Climate Adaptation in Out-Of-Hospital Settings: Building Strategic Disaster Resilience in Ambulance Operations

by

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A Dissertation Submitted to the College of Interdisciplinary Studies
in Partial Fulfilment of the Requirements for the Degree of

DOCTOR OF SOCIAL SCIENCES

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March, 2025

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Abstract

The study contributes insights to the academic dialogue surrounding the resilience and practices of ambulance services, particularly in the context of escalating climate-related risks and overlapping disasters, such as pandemics. This study uses a pragmatic lens to highlight the implications for operational adjustments within the British Columbia Emergency Health Services (BCEHS) and comparable organizations. This research focus is a single BCEHS case study on the ambulance system's resilience in the face of climate change-related disasters. The research focuses on operational capacity and organizational resilience in the context of climate disasters, such as wildfires, floods, heatwaves, and other health emergencies, such as pandemics. Key findings indicate challenges in organizational resilience, with staffing shortages emerging as the most-cited risk identified by 88.3% of respondents, highlighting vulnerabilities. The study applies the principles of high reliability organizations (HRO) and a complexity lens (i.e., wicked problems) and uses a mixed-methods approach involving interviews, a focus group, and a Likert-scale survey. The data were captured from disasters such as COVID-19, the 2021 British Columbia "heat dome" heatwave, and atmospheric river flooding in British Columbia in fall 2021 to explore and offer suggestions to improve situational awareness, disaster planning, and training and exercises, as well as developing strategies to include climate-related disaster risk in organizational planning and risk assessments.

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Chapter 1: Climate Change Impact on British Columbia Emergency Health Services

Climate change continues to affect the operations of the British Columbia Emergency Health Services (BCEHS), particularly as more patients and service users seek help from BCEHS in response to the increasing effects of climate change (e.g., wildfires, smoke, and the heat dome). Given the certainty that these effects and risks will continue to escalate (Intergovernmental Panel on Climate Change [IPCC], 2018; Pachauri et al., 2014), BCEHS's ability to adapt and maintain its resilience as an organization is critical and more urgent than ever (Bosher, 2014). How BCEHS prepares for and responds to the intersecting risks of hazards (e.g., earthquakes, heatwaves, and extreme weather events), public health crises (e.g., the COVID-19 pandemic and the opioid crisis), and other challenges related to the uncertainty and complexity of 21st-century society can save lives and contribute to the resilience of the health care system in British Columbia (BC).

Organizational and Community Resilience Interplay

An intrinsic relationship exists between the resilience of key organizations and institutions such as BCEHS and the resilience of the communities they serve. Such institutions provide core services and employment to communities (McManus et al., 2008) and contribute to a culture of trust and optimism in the context of ongoing challenges. Sustaining this type of leadership requires organizations to be resilient and adaptive. Resilience is described as an organization's capability to minimize the effects of severe disruptions on its operations and its ability to recover after severe incidents (Parsons, 2010). The IPCC (2018) defined resilience as the "capacity of social, economic and environmental systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure while also maintaining the capacity for adaptation, learning and transformation" (p. 557). Organizational adaptability

refers to how quickly and effectively an organization can adjust its practices to meet changing demands and opportunities.

Challenges of Emerging Crises

Given the growing effects of interdependence, increasing pressures, and heightened uncertainties on government agencies—particularly healthcare systems—organizations must learn from each other, develop a shared sense of purpose, and adapt quickly to shifting environments (Barasa et al., 2018). In a time of increasing instability, resilience and adaptability are crucial and rely on adopting a proactive approach that anticipates and prepares for risks and responses. However, the lessons from the COVID-19 pandemic reveal that political leaders, the policies they generate, and organizations such as BCEHS tend to react slowly during unprecedented crises and threats (Klenert et al., 2020).

Need for Sustained Adaptive Resilience

According to McManus et al. (2008), organizations' ability to maintain operations during crises and adversity is vital to a rapid recovery, which includes the wider community's health. However, for leaders, building a resilient organization is complex due to the challenges associated with translating a concept such as resilience or adaptation into tangible working constructs. An inability to build sustained, adaptive resilience can exacerbate a crisis or emergency management's effect on organizational capacity and employees' well-being.

Projected Increase in Disasters

Disasters are anticipated to increase due to extreme weather events, shifts in climate, and weather patterns attributable to climate change (Emergency Management BC, 2018). The BC Ministry of Environment and Climate Change Strategy (2019) recently conducted a strategic climate risk assessment, which indicated that disasters, such as wildfires, floods, and landslides, among others, will continue to increase in BC and cause an increase in health-related effects and concerns. The British Columbia Ministry of Environment and Climate

Change Strategy (2018) states that "climate change hazards are impacting health" (p. 1) by exacerbating social and health problems identified by other researchers and global organizations (IPCC, 2018; Pachauri et al., 2014). These issues have created concerns for the BCEHS and its vulnerable disaster crisis emergency response protocol because its current system and structure appeared to lack resilience during unprecedented crises, such as the COVID-19 pandemic and recent climate change-related weather disasters (e.g., the 2021 BC heat dome).

Capacity Defined

According to the United Nations Office for Disaster Risk Reduction (UNDRR), *capacity* refers to "the combination of all the strengths, attributes and resources available within an organization" and "the ability of people, organizations and systems, using available skills and resources, to manage adverse conditions, risk or disasters" (n.d., p. 1). The capacity of BCEHS and the health care system relies on employees' ability to work and staff ambulances, hospitals, and other relevant health system facilities and resources.

In the current context of escalating and unpredictable disasters due to climate impacts, health care staff—or, rather, the lack of them—represents a vulnerability issue. Staff shortages in the health care system include shortages of paramedics, dispatchers, managers, and support staff and shortages have been reported in news releases (MoH 2024) and in government reports. While precise current data on unfilled postings are not publicly available, BCEHS (2022) state, in a 2021 internal BCEHS progress report, that "We've faced major recruitment challenges—like the rest of the health sector" (p. 3).

This vulnerability has also been highlighted in the media. Some news organizations (Kulkarni, 2022; Little, 2019) have outlined staffing shortages leading to service disruptions in BC hospitals. The Job Bank report did not mention BCEHS specifically but described

"systemic staffing shortages" in the BC health care workforce (Government of Canada, 2021, p. 1).

In times of disaster, these staffing shortages can exacerbate increased patient volume and compromise the capacity to maintain health care services. A case in point; the 2021 heat dome led to a surge in emergency service demand. The 911 incoming calls to the dispatch centres were record-breaking and doubled the usual numbers (BC Coroners Service, 2022). This resulted in service challenges; in "17 instances, 911 callers were placed on hold for an extended period of time" and, in "6 instances, callers were told that there was no ambulance available at the time of call" (BC Coroners Service, 2022, p. 5).

Key Areas for Resilient Organizations

BCEHS has a provincial mandate for prehospital and out-of-hospital care, as stated by the Emergency Health Services Act; it includes providing ambulance and emergency health services, establishing and operating centres and stations for these services, and collaborating with health boards and agencies in BC (British Columbia, 1996, S. 5.1). BCEHS's out-of-hospital care is designated for individual emergencies, such as sick or injured people or those involved in collective widespread disaster emergencies. Links exist between creating resilient organizations that respond to these crises and recoveries, particularly in the context of the complexity of COVID-19 and its effects on the community, the health sector, and out-of-hospital care. For an organization such as BCEHS to achieve resilience, it must address three key areas: situational awareness, vulnerability management, and adaptive capability and capacity (McManus et al., 2008). Wiig and O'Hara (2021) note the need to be resilient and responsive, particularly when facing the challenges of a changing global environment. They argue for a health care system that anticipates and adapts to ensure continuity of care.

British Columbia Emergency Health Services' Resilience and Need for Adaptive Strategies

BCEHS has demonstrated its resilience during the multiple intersecting challenges it has faced due to the COVID-19 pandemic, the heat dome, and the atmospheric river of 2021. An example of its resilience and adaptation is the *multiple patient pathways to care* initiative. Instead of sending all patients who call 911 to the emergency room by ambulance, a new patient pathway is now available for some patients. Through this initiative, paramedics may convey a patient to the hospital or have a family member convey them, depending on the best strategy for patient care. This reduces hospital conveyances by BCEHS and reduces the pressure on 911 responses while ensuring high-quality patient care (Helmer et al., 2021). The *assess, see, treat and refer* (ASTaR) pathway addresses situations such as influenza-like illness (ILI), COVID clinical issues, palliative care, epistaxis, asymptomatic hypertension, minor burns, minor wounds, minor allergies, nontraumatic back pain, gastroenteritis, and heat and cold emergencies (BCEHS, n.d.).

All ASTaR pathways have inclusion and exclusion criteria (BCEHS, n.d.). For disasters such as heat waves, the ASTaR framework for heat emergencies includes protocols for ensuring patients receive appropriate and immediate cooling treatment as well as taking high-risk or sick patients to the hospital. The framework also includes making non-conveyance patients safe at home with family or friends or at a cooling centre while avoiding unnecessary hospital conveyance (BCEHS, n.d.). The success of these pathways is evidenced by improved patient outcomes and operational efficiencies that help address ongoing, emerging health crises due to climate change risks.

Despite these positive signs of organizational resilience in the context of rapid change and uncertainty, organizational resilience also needs to adapt to changing contexts, norms, and demands (McCarthy et al, 2017). From an adaptive resilience perspective, resilience is more than an outcome; it is an ongoing process requiring monitoring and adaptations in systems, structures, and operations. Adaptive resilience is necessary in the context of climate

change, which has been described as the greatest health threat to humanity in the 21st century (Watts et al., 2018). The complexity of climate change risks and the often unpredictable social and cultural changes characteristic of 21st-century society require that BCEHS develops, adopts, and implements strategies and systems that transcend established linear-response models designed to address acute, contained, "tame" emergencies to provide more fluid adaptive responses better suited to the uncertainty and unpredictability of climate impacts.

