaborative efforts during disasters, especially given the fact that public health systems are known to be under-resourced. For example, stakeholders who rarely worked together prior to 9/11 are reported to now meet regularly to plan for coordinated responses and have a mutual understanding of roles and responsibilities (Koh et al., 2008). These intangible efforts require an investment of time and effort but are less expensive than physical resources and critically important.

#### 5.4 Inter- and Intra-organizational coordination has been a known challenge

Scores of scientific publications and the case study undertaken for this research have demonstrated the need for better coordination, communication, and relationship-building among public health departments and other agencies to improve disaster management (Christensen et al., 2013; Crichton et al., 2009; Généreux et al., 2019; Hilts et al., 2016; Koh et al., 2008; Leinhos et al., 2014; Lo et al., 2017; Lorenzoni et al., 2020; Piltch-Loeb et al., 2018; Qari et al., 2014; Raich et al., 2016). Effective and long-term multi-sectoral collaboration between researchers, policymakers, and practitioners is a

recognized requirement yet often lacking. Based on previous post-disaster assessments, coordination among agencies has been noted to be an ongoing challenge.

An important finding from a multi-case study, "Long-Term Impact of Disasters on the Public Health System: A Multi-Case Analysis," conducted in various European countries is that procedures that support interaction between participating organizations needed to be modified to improve cooperation and coordination across multiple sectors, and should include doctors, nurses, psychologists, security, armed forces, and social workers (Lorenzoni et al., 2020). Moreover, the study found organizational boundaries to be a "hindrance to improvements." Another study carried out by Christensen et al. (2013) that analyzed the crisis response to the 2011 terrorist attack in a government complex in Norway identified a lack of internal and external coordination and inadequate means of communication as gaps. They concluded that successful crisis management requires coordination between organizations and different levels of administration. They found that the principle of liability leads to the allocation of responsibility within organizations but also hinders coordination. The Healthcare Coalitions (Courtney et al., 2009), supported by the US Department of Health and Human Services, is an excellent example of a regional effort that facilitates collaboration and information sharing during emergencies. However, it is limited to healthcare systems and focuses mainly on supporting healthcare organizations during response and recovery phases.

Intra-departmental, inter-departmental, and cross-sectoral coordination, communication, and relationship-building should be prioritized by appointing a lead person to be a focal point in each office to meet and share updates as a regular practice. They could share their challenges, new projects, developments, or other updates. It provides an opportunity to understand and respond to a problem from multiple perspectives and discuss the risks and evidence. It also provides exposure to the skills, capabilities, and expertise available among the various fields that could be tapped into as needed. Occasionally, leadership from different sectors should meet and share some of their work with the staff of other sectors. A fund can be allotted for cross-functional collaboration efforts and training to bring together practitioners, policymakers, and

researchers. Such efforts should not only be made an option but incentivized and included in the strategic planning of organizations.

Federal and state governments can play a significant role in bringing these different groups together initially. In fact, as a part of the response and recovery efforts, several different federal and state departments have their individual requirements, each often assuming that they are the only ones requiring documents/information. Because of the differences, however, the beneficiary/end-user has to overcome considerable amounts of bureaucratic hurdles. There is no single structure or coordinating mechanism that might solve all the complex problems given the legal structures and relations with different levels of governing structures. However, efforts in developing and refining platforms like the National Response Framework (NRF) (*National Response Framework* | *FEMA.Gov*, n.d.) are ways to bring a variety of entities together to coordinate for a unified response. So, as a first step, federal, state, and local governments should work together to have more cohesive and integrated efforts, more shared resources, and less bureaucratic burden for everyone. Successful disaster response involves a systemic, cross-sectoral effort and requires the active participation of all stakeholders.

#### 5.5 Social capital needs to be built in advance of disasters, not during

Koh et al. (2008) concluded from their case studies in Massachusetts and the National Capital Region, in and around Washington DC, that social capital and enhanced connections between health departments and other agencies could considerably improve preparedness. They talk about the importance of "bonding social capital" and "bridging social capital," where bonding capital is connections made within groups and bridging capital is across groups. These groups could be local communities, departments, agencies, cities, and beyond. Building social capital improves communication significantly among the stakeholders but also aids consistent messaging to the public. In the case study example as well, it was found that those who were associated with the department for many years were able to leverage those relations across the public services to get their jobs done, while recently hired employees needed to find connections and start building trust in the middle of a high-pressure environment. Individuals and agencies need to

network and build relationship in non-crises times. Meet and greets, events on raising awareness about individual programs and inviting people across groups, conferences for cross-sectoral understanding of priorities, strengths, best practices, and challenges can be organized at federal, state, and local levels are some ways by which such social capital can be built. Ultimately, it will still require individual effort to maintain such relations.

#### 5.6 Good governance, crisis leadership, and adequate use of authority are critical

Good governance has been noted to be the single most crucial factor for effective public health disaster preparedness and response (Généreux et al., 2019). The case study highlighted the adverse effects that lack of good governance can have. A disconnect between the vision of leadership and the employees, political discord, and distrust in relationships led to a lack of shared responsibility and shared expectations. Despite a few plans and structures that might have been in place, the larger systemic mental models undermined the potential for effective response. Such unaddressed systemic issues led to a compromised situation at the city's public health department.

At a time when staff needed leadership to listen, encourage and support them, such interaction was reported to be lacking. A pattern was also noted that the executive leadership at the public health department had changed frequently over the last five years, highlighting the disconnect between the perspectives and expectations of the employees versus those of the leadership. The political influence on those in positions of power and authority also needs to be acknowledged in this case, which can further or impede the work of any public services. By including employee representatives in the selection process of leadership and using their inputs instead of making leadership selection a purely political and executive decision could potentially avoid disconnect and increase ownership of the decision.

A very vital part of crisis leadership is crisis communication, and leaders need to think about what to say and how to say it. Leonard et al. (2020b) recommend that leaders should combine reality, hope, and empathy when addressing the public during crises. Simultaneously, they need to be mindful of the way in which information is conveyed to the stakeholders, such that it is manageable for them. They posit that the public is looking

for answers to four fundamental questions of what is happening, who does it impact, why they should care, and what actions they should take. There are numerous examples of the impact that leaders have made through their crisis communication – whether it be mayors, governors, heads of state, or a company's executive leadership.

While it is essential to be honest and transparent about what is known and what the source of information is, leaders should not shy from acknowledging what is unknown. Crisis leadership differs from leadership in that during a crisis no one knows how to address the rapidly evolving situation, there is uncertainty and a need to experiment and adapt solutions. In such a situation, leaders should be willing to recognize the complexity and avoid being overconfident about what they know and how they will address the situation based on routine emergencies (Pfeifer, 2013).

Crisis leaders should bring together relevant stakeholders from across sectors, flatten the hierarchy and be open to expecting solutions from anyone at any level (R. Heifetz et al., 2009; H. Leonard et al., 2020a). It is also important to acknowledge that owing to the heterogeneity of the multiple organizations, conflicts may arise, but leaders should be willing to look beyond their individual ideas and think of the best solutions overall.

#### 5.7 Unreliable communication and information-sharing can have consequences

Clear and consistent communication across stakeholder groups is not easy. However, sharing and updating information during non-emergency times as a part of a mitigation strategy can help develop relationships and a standardized habit. It can also provide enough time to improve such communication so that interactions will be much smoother during crises (Hilts et al., 2016).

Chief Joseph W. Pfeifer of the New York Fire Department (FDNY), who was the first Chief to arrive at the World Trade Center during the 9/11 attack (2007) analyzed the communication that occurred between the police and fire departments responding at the scene. He explains that years of systematic “organizational bias” impacts social behavior and thus how information is shared between actors when they are responding to the crisis situations together. People are likely to share more information within a group than

across groups, even if it is critical. Such behavior stems from considering one's own group superior to the others or perceiving themselves more powerful by keeping information to themselves. Groups and individuals might also be focused on completing their organizational task under the pressure of a crisis and ignore the important task of communicating information across groups. Thirdly, people might not assume individual responsibility to share information and might assume someone else in the group might have shared it, so even consider the information not important enough to be shared with others. Even if such organizational bias is not deliberate, it needs to be addressed to make crisis response efforts successful. By regular practice through structures like the unified command, where public service organizations rely on one another even for small events or routine emergencies, when knowledge is combined, individuals are responsible to one another for all actions taken, and familiarity with such coordinated responses can information flow naturally among all stakeholders.

A root cause analysis (RCA) that was undertaken after a salmonella outbreak in Alamosa, Colorado to enhance public health emergency preparedness concluded that lack of communication and collaboration among the many components of public services was the critical link that caused a delay in investigating the outbreak. The RCA also highlighted the need for social capital to support the endeavor (Piltch-Loeb et al., 2018). Another study noted that research reports are often sent to department leadership, who may not have the time to look through them or may fail to send them down the chain of command; thus, important findings get lost (Hatry et al., n.d.).