Statement of the Problem

Disasters can "severely disrupt a community's or a society's functioning on a large scale" and societal exposure to disasters can result in "human, material, economic, and environmental losses" and adverse effects (United Nations Office for Disaster Risk Reduction [UNISDR], 2015, p. 1). Disaster hazards and other disasters are anticipated to increase because climate change induces extreme weather events and unpredictable shifts in climatic and weather patterns (Emergency Management BC, 2018; Shrestha et al., 2024). BC Ministry of Environment and Climate Change Strategy (2019) conducted a strategic climate risk assessment that indicated that disasters such as wildfires, floods, and landslides will continue to increase in BC and cause a rise in health-related effects and concerns in the province over time. Additionally, the authors of the strategy (2022) note that "climate change is increasingly challenging the resilience of BC's health system and communities through compounding impacts on health and well-being, as well as pressures on health services and infrastructure" (p. 37) by exacerbating social and health problems (IPCC, 2018; Pachauri et al., 2014). Because BCEHS's organizational structure provides large-scale provincial out-of-hospital care for emergency cases during a disaster or crisis, these recent events and the ensuing issues have created concerns for BCEHS's organizational resilience, particularly as it relates to its disaster, crisis, and emergency response capabilities.

BCEHS's current system and structure appear to lack adequate adaptive resilience to unprecedented crises such as COVID-19 or climate change-related weather disasters, such as the 2021 heat wave and heat dome. These events adversely affected BCEHS's ability to maintain out-of-hospital care, which is essential as it provides the ambulance service for BC. As detailed in an independent audit report by the Auditor General of British Columbia (2019), COVID-19 has exacerbated preexisting issues BCEHS faced, such as extended response and care times outside major urban centres due to poorly resourced staff, a lack of allied responder (e.g., the fire department), and department collaboration.

Personal Motivation and Observations

This research stems from, and builds upon, my decade of work and observations as a practicing paramedic in remote, rural, and urban areas and now as a leader tasked with organizational disaster management. My experiences as a frontline paramedic, manager in disasters and emergency management at BCEHS and an academic sparked concern regarding the organizational structure of ambulance services, the ability to continue to provide out-of-hospital care in a disaster situation, and how these services might function in the context of a large-scale emergency or disaster. Some examples include the following.

1. Staff capacity: Low levels of frontline staff (i.e., dispatch, paramedics) place the system at risk if a surge in patients occurs, which could impact BCEHS's ability to maintain effective out-of-hospital care due to a lack of staffed ambulances, and the ability to meet demand in dispatching 911 calls. Support staff (e.g., logistics personnel and administrators), managers, and leaders have roles in coordinating and deploying resources and personnel during disasters.
2. Critical infrastructure (e.g., communication infrastructure for dispatching paramedics and fuel for ground and air ambulances) and transportation networks: When bridges or roadways are destroyed in an earthquake, there is an obstruction to access to patients

in need and the provision of ambulances and transportation for patients requiring health care facilities. Other critical infrastructure utilities, such as water and electricity, are required to maintain operational capability during disasters.

3. Health system integration: End destinations for patients under paramedics' care. If hospitals' emergency departments become full or are destroyed, this limits ambulances' ability to drop off patients and prevents them from returning to respond to new patients. Capacity and the readiness of other parts of the health system should support emergency ambulance services during a disaster for a patient care continuum, as the ambulance system is not a stand-alone service but is integrated into the wider health system.
4. Patient surges: These include protracted increases in patients from issues such as opioid overdoses, pandemics, and sudden trauma-based large transportation accidents, such as a passenger train derailment, aircraft accident, or violent terrorism, where a sudden patient surge occurs with too many patients for the system to handle.

As a paramedic, I was increasingly struck by the ongoing dilemma regarding the capacity of BCEHS to meet evolving challenges characterized by the complexity of disasters and socially complex health crises (e.g., the opioid overdose crisis). BCEHS has established ambulance response protocols for health emergencies, such as acute health issues and sudden injuries (e.g., broken legs, heart attacks) (BCEHS, n.d.). However, the ongoing opioid overdose crisis (British Columbia Ministry of Health, 2016) showed that the BCEHS system was not well prepared to respond to chronic medical emergency epidemics grounded in such complex social issues as poverty, marginalization, and mental health issues (Belzak & Halverson, 2018). BCEHS also appears to lack the necessary resource support systems required in extended disaster scenarios (e.g., ongoing pandemic and opioid crises) and in response to climate impacts (e.g., heat events). The organization was not originally designed

to respond to these risks; however, it has been increasingly asked to respond to these and other events involving more complex social needs and a larger-scale response.

These issues became a call and motivation to investigate BCEHS's current structure by examining which of the organization's elements are resilient and how BCEHS can be more adaptively resilient to prepare for large-scale crises and disasters. A better understanding of BCEHS's response to the pandemic and other recent disasters can highlight what BCEHS lacks in terms of adaptive resilience in short- and long-term scenarios, including the practices and policies the organization requires to adapt in order to better meet the various evolving challenges and complex health crises associated with climate change.

Research Goals

The overarching goal of this study was to investigate how to support and enhance BCEHS's resilience and adaptive capacity to enable its ambulance operations to respond and adapt more effectively to complex and interconnected disasters and emergencies in the context of climate change and other emergent, complex health crises. Specifically, the goal was to study the organizational resilience of BCEHS by hearing from its frontline employees and leadership. This process explored the potential of integrating climate adaptation and disaster risk reduction to increase organizational capacity and resilience. It is hoped that the outcomes of this study can inform practices and policies related to out-of-hospital care and contribute to BCEHS's adaptive resilience.

Research Question

The main research question guiding this study was: What strategies and structures can best support BCEHS's organizational resilience and adaptive capacity in the context of climate change-induced and other complex disasters?

Scope

BCEHS is a provincial, publicly funded government organization and the central subject of this investigation. Therefore, this research focused on the organizational impacts of disasters on out-of-hospital care ambulance systems rather than medical treatments or patient care, using BCEHS as a case study. Data collection for this study occurred in the following the start of the 2019 pandemic, and the survey portion of the data collection (after interviews and a focus group) followed the heat dome of 2021 and the atmospheric river of 2021 (see chapter 3, Table 7). Disaster risk reduction (DRR) is the objective of a disaster risk management strategy defined by the United Nations as "reducing disaster risks through systematic efforts to analyze and manage the causal factors" and reducing "hazards, [and] lessening vulnerability" (p. 1). This broad definition, when viewed from an out-of-hospital care perspective, encompasses two distinct but interconnected streams of analysis. The first is internally focused and addresses the organization's ability to maintain out-of-hospital care functions during a disaster. The second is externally focused and pertains to the health and well-being of communities and the general vulnerabilities and hazards faced by the public.

Given this interrelationship between DRR and out-of-hospital care, this research also extended beyond the specific case of BCEHS, with the overarching goal of contributing to DRR more generally in the province. The insights derived from the lived experiences of BCEHS staff in the context of disasters and complex health crises can add to the academic discourse for similar systems and organizations with an understanding of adaptive strategies and structures that bolster organizational resilience in emergency health organizations such as BCEHS. By exploring the intersection of climate change, disaster management, and complex organizations, this research sought to inform policies and practices used for the evolving disaster risks and multifaceted crises of the 21st century.

Chapter 2: Literature Review

This literature review investigates the complexities in ambulance systems regarding the provision of out-of-hospital care, focusing particularly on challenges from climate-related disasters. Literature reviews can be constructed using various methods, including chronological, thematic, and methodological organization (TUS Library Midlands, n.d.). This literature review uses the broad-to-specific method (TUS Library Midlands, n.d.), as it starts with broad theoretical concepts and narrows to specific cases. It also has a logical flow for contextual clarity and comprehensive coverage to identify gaps in current research and to frame the research question (Snyder, 2009) within the broader context of emergency and disaster management as an overarching theme and context. The structure of this literature review was chosen for depth and breadth of coverage and divided into six sections: theoretical perspectives; disasters and climate change; impact on emergency management; high reliability organizations (HROs) in health care; organizational resilience and risk management; organizational adaptations to climate change; and BCEHS operations and challenges.

Theoretical Perspectives, Complex Systems, and Organizational Dynamics

Various theoretical perspectives or concepts are involved in discussing complicated or complex problems. Such theories include complexity theory, the study of "dynamic behaviours of complexity interacting, interdependent, and the adaptive agents under conditions of internal and external pressure" (Marion, 2008, p. 3). Complexity theory, as discussed by Berlow (2010), Anderson (1999), and Wheatley (2006), emphasizes the distinction between "complex" and "complicated" systems. Complicated systems are akin to an engine of many intricate parts understood by breaking down these parts linearly

(Anderson, 1999). Complex systems are interconnected and include nonlinearity; "systems change inputs to outputs in a nonlinear way because their components interact with one another via a web of feedback loops" (Anderson, 1999, p. 216). Furthermore, they are unsolvable and require a systems nonlinear approach, as they lack clear solutions. Complex systems are systems with multiple interacting components such that the collective behavior is nonlinear, and emergent (Sturmberg et al., 2017). Complexity is like trying to restore a destroyed ecosystem as the complex interactions of soil, water, plants and animal cannot just be put back together, even with effort, if there has been significant disruption to the ecosystem (Jones et al., 2018, p. 5). Jones et al. (2018) note that it "could take millennia for full recovery of ecosystems pushed well away from their reference conditions" (p. 5).

Predictive models lose their accuracy when managing complexity due to the dependence on initial conditions and the continual interaction of numerous variables (Marion, 2008). Marion (2008) discusses chaos within complex systems that do not lead to disorder, which often precedes emergencies. Wheatley (2006) notes that chaos in such systems can lead to the emergence of order, necessitating a shift from traditional problem-solving methods to understanding the dynamics of complexity and chaos in organizations.