The case study validated that clear communication protocols and quick responses from higher-ups were consistently reported to be a challenge; overlap and gaps in information communication slowed down efforts and caused confusion. As banal as it may sound, setting predefined protocols of communication in the department for consistency across the board, without assuming them to be implicit work practice, can help reduce this challenge.

Communication with the public is another element of information management that needs to be consistent and repetitive. Lack of collaboration and varying information by



different public service authorities can create distrust in public. In the case study, the city faced challenges because neighboring counties had different regulations on gatherings and for businesses. The discrepancy in advisories because of different political orientations and standards created distrust. The unintended consequences of such mismanaged communication are that it becomes challenging for people to adhere to guidance and recommendations in other situations. Guidance from a single independent source of authority on the topic (like the CDC in case of public health crises, if it could be perceived as an apolitical national entity), coupled with other relevant contextual information at lower jurisdictional level could garner public trust.

#### 5.8 Addressing inequity and vulnerabilities of communities can help mitigate disasters

Regardless of the non-differentiating nature of the pandemic, it has been shown that vulnerable populations are more susceptible to adverse outcomes (Brown et al., 2018). As discussed in the introductory chapters, Weisner's framework illustrates the social causation of disasters. For centuries countries have struggled with abject inequality and it clearly is not an easy problem to solve. Nonetheless, it is critical. In the context of this field of disaster management measuring, analyzing, and reducing people's economic and social vulnerabilities and trying to reduce the inequities can be an effective way to build resilient communities. Disaster management professionals should collaborate with other sectors focused on reducing inequities and highlight to policy makers the multi-fold advantages of doing so, including direct reduction in frequent large recovery efforts as an example.

Mitigation and prevention measures should be incentivized for private and public entities to encourage disaster risk reduction. If populations are to receive disaster relief aid, they could also be expected to show effort and desire to seek help for prevention and mitigation. Raising awareness and public education among local communities on the importance of disaster preparedness and steps in that direction can have significant impacts. Similarly, enabling the communities to make their own disaster preparedness plans and regularly revisiting them can empower them to take action toward resilience-building and becoming self-reliant.

As much as local resilience-building is essential, it should not become the entire responsibility of vulnerable communities, which could lead to the deepening of structural inequalities.

#### 5.9 Understanding and involving community perspectives will gain trust and improve implementation

Using the Iceberg Model to understand the community's underlying beliefs and structures provides insights into how they are likely to behave and can help in planning and getting that plan implemented. This will lead to a more effective response than if they are expected to conform to a plan that is quite contrary to their underlying belief system and mental model. Crises circumstances and personal experience can lead to changes in individual perspectives, but over the years communities form beliefs that may be difficult to change. Heidi Larson, the founding director of the Vaccine Confidence Project talks about “collective problem solving” to increase vaccination. It necessitates building trust and confidence by reaching out the different communities, empathetically understanding their perspectives and then demystifying any false beliefs (J. Anderson, 2020; Figueiredo et al., 2020). Using a systems approach involves listening to and communicating with the community on ways to build resilience and prepare for disasters. Mitigation plans and efforts should have the representation of the community by offering them opportunities to share their needs and concerns, including being made aware of detailed plans of how a community might need to respond, the reason and intention behind such response, and plans for advance recovery as well. Voluntary representation for such efforts might be very low, and even then, might not be a well-balanced representation of the community. They might not be capable of communicating sufficiently with the rest of the community either, but by providing opportunities to get the communities voices heard can contribute to better preparedness and response efforts.

It is essential that leadership show fairness in their efforts with due consideration given for barriers caused by race/ethnicity, income, education, disability status, or gender. When a community feels safe to trust its leadership, it will build confidence and gain the

support of the community to follow public health guidelines, whether it is in preparation or response to a crisis.

#### 5.10 Learning from other sectors can enhance overall preparedness

Recurring themes in studies of different disasters suggest that lessons can be learned from other crises and contextualized to individual settings for future improvements. This study recommends that valuable crisis management lessons and best practices can also be learned from sectors outside of one's own, which are often overlooked as irrelevant. Fully acknowledging political, socioeconomic, cultural, and environmental differences and that hazard conditions vary with every disaster, some best practices can still be transferable and help "think about the unthinkable" in one's own context.