Complexity theory that is not predictable can evolve spontaneously through an adaptive nature when a complex system faces destabilization or becomes overly rigid (Marion, 2008). As Dooley (1997) points out, an ability exists to self-organize where new patterns of operation emerge.

As Berlow (2010) states, "complex" and "complicated" are not synonymous. Complex systems are not analyzed by examining one factor's direct link in the system, but by examining the entire ecology of the system and determining how the connections within the entire web of interconnectedness interact (Berlow, 2010). This interconnectedness and the focus on patterns within the system do not necessarily result in complicated answers. Instead,

they can generate simple answers to complex questions. Thus, zooming out to understand the whole system can provide insights that may not inherently be complicated or complex.

Marion (2008) suggests that interconnectedness within complex systems has the potential for novel solutions and adaptive strategies in a highly ordered system. This capacity for innovation is a direct result of the diverse, rich interactions and feedback mechanisms inherent in complex systems. Simple answers can arise from the complexity. Specifically, looking at the bigger picture to understand the whole system can provide a simple answer to the specific problem. Conversely, narrowing one's focus on a problem may not yield the solution.

The concept of *wicked problems* aligns with the term "complexity," while *tame problems* are related to the term "complicated." Wicked versus tame problems describe complexity in the context of organizations that address emergencies (linear) and disasters (complex) (Grint, 2005; Ritchey, 2013; Rittel & Webber, 1973). Wicked problems are inherently complex, while tame problems are more straightforward or "complicated." Rittel and Webber (1973) introduce the term "wicked problems" as the "scientific basis for confronting problems of social policy" (p. 1). Conklin (2005) expands on organisational ideas concerning human interactions to solve complex problems that resist solutions; wicked problems are intractable because of their ability to move from being complicated (linear) to complex, making it impossible to test solutions, and they include a high degree of uncertainty as outlined in Table 1. In summary, wicked problems are complex with no clear solutions, while tame problems can be complicated but have solvable outcomes (Rittel & Webber, 1973). Table 1 offers further identification of the differences between tame and wicked problems.

Table 1

Key Differences Between Tame Linear Problems and Wicked Complex Problems

Tame Problems (Linear)	Wicked Problems (Complex)
Well-defined, belong to classes of similar problems (Conklin, 2005)	Interconnected, and "there is no definitive formulation" (Rittel & Webber, 1973, p. 161), as they are unique
Definite endpoint (solution found) (Conklin, 2005)	No endpoint (Rittel & Webber, 1973)
"Objectively evaluated as right or wrong" (Conklin, 2005, p. 9)	A spectrum of answers may be applied, with some better than others; "not true-or-false, but good-or-bad" (Rittel & Webber, 1973, p. 162)
"Belong to a class of similar problems all solved" (Conklin, 2005, p. 9)	No ultimate test of a solution to a wicked problem (Rittel & Webber, 1973, p. 163)
Trials and errors are possible, and planners can learn from failures (Conklin, 2005)	Each attempt at solving a wicked problem has significant consequences as it alters the situation (Rittel & Webber, 1973)
Finite set of solutions (Conklin, 2005)	Infinite potential solutions (Rittel & Webber, 1973)

Whereas linear problem-solving approaches work for many problems, the nonlinearity and complexity of wicked problems require a different approach. Hardin (1987) explains that understanding concepts like wicked problems requires a higher order of thought. Hardin (1987) refers to three orders of thought, which he termed "filters"; literal, numerate, and ecologate.

Literal refers to someone's ability to understand what is being said as being perceived literally. This basic level of understanding concerns sharing, or even suppressing, ideas at a concrete level of comprehension, such as talking about a rock or trees in a forest. The *numerate* level of thinking is the ability to measure, weigh, and test, which places the

understanding of the rock and trees at the next level so that one knows that the rock comprises atoms and that trees use energy from the sun for photosynthesis.

Ecologate thinking represents the most advanced level of thought, where an individual recognizes the interconnectedness of systems and understands that actions taken by one person or entity can have widespread, cascading effects (Hardin, 1987). An example of ecologate thinking might include understanding that excessive deforestation not only depletes local resources but also disrupts global climate patterns, leading to broader ecological imbalances (Curtis et al., 2018). Climate change-related problems need an ecologate thought process that supports an understanding of the interconnectedness of actions and consequences across scales, such that what one person, community, organization, or country does directly affects others and the planet. Bridging the gap between people who think literally and those with a numerate thought process requires considering the experiences of those involved from the ecologate level of thinking. concepts should therefore be grounded in all three levels of thought; literal, numerate and ecologate.

Integrating Hardin's (1987) three filters of thought in an organization such as BCEHS, where some people provide patient care—for example, paramedics constantly employing critical thinking to adapt to unpredictable patient presentations, policy, and strategy—development often requires an additional systems-level perspective, incorporating organizational, political, and broader ecological factors. By integrating literal, numerical, and ecological thinking, organizations can avoid an over-reliance on language or numbers alone, recognizing the interconnectedness of systems, communities, and ecological impacts necessary for climate change adaptation (Gunderson, 2010).

Organizations require constant adaptation to address wicked problems and complexity. Anderson (1999) describes complex adaptive systems as nonlinear and self-organizing, as an organization can become obsolete if it remains in a state of decay and does

not adapt. He further addresses the fact that this state can occur when organizational silo members interact only among themselves, and incestuous feedback loops prevent information exchanges, which ultimately suppresses change. Chaotic volatility occurs when unfettered change moves through a complex system, and Anderson (1999) contends that, for a model to be effective, a "continuous injection of energy is necessary to sustain a pattern of interactions in a network" (p. 223). Wheatley (2006) adds that order can emerge from chaos.

Indeed, the world is now concerned with information, which can sometimes appear overwhelming. Individuals and organizations can understand complicated problems when complexities are made more understandable and old ways of knowing yield to a new state. Hence, emerging research on organizational resilience is moving from focusing on complicated relationships to a focus on the state of complexity (Uhl-Bien & Arena, 2017). As Plsek and Wilson (2001) state, "Treating organisations as complex adaptive systems allows a new and more productive management style to emerge in health care" (p. 746). Wheatley (2006) explains that chaos is normal and natural; it exists within organizations as a renewing and revitalizing force.

Disasters and Climate Change

The complexity and severity of climate change are amplified because of climate change's role in escalating the frequency and intensity of disasters such as floods, storms, and wildfires, thereby causing significant economic and societal impacts. According to the federal government, the impacts of climate-related disasters affecting Canada have escalated, as have the costs of these impacts: "Over the past five decades, the costs of weather-related disasters like floods, storms, and wildfires have risen from tens of millions of dollars to billions of dollars annually in Canada" (Climate Action Secretariat, 2023, p. 20). This pattern of escalating costs due to climate-related disasters also holds globally; "The cumulative

scientific evidence is unequivocal: climate change is a threat to human well-being and planetary health" (IPCC, 2023, p. 89).

Climate change is inherently a wicked problem due to its complex, interconnected nature. As such, it resists straightforward solutions and has no clear stopping rules. Some of this complexity can be observed in the broad range of impacts, wherein climate change "increasingly threatens the health and livelihoods of people around the globe, ecosystem health, and biodiversity, with severe adverse consequences for current and future generations" (IPCC, 2023, p. 92). Given climate change-related disasters and impacts, the wicked complexity of the problem of climate change is global and transboundary (IPCC, 2023) and, as described previously, has no simplistic right or wrong answers, and is a wicked problem that is better or worse on a spectrum.

Implications for Disaster and Emergency Management

Coppola (2011), Quarantelli (1988), and Conklin (2005) argue that a shift in disaster and emergency management (DEM) paradigms is necessary due to climate change, highlighting the ways in which climate change is challenging traditional response-focused emergency management frameworks. Traditionally, the major focus of disaster and emergency management (DEM) has been on the response aspect (Coppola, 2011; Quarantelli, 1988) and has tended to examine disasters in isolation from each other and from other intersecting issues. The complexity of climate change, as articulated by Ylhäisi et al. (2015) and IPCC (2007), demands that emergency management adopt more novel, holistic, and proactive approaches. This includes risk-analysis methods that consider intersecting risks, address the uncertainty inherent in complexity, and allow for value-based judgments in assessing the trade-offs between risks (Ylhäisi et al., 2015). Furthermore, the notion of disaster risk reduction (DRR), which has been part of emergency management for some time, has become even more important in the context of climate-accelerated disasters and now

needs to include a consideration of both the climate impacts (e.g., greenhouse gas emissions) of measures, and the ways in which measures consider the need for adaptation or the "initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects" (IPCC, 2007, p. 76)

Table 2, below, is informed by the World Health Organization health emergency and disaster risk framework and more clearly outlines the shift from traditional emergency management practices to emergency management driven by disaster risk reduction.

Table 2

Shift From Traditional Emergency Management to Disaster Risk Reduction Driven EM

From	To	Reference
Event-based	Risk-based	(UNDRR, 2015, WHO, 2019)
Reactive	Proactive	(UNDRR, 2015; World Health Organization [WHO], 2019)
Single-hazard	Prioritized hazards based on risk assessment	(Bodas et al., 2020)
Hazard focus	Vulnerability and capacity focus	(WHO, 2019)
Single agency	Whole-society	(UNDRR, 2015)
Separate responsibility	Shared responsibility for health systems	(WHO, 2019)
Response focus	Risk management	(UNDRR, 2015; WHO, 2019)
Planning for communities	Planning with communities	(WHO, 2019)

Note. Table adapted from WHO (2019) Health Emergency and Disaster Risk Management Framework, p. 5.