Based on lessons learned and after-action reports for disasters, it has been seen that reports are usually circulated internally within departments or organizations. However, some recurring themes are not sector-specific and can be utilized by other sectors. Crichton et al. (2009) conclude that organizations can become wiser by learning from outside organizations, without having to go through the failures themselves; some examples of high-profile disasters that had have been studied outside their sector include the Bhopal gas leak (1984), the Chernobyl nuclear disaster (1986), the Challenger space mission failure (1986), and the BP Deepwater Horizon oil spill (2010) among many others.

Learning from others, whether in the same sector or across sectors, has its challenges. It first needs to be acknowledged that it is not easy to learn from others' experiences. Nuances of the information around what was transpiring, what was known and available, what was unknown, ad hoc reactions versus planned responses are often lost in the reports, and only what was learned is presented. It requires a lot of effort and extrapolation to implement such lessons into one's own mitigation plans.

Moreover, as has been elucidated earlier, the field uses varying terminology. In fact, people in charge of the different phases of the disaster management continuum also use different terminology. Same terms often have different interpretations; for example, the

meaning of mitigation in the disaster management cycle is different from mitigation in climate change is different from mitigation as used in general terms. As with anything, inferences can be drawn very differently, necessitating adequate technical language standardization across sectors.

Furthermore, the general tendency is to ignore other disasters as not relevant to one's own context or not likely in one's own case. By looking deeper through the Iceberg Model framework, teams working on disaster management in a given context will be able to find deep-rooted patterns and behaviors that are similar to what may have transpired in another very different context.

#### 5.11 Practical, actionable, and accessible recommendations are required

There is a need for useful, actionable, and accessible recommendations. For instance, when in the middle of response efforts, checklists are more useful than going through long plans and guidance (Gawande, 2010). While substantive checklists can be useful for routine emergencies with more or less standardized responses, novel crises would benefit from process checklists because of the many unknown factors. Process checklists can help determine the nature of an evolving crisis and how to accordingly develop the response steps. As response operations are optimized, substantive checklists become useful. Plans and protocols also need to be updated regularly, at least annually, if not bi-annually. More effort is necessary for developing response plans for anticipated scenarios, including cross-sectoral drills for less likely events.

Similarly, scientific research findings and relevant recommendations should be presented in a way that is accessible by non-experts. Accessibility here refers to two aspects: explained in a simplified manner so that anybody can understand the information; and available through media like newspapers, flyers, websites, social media, public space advertisements, etc., not just through professional research publication portals to which most people don't have access. It is more feasible to use creative ways to scale up during a disaster, like training community volunteers in advance who can be used as standby capacity, rather than expecting resources being spent on building such professional capacity during non-crisis times.

## 5.12 A systems thinking approach can provide a holistic perspective of long-term unintended negative consequences and how to address them proactively

Disasters are known to impact public health systems negatively. Conversely, implementing a public health systems-based approach to mitigate the effects of disasters can reduce the overall adverse effects of disasters, including on public health systems themselves.

The direct and immediate effects of disasters become evident right after disaster strikes. The indirect effects roll in slowly, are not readily perceivable or evaluable, and, hence, are often overlooked (Ismail-Zadeh & Takeuchi, 2007). Systems thinking can help evaluate long-term indirect effects, which can be very valuable for the recovery and mitigation phases of disaster management. For instance, production and supply chains can be affected for months following a disaster leading to livelihood issues for low-wage laborers. Loss of education days for children, deterioration in water quality due to contamination, long-term health concerns and their costs, societal unrest, and psychological trauma are other indirect non-tangible losses. Analysis of disaster's indirect long-term consequences can help in better decision-making (Kafiluddin, 1991). Adapted to the context of the disaster, it can enable planning and mitigation efforts. As discussed earlier, because of the novelty of disasters, specific *scenario-based planning* for preparedness, response and the varied consequences of these efforts and the disaster itself is difficult. For instance, little is known about the long-term consequences of being infected with COVID-19, the long-term effects of the COVID-19 vaccination response measure, or other counter measures like social isolation. However, the systems thinking approach can help ideate and prepare capabilities and all-hazards processes for out-of-the-box scenarios. Such planning can help develop capacity and prove useful. During COVID-19, in many countries digital financial services served as an innovative opportunity to transfer subsidies from governments to households and enable contactless payments (Allmen et al., 2020).

As found in a study conducted after terrorist attacks in Norway in July 2011, effective crisis management requires cross-boundary response (Christensen et al., 2013; Hiltz et al., 2016). When cross-boundary coordination structures are absent and responsibility

and accountability mechanisms lie only within individual organizations, they prove to be inadequate and hinder response (Christensen et al., 2013; Hiltz et al., 2016). A systems thinking approach for disaster management can help understand the limitations of such measures during a crisis and provide evidence as well as means of overcoming this limitation.