Implications for DEM-Informed Emergency Response Organizations

Organizations, such as BCEHS and other emergency and disaster-response organizations, face a spectrum of issues, including emergencies, disasters, and catastrophes (Quarantelli, 2000, 2006). Although typologies of emergencies, disasters, and catastrophes are not universal in disaster research (Perry, 2007), the following are used in this research.

Etkin (2015) describes emergencies as linear and routine, enabling direct and straightforward solutions, while disasters and catastrophes are complex (see Figure 1). The United Nations marks disasters as disruptions to a community's functioning or to society on a large scale, which can result in human, material, economic, and environmental losses and other adverse effects (UNISDR, n.d.). Catastrophes "require different kinds of planning and managing than even major disasters" (Quarantelli, 2000, p. 4).

Etkin (2015) describes disasters as requiring complex, coordinated efforts across various sectors within a community, since they are unpredictable and sustain a higher level of impact than emergencies. Etkin et al. (2023) propose that preparing and mitigating disaster risks requires adaptive management strategies and includes diversifying risk management, which is the precautionary principle for severe destructive events.

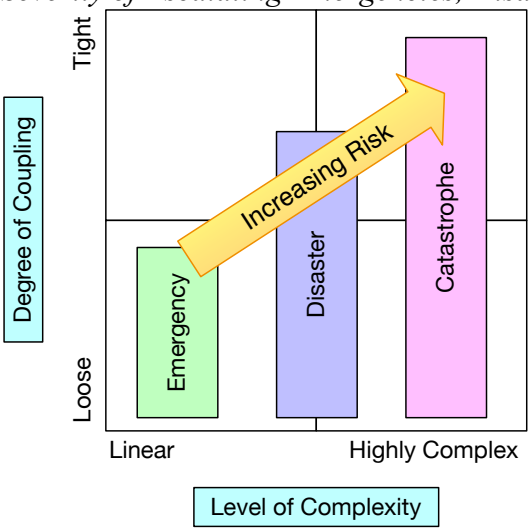
The distinctions between these events are important because of their operational implications for organizations like BCEHS, which are part of a disaster and emergency management (DEM) response system from an out-of-hospital patient care perspective. During routine emergencies, BCEHS coordinates primarily with local health authorities and municipal first responders. As disasters escalate into regional or provincial disasters, agencies such EMCR and PHSA may activate higher-level coordination structures, requiring BCEHS to adjust its operational priorities and resource deployments.

An emergency, as a tame problem, requires an organization to address serious issues without experiencing significant operational disruption (UNISDR, n.d.). For instance, an emergency BCEHS might face could involve responding to a motor vehicle accident or a range of patient injuries, something it does approximately 1,600 times per day (Ministry of Health, 2024). A disaster, however, requires an organization to prepare for and recover from an increased volume and complexity of issues, often while managing its own operational disruptions (UNISDR, n.d.). An example of a disaster response for BCEHS could be a

widespread heat event or the complex demands of a pandemic, both of which may cause an overwhelming increase in demand that exceeds BCEHS's capacity. Figure 1, below, illustrates the escalating complexity from a contained, linear tame problem of an emergency to a more complex disaster, and, finally, to the unboundedness and unpredictability of a catastrophe.

Figure 1

Severity of Escalating Emergencies, Disasters, and Catastrophes



Note. Linear emergencies are complicated, whereas disasters and extreme catastrophes are complex (adapted from Etkin, 2015).

Organizational Adaptations to Climate Change

Given the fact that climate change is accelerating the frequency of disasters (e.g., increased incidence of extreme heat events and wildfires) and amplifying their magnitude (e.g., the increased size and impacts of wildfires and extreme weather events), organizations across sectors need to adapt. According to the IPCC (2022), organizational adaptation to climate change requires both proactive and reactive strategies and it requires adaptation at multiple scales. The IPCC (2018) defines adaptation as "the process of adjustment to actual or expected climate and its effects, to moderate harm or exploit beneficial opportunities" (p. 542). Such adaptability within emergency services organizations is particularly important

given the constantly changing nature of the threats they face, and the constantly increasing complexity of the environments in which they work

For government organizations such as BCEHS, adopting elements of decentralized decision making and adaptability may enhance their capacity to respond effectively to climate-related disasters. Part of such adaptability includes the capacity to learn from successes and failures and to be able to nimbly react to environmental changes and risks. Sagarin (2012) draws on the natural world to illustrate this kind of orientation, pointing to the ways in which species learn to survive in competitive spaces, such as tide pools, despite strong competition and uncertainty. He explains that, when a gap exists in nature, factors emerge from necessity and opportunity, highlighting the importance of adaptability. Organizations often only focus on improving aspects that are wrong. However, hierarchical decision making opposes adaptability and sharing power; thus, a decentralized ability to react to changes in the environment is crucial (Sagarin, 2012). Most organizations have an informal mode of functioning beyond their official organizational charts, and people develop networks of relationships that evolve naturally. According to Barasa et al. (2018), there is a

> recognition of resilience as an emergent property of complex adaptive systems. Resilience is both a function of planning for and preparing for future crisis (planned resilience), and adapting to chronic stresses and acute shocks (adaptive resilience). Beyond resilience to acute shocks, the resilience of health systems to routine and chronic stress (everyday resilience) is also key (p. 491).

Sagarin (2012) suggests that, while organizations often focus on what is wrong when trying to improve their performance, they should emphasize adaptive decision making and decentralized systems to prepare themselves to react to changes.

Other organizations have adopted novel approaches that can also be applied to climate change risk. For instance, Hock (2005) describes the process of becoming such a pioneering

adaptive organization, one not based on traditional structures but, instead, resisting traditional ideas. Hock (2005) coined the term *chaordic* to denote organizations with a balance of chaos and order. Hock (2005) makes the argument that the credit card company, VISA, for instance, is chaordic and was designed to be a leaderless organization based on a shared vision rather than having a traditional financial structure steeped in tradition and a solid structure that would resist innovation. VISA is among the largest financial organizations worldwide and, when it began, no similar organizations existed on which it could base its structure (Hock, 2005).

Sagarin (2012) emphasizes the importance of decision making, adaptability, and decentralized systems. Moreover, Hock (2005) favours a shared vision rather than a traditional rigid organizational structure. It is important to foster innovation and adaptability because they offer adaptive models rather than the more traditional approaches government organizations, such as BCEHS, use. Adaptation and flexibility are core components of what has become known as *organizational resilience*, or the capacity of an organization to weather disruptions and uncertainty, and continue to function. High reliability organizations (HRO) operate successfully in complex, high-risk environments (LaPorte and Consolini 1991; Roberts, 1989; Sutcliffe and Weick, 2015) to enhance resilience in climate change-related disasters. HRO are discussed later in this chapter.

Organizational Resilience and Disasters

Organizational resilience is defined as an organization being able to bounce back from a disruption, such as a disaster, and is rooted in fields like mechanical engineering and ecology, where resilience refers to the capacity of a system or material to absorb disturbances and still retain its basic function (Holling, 1996). This concept has been adapted to organizational contexts of adaptation and preparation for disruptions (Holling, 1996). However, organizations also have adaptive aspects, “such as policies, processes and

organizational culture" (Barasa et al., 2018, p. 491), which are part of resilience in the context of this research. Organizational resilience is reliant on the resilience and capacity of its staff. In the case of emergency response or service organizations, both frontline and management staff must balance risk and resilience in response to various uncertainties, such as what impacts the disaster has on the community (including people, environment, and infrastructure), how many people are directly and indirectly impacted, and what disruptions occur in the shorter and longer term that may affect the organization's ability to respond.

Existing organizational structures, practices, and policies, even when well-practiced and proven, may not be well suited for addressing this complexity and uncertainty at the frontline. Many emergency response organizations have adopted the command-and-control system for disaster response. Command-and-control management systems emphasize "vertical, linear information flow: in general, information flows up the chain of command and orders flow down. Discipline and coordination are imposed from above" (Chaudhury et al., 2012, p. 256). This traditional command-and-control system for an emergency response to smaller-scale "tame" emergencies is not well suited to the complex "wicked" nature of disasters (Conklin, 2005; Freudenburg et al., 2012; Neal & Phillips, 1995; Quarantelli, 1988). For instance, the COVID-19 pandemic affected emergency service providers at the frontline of the response, in terms of the volume of calls, the nature of those calls, and what they required (e.g., personal protective gear), how COVID-19 intersected with other ongoing crises (e.g., opioid crisis) and emergencies, and how the pandemic affected workers and staffing directly (Friedman and Strayer, 2020; Marazziti et al., 2021). Because of these multiple, intersecting impacts and the uncertainty and complexity, the COVID-19 pandemic and climate change are redefining organizational approaches to disaster risks, and control has become extremely difficult (Klenert et al., 2020).

A 2022 government report describes how the traditional emergency management approach to the COVID-19 disaster in BC could be scalable to a province-wide crisis "in theory" (de Faye et al., 2022, p. 26). However, the approach was abandoned early in the pandemic due to "debate since early in the pandemic about the applicability of emergency management to pandemics" (de Faye et al., 2022, p. 25). The report recommended that, "given the uncertainty and evolving nature of a major event, a principle-based approach would offer guidance but recognise the need for flexibility" (de Faye et al., 2022, p. 73).

While no single method exists to manage a disaster, flexible and adaptable approaches can decrease vulnerabilities, depending on their scale and complexity. Wright et al. (2020) state that "building on emergency preparedness and response, while simultaneously putting a greater emphasis on prevention and recovery" (p. 215) marks a shift from traditional command-and-control models towards one of organizational resilience. This aligns with the principles of high-reliability organizations which emphasize decentralized decision making and adaptability to maintain reliability in complex environments (LaPorte & Consolini, 1991; Roberts, 1989; Sutcliffe & Weick, 2015).

Organizational Resilience in Ambulance Services

According to Gayton and Lovell (2012), resilience in ambulance services organizations, such as BCEHS, helps develop the ability to find and address internal vulnerabilities before they adversely affect business operations. While this would be necessary in any context, it is particularly important in the context of disasters and climate change events; the complexity of disasters and climate change-related events pose multiple, often unanticipated, and prolonged demands that result in, or exacerbate, internal vulnerabilities for response organizations like BCEHS. Consequently, such organizations need multiple adaptive approaches to anticipating and managing these demands and vulnerabilities (Kendra & Wachtendorf, 2002; Quarantelli, 1988; UNISDR, 2018).

Quarantelli (2006) contends that some measure of organizational adaptation occurs during a disaster when many people are injured or ill;

> Different performance standards are applied. For example, the normal speed of response and individualized care given to treating the injured is superseded by a need to curtail the level of care given to victims as well as spending time, efforts and resources on more equitably distributing the many victims in the available medical facilities (p. 1).

The concept of HROs has been proposed as a way of thinking about organizations whose organizational structures and practices consider and can effectively respond to complexity.

High Reliability Organizations

HROs are described as organizations that operate effectively and safely in complex, often high-risk, environments. As Enya et al. (2018) define them, HROs "are known to operate nearly error-free in extremely challenging and uncertain environments, where complex procedures, technology, and guidelines are used to manage complex systems and conditions" (p. 1). The principles of high reliability organizations, relevant in complex environments such as health care and emergency services, were explored by LaPorte and Consolini (1991), Roberts (1989a), and Sutcliffe and Weick (2015).

These principles of HROs provide a framework for understanding the functioning of complex systems such as health care and emergency services. Initially, research in this field focused on organizations in high-risk sectors, such as nuclear power plants and aircraft carriers (LaPorte & Consolini, 1991; Roberts, 1989a). The aim was to discern how these complex organizations could operate in hazardous environments without accidents while maintaining functionality during emergencies (Sutcliffe & Weick, 2015). Roberts (1989a) argues that accidents are not inevitable in such high-risk organizations.

A systems perspective is central to understanding HROs, since they are characterized by operating in complex uncertain environments with high interdependence among various components of the system(s) (Enya et al., 2018). HROs are not error-free but excel in error detection, reaction, and recovery (Sutcliffe, 2011; van Stralen & Mercer, 2020). HRO research has expanded to include such diverse industries as construction and health care, with a resultant framework for understanding and identifying HROs based on five core principles: preoccupation with failure; reluctance to simplify interpretations; sensitivity to operations; commitment to resilience; and deference to expertise (Sutcliffe & Weick, 2015). Table 3, below, provides the five principles of HRO characteristics, with their associated descriptions.

Table 3

Five Core Principles of HROs

HRO Characteristic	Description
Preoccupation with failure	Continuous focus on identifying and mitigating potential failures and errors (Enya et al., 2018; Roberts, 1989a)
Reluctance to simplify	Avoids oversimplification of complex processes (Enya et al., 2018; Roberts, 1989a; Roberts, 1989b)
Sensitivity to operations	Responsiveness to the state of operational systems and environments with a detailed system of processes and the state of organizational systems (Enya et al., 2018; Roberts, 1989a; Roberts, 1989b)
Commitment to resilience	Ability to adapt, recover, and learn from events and errors (Enya et al., 2018; Roberts, 1989a; Roberts, 1989b)
Deference to expertise	HROs consult experts with the organization and base decisions on expertise and knowledge rather than hierarchical position (Enya et al., 2018; Roberts, 1989a; Roberts, 1989b)

HROs in Health Care Systems

Health care systems are inherently complex and comprise multiple components that interact to influence the quality of patient care (Sutcliffe et al., 2017). This complexity presents challenges to the traditional application of HRO principles, like industry, as argued

by Sutcliffe (2011). Ambulance services, as a component of health care systems, operate in uncertainty and unpredictability—the very contexts that define HROs—and this also includes incomplete background information, time constraints leading to rushed judgements, and limited feedback on the effectiveness of interventions (McAllum, 2019).

Within the context of disasters—including extended events such as the COVID-19 pandemic—ambulance services, if they were fully operating as HROs, could theoretically maintain operational effectiveness despite the complexity of disruptions and ongoing uncertainty (van Stralen & Mercer, 2020). However, van Stralen and Mercer (2020) caution that

> adopting the normative form of HRO while continuing rigid enforcement of rules or authoritarian structures, such as obedience without initiative or conformity without creativity, degrades HRO. The qualities that make HRO a powerful method against severe adversity or operations in hostile environments are lost in the moment they are needed most (p. 8).

This critique underscores that applying HRO principles in healthcare without flexibility can hinder, rather than enhance, resilience.

Critics of HRO in healthcare argue that inherent variability and unpredictability in patient care challenge the application of HRO principles in day-to-day circumstances and complex disaster contexts. Martelli et al. (2018) suggest that fully implementing HRO principles in healthcare "may be limited without adjustments that account for healthcare's operational diversity and often unpredictable environment" (p. 674). This indicates that the potential for health systems to operate as HROs exists, but achieving this requires a deliberate effort to adapt HRO principles to the unique demands of healthcare settings.

Several factors contribute to organizational resilience, such as leadership, culture, communication, and innovation (Lee et al., 2013; Serrat, 2013). In the case of risk

management, Seville (2016) advocates building resilience through flexible and decentralized organizational structures, supported by automation and data analytics for detection of failure risks. Additionally, Barasa et al. (2018) emphasize that resilience in health systems is an emergent property of complex adaptive systems, noting that

> resilience is both a function of planning for and preparing for future crises (planned resilience), and adapting to chronic stresses and acute shocks (adaptive resilience). Beyond resilience to acute shocks, the resilience of health systems to routine and chronic stress (everyday resilience) is also key (p. 491).

By integrating HRO principles and focusing on organizational resilience, ambulance services can prepare for and operate to the inherent complexities of healthcare and disaster situations. Although health systems are different from, for instance, the industry of aircraft carriers (LaPorte & Consolini, 1991; Roberts, 1989a), there is compatibility with HRO principles, but it is important to acknowledge the necessity for organizations to adopt and adapt (if needed) the processes, procedures, and resources required to function as HROs.

British Columbia Emergency Health Services: Operations and Challenges

This section offers an in-depth examination of BCEHS's operations and challenges, and contextualizes the previous discussions in a real-world setting. Based on the report by the Auditor General of British Columbia (2019), this section details BCEHS's functioning, the complexities of out-of-hospital care, and the need for adaptability and resilience in facing climate change and disaster-related challenges.

British Columbia Emergency Health Services' Operations Overview

Understanding the capacity of BCEHS first requires a discussion of the functioning of the current system. The following section shows how the out-of-hospital system works in BC. Established in 1974, BCEHS is legislatively responsible for out-of-hospital care in BC. Since 2018, it has responded to more than 500,000 events per year, supported by three dispatch

centres, 183 stations, two corporate head offices with regional offices, four helicopters, approximately 500 ambulances, and over 4,000 staff (Auditor General of British Columbia, 2019).

In 2010, BCEHS was placed as one of six health authorities in the province "with the intent of better integrating BCEHS into the health system" (Auditor General of British Columbia, 2019, p. 15) from a direct government ministry portfolio. BCEHS has several regions that split the province into different administrative sections and further divide each administrative section into 1) remote stations that operate with on-call paramedics in small communities with fewer than several hundred patient events per year; 2) mid-sized communities with a mix of on-call and full-time staffed ambulances with several hundred to a few thousand ambulance events per year; and 3) urban and metro communities with multiple 24-hour stations that are fully staffed, have ambulances, and receive tens of thousands of individual 911 events and interfacility transfer calls per year.

Hence, in this diverse organizational and response structure, hinterland paramedics may see only a few dozen patients per year while metro paramedics may see thousands (Auditor General of British Columbia, 2019; Operational Research in Health [ORH], 2015).

The traditional ambulance response model is built around patient injuries and ambulance calls. The model has a beginning, during which a member of the public calls 911 for help; a middle, when an ambulance is dispatched and responds to an injury or an illness, and patients receive treatment to address their complaints; and an end, which occurs when the person is taken to a hospital. After more than 500,000 out-of-hospital events in 2019, 71% of the patients involved were taken to a hospital (BCEHS, 2019). Ambulances must offload patients before being cleared for another call, so delays adversely affect their availability to complete more responses or transfers (Kelen et al., 2021).

The out-of-hospital emergency response part of BCEHS receives patient information from two primary sources: a) public emergency calls from a 911 call centre, where, if someone requires medical attention, BCEHS receives the call to their dispatch call centre, and b) from the health system, when a patient must be moved from one facility to another. The information is received by an emergency call-taker in a call centre coded into different acuity levels by software, which establishes the triage level by sorting patients into categories of what they receive, and when, and the speed and level of care. The highest acuity receives the most advanced care and receives it quickly (ORH, 2015).

British Columbia Emergency Health Service Staff

See the table below for a breakdown of the different roles at BCEHS.

Table 4

BCEHS Breakdown of Staff in Numbers (2021)

Category	Role/Position	Number of Personnel
Leadership	Leaders (including managers and executives, nonunionized)	250
Primary response	Primary care paramedics	2,882
	Emergency medical responders	488
	Advanced care paramedics	264
	Community paramedics	87
	Critical care paramedics	83
	Infant transport team paramedics	25
Patient care communications and planning	Emergency medical call takers	124
	Emergency medical dispatchers	228
	Paramedic specialists	22
	Secondary triage paramedics	8
	Physicians	33
	Low-acuity patient navigators	2
Patient transfer network	Patient transfer coordinators	40
	Community paramedic coordinators	4
	Patient transfer supervisors	5
Patient transport coordination centre	Emergency medical dispatchers and call takers (Five, part-time)	43

Grand total	4,388

Note. The total number of personnel at BCEHS was reported as 4,338 (BCEHS, 2021).