## **6 Conclusions**

Increasing frequency and magnitude of disasters call for better preparedness and more resilience in facing these hazards. It is very important to understand the impact of disasters because disasters do not just suspend efforts to improve the development or advancement of a community. In fact, in most instances, disasters set us several steps back because of the disarray they cause.

Complex public health emergency preparedness and response efforts cannot have standardized prescriptive best strategies. They have to be contextualized. Additionally, in the absence of any national-level comprehensive reviews and evaluation metrics such as those found in other public health fields, one must rely on evidence-based best practices. Learning from other sectors is especially valuable and should not be overlooked as irrelevant.

While there may not be a standard best approach, there will always be ways to respond better and improve outcomes. As public health professionals we should continuously aspire to improve population health outcomes, although it is an extremely complex and challenging endeavor. It requires actively looking for inclusive data, translating that data into knowledge and the knowledge into implementation, evaluating the process, adapting, and then reiterating, always keeping the population at its center (Figure 18).

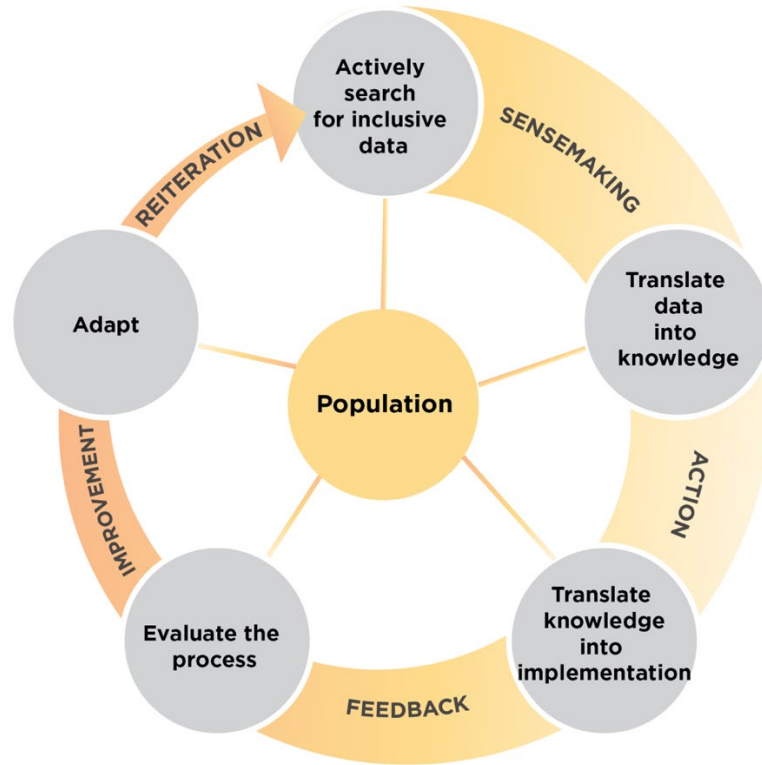


Figure 18: Improving Outcomes. (Source: Shroff, A)

Disaster risk management and mitigation require long-term collaboration between stakeholders, including researchers, policymakers, and practitioners/ implementors at all levels and across organizations. Efforts to facilitate such a coordinated multi-sectoral approach need to be implemented much in advance, not in preparation for an approaching disaster, and definitely not on an ad hoc basis to fill gaps during the response. Several barriers exist that make inter-sectoral collaboration challenging, but by approaching disaster management from a systems perspective throughout the cycle, stakeholders can possibly identify gaps more clearly and take steps to overcome any shortcomings much in advance of disasters.

The importance of building social capital and long-term relationships as processes to mitigate disasters cannot be highlighted enough. The focus of mitigation should be well-balanced between structural outcomes like infrastructure and plans, as well as intangibles like capacity-building and multi-stakeholder partnership-building. Finally, community



engagement and clear communication are necessities for resilience building cannot be addressed as an afterthought.

As with any disaster, after-action reports are being developed to the COVID-19 pandemic response. Lessons are being learned, emergency plans of individual organizations all the way to countries' strategies will be updated. Simultaneously, a "window of opportunity" has opened up for us – researchers, policymakers, and practitioners – to integrate into the structures better ways to focus on the interconnectedness of sectors through a system's approach and utilize it to become more resilient for the future.