Dispatch has call-takers, who answer 911 telephone calls from the public, and emergency medical dispatchers, who send the calls to ambulances. Dispatch also coordinates interfacility transfers. Different paramedic classifications exist within BCEHS, with the majority being primary care paramedics providing basic life support (BLS) and transport capabilities. Almost all calls are sent with BLS, and higher acuity patients (i.e., those with chest pain) are layered with two ambulances and an advanced care paramedic (ACP) to provide advanced life support (ALS); "Ninety-five percent of responses are made by BLS (82.2%) and ALS (12.9%) units" (ORH, 2015, p. 12). BLS is provided to 66% of interfacility transfers in metro areas. ALS paramedics are only in large metro urban centres, such as Vancouver, Victoria, and Kamloops, and "some patients in rural and remote areas can experience a lower level of service" (Auditor General of British Columbia, 2019, p. 7).

Critical care paramedics (CCPs) are available to respond to 911 calls by air and ground, offering the highest level of care on the scene and during transport to a hospital. CCPs also conduct patient transfers. Additionally, ACPs and CCPs work as paramedic specialists in Vancouver's on-scene support, driving nonpatient, transport-capable cars for street crews in complex situations and providing telephone support for the remainder of the province. BCEHS physicians are also available to on-scene crews requiring extraordinary medical advice, such as discontinuation of resuscitation efforts. BCEHS also has rural and remote communities with emergency medical responders (EMRs) for the most basic level of medical care. See Table 5, below, for a breakdown of levels.

Table 5

Paramedic Credentials and Levels

Role	Description
Call takers	Receiving all ambulance requests for service through the 911 system and other communication routes
Emergency medical dispatcher	Directing the timely and efficient response of ambulances, paramedics, and other resources to emergency calls
Emergency medical responder	Licensed to administer basic life-saving emergency medical care
Primary care paramedic	Licensed to administer more advanced patient care than EMRs; most BC paramedics are primary care paramedics (PCPs), and they handle most 911 calls
Advanced care paramedic	Specializing in advanced care of medical and trauma patients with a focus on advanced cardiac resuscitation
Critical care paramedic	Highest level of specialized care with a focus on acute interfacility transport, air medical response, and infant, child, and perinatal care
Paramedic specialist	Advanced care and CCPs who provide on-scene technical support for high-risk situations and mass and complex patient events, and telephone support to paramedics and patients
Community paramedic	Licensed at the PCP-IV level or higher to provide nonemergency and scheduled care to patients as part of an integrated health care team

Note. Table adapted from paramedic credentials and levels (Provincial Health Services Authority, n.d.).

Out-of-Hospital Care Nonresponse Staff

Patient injury and illness ambulance response calls are among the many services BCEHS provides (BCEHS**,** 2018). Other out-of-hospital roles of BCEHS include a) interfacility transfers, b) telephone support to 911 callers, and c) community paramedicine. Other services include the following:

- Over 90,000 interfacility transfers between hospitals, community-care facilities, and homes occur annually (Auditor General of British Columbia, 2019).

- BCEHS has a clinical hub that provides advice for the lowest acuity calls for *secondary triage* "self-care advice" (p. 1), and other non-ambulance responses, such as self-transport to a doctor's office or the emergency room to "ensure low acuity patients receive the right care the first time they contact 911" (p. 1). Its suite of initiatives is the first in Canada, and it continues to innovate (BCEHS, 2023).
- Community paramedics work in rural BC and provide scheduled care (nonemergency) for patients with complex and chronic medical problems who do not need to be taken to hospital and are treated at home. Home visits are coordinated with health authorities. The focus is "prevention, health promotion and primary health care" (BCEHS, 2017, p. 1).
- The corporate side of BCEHS supports out-of-hospital care with different business areas and executives, with additional support from the Provincial Health Services Authority (PHSA).
- BCEHS has direct reporting systems for adverse patient encounters, medical review of treatments, and education programs to introduce or correct patient treatments (Provincial Health Services Authority, n.d.).

BCEHS and Organizational Resilience

According to recent reports, BCEHS provides effective care services to patients in some areas of BC (Auditor General of British Columbia, 2019). However, an analysis of the organization also suggests that it requires better resources, collaboration, and coordinated access to ambulance services across provinces. McChrystal et al. (2015) assert that

> The pursuit of efficiency was once a laudable goal, but being effective in today's world is less a question of optimizing for a known (and relatively stable) set of variables than responsiveness to a constantly shifting

> environment. Adaptability, not efficiency, must become our central competency (p. 27).

Therefore, BCEHS's resilience and adaptability must become central to achieving effectiveness and competency.

When a demand occurs on a system such as BCEHS due to a disaster, it must have the continued capacity to respond while managing unexpected, complex, and intersecting threats to such continuity. In other words, it must be resilient, and, given the vital importance of the services it provides, it must ideally be highly resilient. It is with this knowledge in mind that this study was designed.

The study outlined in this dissertation contextualizes BCEHS as a part of the wider health system as out-of-hospital patient care. Previous research has covered climate change adaptation with respect to patient surges and the need for increased capacity (McMichael & Lindgren, 2011; Thornes et al., 2014). Recent studies have also revealed the complexities of operating in an unprecedented crisis, such as those experienced during the COVID-19 pandemic (Masterson et al., 2021; Sekine et al., 2020). However, there has been a lack of research to date on how a climate change crisis can affect an out-of-hospital ambulance organization's ability to function.

Although paramedic clinical treatment often begins on scene (in some cases, there is no need for hospital transport), during extreme heat or cold, patient volumes can surge, creating additional demands on both ambulance out-of-hospital care and emergency departments. While paramedics may stabilize patients in the ambulance or scene, higher-than-usual 911 events may exist during extreme weather conditions (e.g., ice, snow, fog, gales, flooding, or heat waves) (Thornes et al., 2014), and this can strain the overall health system's capacity. In Birmingham, in the United Kingdom, Thornes et al. (2014) report that, during severe cold, ambulance events rose by 20%, and that each 1°C drop in temperature

corresponded with a 1.3% reduction in performance. Hot weather similarly increased ambulance events which surged by over 30%, especially on days when temperatures exceeded 30°C (Thornes et al., 2014).

In summary, the organizational features described here—such as BCEHS's provincial mandate, mix of on-call and full-time staff, and reliance on integrated dispatch—align closely with the concepts of complexity theory and high reliability organization (HRO) frameworks. For instance, the ability to adapt to surges in demand and navigate interdependent systems aligns with HRO's core principles, such as preoccupation with failure, sensitivity to operations, and deference to expertise. BCEHS's ability to be resilient and to absorb effects from extended disasters, such as the COVID-19 pandemic, and climate-related disasters, such as heat domes, while continuing to function, requires understanding what supports that functioning or resilience in order for BCEHS to be able to prepare for the future escalating impacts of climate change.

This research addresses the broader question, then, of how BCEHS can develop its resilience and adapt its systems, strategies, and structures to more effectively and efficiently respond within the context of disasters and climate change. This includes examining and offering insights into how to improve hospital capacity or out-of-hospital responses, along with the capacity and capability to address the wicked problem of the unpredictable, often unprecedented, and overlapping disasters that are arising and will continue to arise as a result of climate change. The next chapter provides a detailed exploration of the research methods, methodology, and ethics used in this work.

Chapter 3: Methodology

Research Approach

Given the complexity of the challenges BCEHS faces, particularly those related to disasters and climate change, I deemed an interdisciplinary approach necessary for this study. The interdisciplinary lens was informed by a pragmatist research philosophy, which allowed for the incorporation of multiple disciplines, methods, and perspectives.

The capacity of BCEHS to respond to wicked problems—such as acute medical issues, poverty, mental health, addiction, organizational challenges, and climate change-related disasters—requires an interdisciplinary approach. These complex issues necessitate "melding disciplinary silos, allowing stakeholders to cross disciplinary boundaries...to define the problem and find an effective solution" (Shah, 2018, p. 2). As wicked problems become the new norm for BCEHS, "traditional analytical techniques are inadequate" (Levin et al., 2012, p. 1), making interdisciplinary strategies appropriate to address the resulting complexity and uncertainty.

Pragmatism and Interdisciplinary Research

Climate change requires an interdisciplinary approach. Climate change research includes the consideration of many issues that are often separated into two broad categories; mitigation, defined as the curbing of man-made emissions (anthropogenic)—mainly carbon emissions (Watts et al., 2018)—and adaptation, defined by the IPCC (2007) as "initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects" (p. 76), which have "emphasized above all interdisciplinary collaboration" (Mitchell, 2009, p. 300). Both mitigation and adaptation are interdisciplinary topics drawing from natural sciences (e.g., measuring temperature changes and predicting weather patterns) and social sciences (e.g., behavioural change, education, awareness, and psychology of climate grief).In this doctoral study, I focus on adaptation strategies and their

implications for BCEHS's organizational resilience, rather than the broader mitigation and adaptation research (such as decarbonization) in the climate literature.

Climate change and related disaster research on these topics is inherently interdisciplinary and requires the integration of knowledge and modes of thinking (Bhaskar et al., 2010; Frodeman et al., 2017). For these and other complex problems, the linear approach of rapidly transporting someone to the hospital does not address the social, political, cultural, and economic issues that can lead to surges in ambulance calls or poor health outcomes caused by chronic and complex problems. BCEHS needs to be adaptable and flexible, given the rapid changes that can affect the organization, its staff, and the patients it serves. As Wheatley (1992) states, siloed organizations fracture into disconnected departments and become unable to deal with wicked problems, so an organization such as BCEHS would need become a "boundary-less organization" (p. 13) that shifts its thinking from a narrow perspective to a more networked and complex systems thinking. This type of organization and the approach to supporting it in becoming adaptive, as suggested by the working model presented by Wheatley (1992), require an interdisciplinary approach in this research.

Pragmatism is especially suitable for interdisciplinary research due to its flexibility and emphasis on practical solutions (Creswell, 2013). Unlike positivism and interpretivism, which adhere to more rigid inquiry approaches (Morgan, 2014), a pragmatic, mixed-methods design can integrate both quantitative and qualitative elements (Feilzer, 2010; Petter & Gallivan, 2004). This approach is advantageous for addressing complex and dynamic issues requiring insights from multiple disciplines (Johnson & Onwuegbuzie, 2004).

This approach focuses on practical implications, which makes it relevant to real-world problems (Cherryholmes, 1992; Tashakkori & Teddlie, 2003). Metcalfe (2008) outlines five interrelated principles for practical solutions (see Table 6), which emphasize that "the practicalities of a situation should drive our thinking" (p. 1092). Morgan (2014) also

highlights pragmatism's focus on "real-world problems" (p. 1046), which is particularly suitable for addressing issues like developing organizational resilience for disasters.

The pragmatic approach in this study facilitates the integration of theories and methods from various fields, such as complexity, organizational behaviour, disaster management, and ethics. It offers a solution-based philosophy on real-world experiences that align with the researcher's beliefs and offers mixed methods to provide data and a narrative to reveal the meaning of the numbers (Creswell & Plano Clark, 2011). This interdisciplinary strategy provides a nuanced understanding of how BCEHS could enhance its resilience and adaptability to climate change, disasters, and other public health crises (Patton, 1990; Rorty, 1990). The combination of quantitative and qualitative methods offers a comprehensive view of the data to reveal deeper insights and contextualize the numerical findings (Creswell & Plano Clark, 2011).

Metcalfe (2008) describes five interrelated principles of pragmatism and emphasizes the importance of diverse experiences, exploring contrasting concepts, transforming ideas into practical solutions, testing solutions, and reflecting. These interrelated principles of pragmatism are used in my study to explore the complex and practical aspects of EHS. Table 6 outlines these five principles.

Table 6

Five Interrelated Principles of Pragmatism

Principle (Metcalfe, 2008)	Explanation
"Assume each community of stakeholders use[s] different prior experiences" to interpret physical events (p. 1092)	Recognize and value the diverse experiences and perspectives of people when understanding a situation
"Identify a dialectic of useful concepts" (p. 1093)	Explore and identify contrasting and complementary concepts that can offer deeper insights

"Operationalise concepts into conjectured ideas or solutions" (p. 1094)	Transform abstract concepts into practical solutions that can be applied
"Trial conjectured ideas, use these to act on the conundrum, then carefully note what happens" (p. 1095)	Develop ideas in practice and carefully observe and document the outcomes
"Reflect on the consequences of acting on the conundrum" (p. 1095)	Critically evaluate the applied solutions by analyzing the effect-applied solution to gain insights and inform future practices

Research Design

Multistage Mixed-Methods Strategy

I employed a multi-stage mixed-methods approach to data collection to explore how BCEHS can improve its resilience and adaptability, which incorporated qualitative interviews, a focus group, and a quantitative survey. A multi-stage mixed-methods approach involves "three or more stages when there is a sequential component, or two or more stages when there is a convergent component" (Fetters et al., 2013, p. 2137). This study employed a sequential design where data from one phase informed the subsequent phases.

Data Collection Timeline and Context

The presurvey interviews in fall 2020 took place during the early stages of the COVID-19 pandemic. The interviews occurred after two major public health emergencies in the province: 1) the COVID-19 pandemic, declared under British Columbia's Public Health Act, and 2) the opioid crisis in BC (British Columbia Ministry of Health, n.d.), which was declared a public health emergency in April 2016 (Government of British Columbia, 2016). The COVID-19 pandemic declaration enabled organized, wide-scale measures to mitigate the virus's spread and coordinated response efforts to protect the health system and stop people from becoming sick and requiring hospitalization. The opioid declaration was in response to a significant increase in opioid-related overdoses and deaths.

The focus group took place in November 2021. A wildfire-provoked provincial state of emergency was declared on July 21, 2021, and remained in effect for 56 days until September 14, 2021, with 181 evacuation orders and 304 evacuation alerts (British Columbia Wildfire Service, n.d.). The wildfires included the 2021 heat dome and the Lytton fire; on June 30, the town of Lytton and an ambulance station burned down (Hoffman et al., 2022). At the time of the focus group, flooding had not yet occurred.

The survey was open for six weeks in March and April 2022. Survey participants also experienced catastrophic rainfall, known as an atmospheric river, and subsequent flooding from overflowing rivers in fall 2021 (Déry et al., 2024). Additionally, in late December 2021, the main Vancouver dispatch centre experienced a flood due to faulty plumbing, which led to an evacuation to a backup centre. All of these issues were still recent when the survey was opened in March/April 2022. Consequently, many respondents' perceptions may have been informed by their experiences, as outlined in Table 7, below.

These events culminated in a "disturbance cascade" (Hoffman et al., 2022, p. 1), with the wildfires contributing to landslides and floods in fall 2021 (British Columbia Wildfire Service, n.d.; Hoffman et al., 2022). The resulting floods had a major effect on the transportation infrastructure (e.g., rail and highways) and effectively isolated the lower mainland from the rest of the province (Gillett et al., 2022). The 2021 heat dome significantly impacted BCEHS's operations since it resulted in a record number of ambulance calls from June 27 through July 2, 2021 (Henderson et al., 2022). These public health emergencies and disasters were directly relevant to the data collected since they impacted BCEHS's employees and the delivery of out-of-hospital care, which influenced the organization's capacity and resilience. The table below provides an overview of the timeline for data collection and significant events that occurred during the research period. This table illustrates how these events were part of the context in which the participants engaged in the survey, and thus may

have influenced their answers within the study at each data collection point and the subsequent findings described in later chapters. The table captures both ongoing and overlapping events for context of the results.

Table 7

Time of Data Collection and Overlapping Events During Research

Timeframe	Data Collection	Events
April 2016, onwards		Opioid crisis (Government of British Columbia, 2016)
March 2020, onwards		COVID-19 pandemic (World Health Organization, 2020)
Fall 2020 (October, on)	Presurvey interviews	Ongoing: Opioid crisis, COVID-19 pandemic
Reported in 2021, onwards		Burgeoning healthcare staffing crisis (Canadian Medical Association, 2021; Statistics Canada, 2022)
June 27–July 2, 2021		Heat dome with record morbidity and mortality in Canada (Henderson et al., 2021, 2022)
June 30, 2021		Lytton wildfire; destruction of town and ambulance station (Hoffman et al., 2022)
July 21–September 14, 2021		Wildfire state of emergency (British Columbia Wildfire Service, n.d.)
Summer 2021		Wildfires overlapping with heat dome
November 2021	Focus group	Ongoing: Opioid crisis, COVID-19 pandemic, staffing crisis Events: Heat dome, wildfires
Fall 2021		Atmospheric river; flooding and landslides (Déry et al., 2024)
Late December 2021		Dispatch centre flood (plumbing failure)
March–April 2022	Survey	Ongoing: Opioid crisis, COVID-19 Pandemic, staffing crisis Events: Flooding, dispatch centre flood, Wildfires, heat dome, landslides

Data Collection Methods

Interviews

Face-to-face, semi-structured interviews (n = 3) took place to identify barriers to resilience within BCEHS. Semi-structured interviews were used as a way to gather qualitative data while maintaining some flexibility (Gill et al., 2008; Opdenakker, 2006). The interview questions focused on identifying organizational challenges, leadership dynamics, communication during crises, and the impacts of overlapping public health emergencies, and I structured the interview guide to focus on resilience indicators. These indicators aligned with the categories used in the subsequent survey: leadership and culture (2a), networks (2b), preparedness for change (2c), and organizational performance. (See the Appendices for the list of questions). Participants received information about the study's purpose and could opt out at any time. Each interview lasted between 45 and 60 minutes and was subsequently transcribed. Ethical considerations were followed to anonymize the participants' identities.

Focus Group

A focus group (n = 3) took place following the interviews. Focus groups were selected to capture collective perspectives and group-level dynamics that might not surface in individual interviews and according to Morgan (1996), focus groups are a "useful and practical method for gathering qualitative data" (p. 147). Prior to participating in the focus group, participants created timelines detailing key events and related organizational changes, which provided contextual information to guide the questions and discussion during the focus group. Kolar et al. (2015) suggest that timeline mapping allows participants to put complex occurrences in a coherent way. The focus group built upon the findings from the interviews and the insights gained from the timeline exercise (see the Appendices for timelines). Timeline mapping, as a methodological approach, enhances understanding by "experiences in a way that allows them to put complex occurrences in a coherent way"

(Basnet et al., 2023, p. 6). Timeline mapping enabled participants to visualize key events (e.g., COVID-19, heat dome) and to discuss them in chronological context, thereby focusing group dialogue.

The focus group questions were developed based on themes identified in the interviews and the timelines, focusing on BCEHS's structures and barriers, including crises and disasters, barriers and facilitators to organizational resilience, and personal and organizational adaptations to changes in the work environment.

During the focus group, participants discussed the past performance of BCEHS to identify how the organization adapted or did not adapt to the demands and impacts of previous disasters, organizational changes, and climate change (see the Appendices for detailed questions). The integration of the timeline exercise into the focus group allowed participants to reference specific events and discuss their implications in greater detail.

Survey

A structured survey (n = 163) was conducted following the focus group. The survey collected both quantitative and qualitative data (i.e., Likert-scale and narrative questions, respectively. This survey was based on the Benchmark Resilience Tool (BRT), a structured survey designed to evaluate an organization's ability to respond to incremental changes and sudden disruptions to operational continuity based on HRO theory (Lee et al., 2013). It was chosen as it assesses organizational resilience in a similar context to BCEHS and the principals of HRO. This survey tool has been validated in numerous studies (Gonçalves et al., 2019; Lee et al., 2013; Whitman et al., 2013) as an organizational-level resilience quantification methodology designed to assess behavioural traits and perceptions linked to organizational resilience, or an organization's "ability to plan for, respond to, and recover from, emergencies and crises" (Whitman et al., 2013, p. 1).