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## 8 Appendices

### 8.1 Interview Protocol and Guide

Thank you for taking the time to speak with me. My name is Anshu Shroff. I am a doctoral candidate at Harvard University's School of Public Health. For my doctoral dissertation, I'm looking at [the city's] Public Health Emergency Preparedness. The research goal is to draw out what opportunities and challenges exist in making the planning of the pandemic response more efficient.

The [city] Public Health Emergency Preparedness (PHEP) team, along with other staff members began their response to the pandemic earlier this year. Similar to what can be seen worldwide, they have had to address multiple emergency response challenges, tackle additional roles and responsibilities, along with ad-hoc creative improvisation for many stopgap measures. It has required internal coordination of efforts within the department's many bureaus and externally across the many departments of the City-County public services.

The research goal is to understand the inter- and intra-departmental coordination of response efforts that enabled the success of the pandemic response so far while also drawing on the lessons learned from the current pandemic with regards to coordination and planning for the future. Since coordination and relationship building is a long-term process, the study intends to be a timely exercise in analyzing efforts that may not have been explicitly listed for pandemic planning purposes but may be significant to support response efforts.

The purpose of the interview today is to learn from your efforts and insights and trying to understand what lessons can be drawn in making the planning of the pandemic response more efficient.

There are no right or wrong answers. And I apologize if I cut you off at any point – there's just lots to ask you about and I want to make sure we cover as much as we can.

The interview should take no more than 60 minutes.

If it's ok with you, I'm going to record the conversation. This will ensure I cover everything you say accurately in my analysis, especially if I miss them out on my notes. Also, I apologize, I might be looking down sometimes, but that's only because I'm taking notes. Please be assured that I will never share anything you say in connection with your name or designation, with anyone.

You're welcome to skip any questions you don't want to answer, and you can stop the interview at any time.

If you don't understand any of the questions, please let me know and I will explain them.

Do you have any questions before we start?

Research question: How has internal and external coordination affected the COVID-19 pandemic emergency response efforts by [the city's] Public Health Department?

## **Semi-structured interview questions:**

### **Introductory questions:**

1. Could you please talk about your current role? How long have you been working with the department?
2. Could you please share a little about your career path and background?
3. What have been your and your Bureau's additional roles during the pandemic?
4. Was there a collective decision or prior planning on these roles and responsibilities for the pandemic? Was it something for which you volunteered your team/ your skills? Was it asked of you? Why?
5. What challenges did you and your team face in fulfilling your core responsibilities and balancing additional responsibilities during the pandemic?
6. Do you think there could be other areas where your team could have contributed?
7. What resources/guidance were available to help your team do your job? What else could have been helpful?

### **Internal Communication and Coordination:**

8. According to you, what are some of the essential skills and competencies needed for a Public Health Department during a pandemic?
9. How would you define good coordination?
10. Who are the people outside your immediate team that you have to work with during the pandemic?
  - 10.1. Was there a prior working relation? How was it?

- 10.2. What kind of work? How often and how do you communicate and coordinate your work? Is there a focal point? Are there challenges of carrying coordination out remotely?
- 10.3. Is there clarity of roles and responsibilities?
- 10.4. What has been working? What has been challenging? Why so? What could be improved?
- 10.5. How was this partnership planned out, or was it organically built?
- 10.6. How much do they rely on you and your team to support them?
- 10.7. Do you have an understanding of the challenges faced by them?
- 11. Who else do you work with during the pandemic?
  - 11.1. Repeat previous sub-questions.

**External coordination:**

- 12. Are there any external partners outside of the department that you have to work with these days? (Others in public service, govt., non-govt, hospitals, community)
  - 12.1. Was there a working relationship prior? How was it?
  - 12.2. What kind of work? How often and how do you communicate and coordinate your work? Is there a focal point? Are there challenges of carrying coordination out remotely?
  - 12.3. Is there clarity of roles and responsibilities?
  - 12.4. What has been working? What has been challenging? Why so? What could be improved?
  - 12.5. How was this partnership planned out, or was it organically built?
  - 12.6. How much do they rely on you and your team to support them?

- 12.7. Do you have an understanding of the challenges faced by them?
13. What were the ways in which communication occurred between the department's leadership and the staff prior to the pandemic?
14. How about now? How often? What kind of information is communicated?
15. Do you think the priorities of the department have been clearly communicated?
16. Have other initiatives in the past worked as well? Where they with this organization or another?
17. What are you most proud of about the COVID-19 response work so far? Why do you think it worked well?