To this baseline instrument, I added narrative questions that were shaped to reflect the contextual information gathered during the initial qualitative phases (i.e., the interviews and the focus group). The resultant survey included questions that used Likert scales—a unidimensional scale designed to measure opinions, behaviours, and attitudes—including multiple-choice questions, open-ended questions; and additional narrative questions added by the researcher. These questions were organized in the following categories:

Demographic Information (Four Questions).

- Gender identity (multiple-choice: male, female, other)
- Age (multiple-choice from six age ranges)
- Position within the organization (multiple-choice from six job roles)
- Job title (open-ended)
- Tenure (two questions)
- Duration of employment in health care (multiple-choice from five time ranges)
- Duration of employment at BCEHS (multiple-choice from five time ranges)

Organizational Resilience (59 Questions).

- Leadership and culture (25 Likert items)
- Leadership, staff engagement, situational awareness, decision making, innovation, and creativity (5 questions each)
- Networks (16 Likert items)
- Effective partnerships, leveraging knowledge, breaking silos, and internal resources (4 questions each)
- Change readiness (18 Likert items)
- Unity of purpose, proactive posture, planning strategies, and stress-testing plans (4 to 5 questions each)

Crisis Experience (Five Questions).

- Has your organization experienced a crisis in the last five years? (multiple-choice: yes, no, don't know)
- Describe the crisis (open-ended)
- Rate severity (choose option on a 6-point scale)

Risk Identification (Four Questions).

- Identify risks from a list (multiple-choice questions)

Additional Open-Ended Questions.

- Disaster impact(s) on BCEHS (open-ended questions)
- Is there anything else you would like to say? (open-ended questions)
- BCEHS plans a sufficient standard. If "no", explain (open-ended questions)

Data Integration

Data integration employed the "building" approach (Fetters et al., 2013), where qualitative data from initial phases informed the development of quantitative survey questions. This strategy enriched the context and meaning of the overall data collected. Below is a description of the three data-gathering phases and how they were integrated.

Phase 1: Initial Interviews

As described previously, three people from BCEHS management agreed to participate in the pre-survey qualitative data gathering. Semi-structured interviews were conducted with these three participants to learn about barriers to resilience at BCEHS. These interviews revealed a need to understand the chronological aspects of the data relevant to organizational changes and responses to disasters, such as COVID-19.

Phase 2a: Timeline Creation (Focus Group Activity)

To respond to this need, I developed a timeline activity for "focusing participants' attention during interviewing" in Phase 2a (Sheridan et al., 2011, p. 553). The timeline helped

identify key events using a temporal method (Kolar et al., 2015). This step in Phase 2 helped identify contextual information and questions that shaped the subsequent focus group discussions in Phase 2b.

Phase 2b: Focus Group Discussion

The focus group discussion centered on the past performance of BCEHS to identify how the organization adapted or did not adapt to the demands and impacts of previous disasters, organizational changes, and climate change.

Phase 3: Survey Implementation

Phases 1, 2a, and 2b helped identify specific questions that required further exploration and inquiry in the survey phase. As described above, the survey phase utilized a modified version of the BRT. Phase 3 included a convergent component, as described by Fetters et al. (2013), where the qualitative data influenced the addition of open-ended questions to the originally prescribed survey. The multistage mixed-methods strategy expanded my exploration of resilience at BCEHS, which was identified in earlier phases.

I used the BRT as the survey instrument because it was a validated survey tool focused on organizational resilience. However, I added the building approach to systematically develop the survey's open-ended questions beyond the established Likert-style questions. This approach was designed to provide context items based on qualitative data and facilitated a merging approach to evaluate congruence between the findings of the two phases. I chose to apply a survey tool because it allowed me to collect a large, structured volume of data anonymously.

The BRT is structured in three sections (see Appendices for all questions). The introduction provided the survey instructions, addressed ethical considerations, and defined key terms. Section 1 focuses on the participants' demographic characteristics: gender, age, position within the organization, number of years within the organization, and industry.

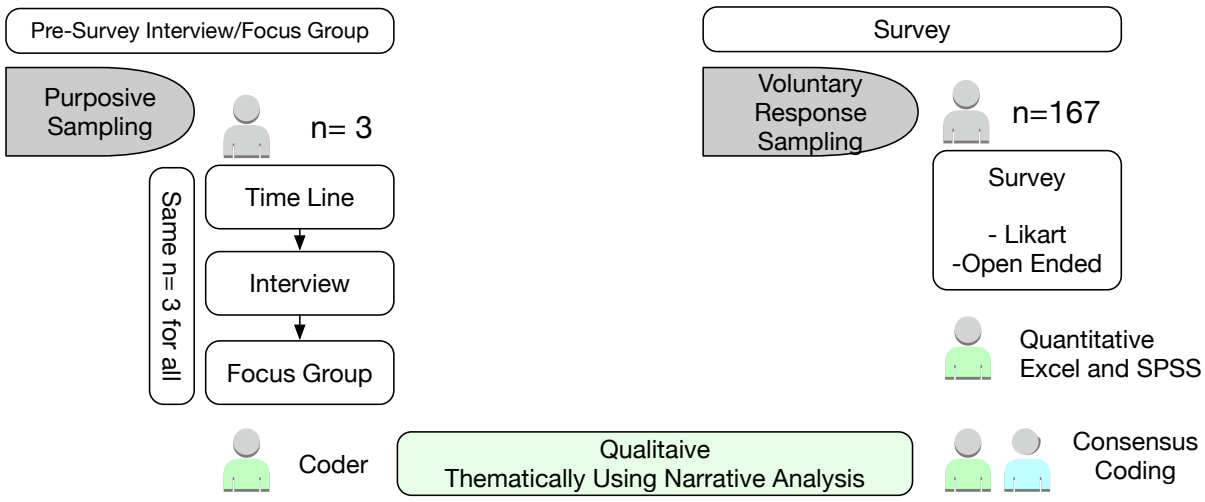
Section 2 focuses on indicators of organizational resilience. Section 3 focuses on questions related to organizational demographics and performance.

Three-Phase Design

These three research phases, and the methods applied in each of them, are outlined below in Table 8, along with a brief description of the purpose of each phase. This multistage approach integrates both qualitative and quantitative methods to explore barriers to resilience and adaptive capacity at BCEHS.

Figure 2

Multistage Mixed Method



Note. There were n=3 people for the pre-survey interviews and focus group and 163 for the survey.

Table 8

Research Phases and Methods

Multistage Phase	Data Type	Method	Description
Phase 1	Qualitative	Interviews	Semi-structured interviews were conducted to identify barriers to resilience at BCEHS.

Phase 2a	Qualitative	Pre-focus group timeline	Participants created timelines detailing key events, such as the impacts of COVID-19 on the organization and organizational changes related to those impacts.
Phase 2b	Qualitative	Focus group	Focus group discussions on past performance and adaptive resilience related to disasters and climate change.
Phase 3	Quantitative and qualitative	Survey with Likert and narrative questions	Structured survey, the BRT, for organizational-level resilience quantification.

Sampling and Recruitment

Interviews and Focus Group

A purposive sampling approach was used to select participants with relevant knowledge and experience at BCEHS (Kumar, 2011; Marshall, 1996; Saunders & Bezzina, 2015) for the interviews and subsequent focus group. Therefore, I reached out to a "selection of the most accessible subjects" (Marshall, 1996, p. 523), or, as Kumar (2011) describes it, finding the right people with the right information. I wanted people with relevant knowledge and experience at BCEHS for this study (Kumar, 2011; Saunders & Bezzina, 2015). Therefore, this sampling strategy is suitable for triangulating data because deliberately selecting participants with relevant knowledge about and experience with BCEHS allowed me to compare these initial qualitative findings with the data generated through the broader organizational survey. The goal was to have the findings from these interviews provided by insiders (Coyne, 1997) with contextual information to support my interpretation of the data collected from the survey. Of the initial ten potential participants, three managers agreed to participate in the interviews and the focus group, which provided insights from an organizational decision-making perspective on the questions about BCEHS's organizational resilience. Although the sample size was limited, the people were selected for their

experience within BCEHS, providing depth to the qualitative data. This purposive sampling is appropriate for exploratory research for detailed insights.

Survey

All staff members (N = 4,300) were invited to participate in the survey through the BCEHS newsletter, which resulted in 163 completed surveys. The survey captured demographic data such as age, gender, job role, and years worked. I used a self-selection sampling to participate voluntarily. The newsletter included a link to the survey, allowing participants to decide whether they wanted to take part of self-selection sampling, where participants opt in or choose not to opt in (Bethlehem, 2010). I chose this method because the newsletter provided accessible outreach to the entire BCEHS staff, and I wanted anonymity for prospective participants.

The newsletter approach may have introduced selection bias, as those who chose to participate might not be representative of the entire BCEHS. Bethlehem (2010) discusses how self-selection and under-coverage can lead to non-representative samples in web-based surveys. Additionally, Wright (2017) highlights that online surveys, though efficient, can face challenges related to response rates and data validity. My response rate was 163 of 4300.

Data Analysis

Presurvey Interviews and Focus Group

The qualitative data from the interviews and focus groups were transcribed and analyzed thematically using narrative analysis to understand the experience. Quantitative survey data were analyzed, and I interpreted events to explore complex phenomena (Shufutinsky, 2019). Sahni and Sinha (2016) note the value of "stories captured through structured and semi-structured interviews followed by case studies where in-depth interviews and focus group techniques for data collection have been used" (p. 373). Furthermore, they observe that "narratives also have the power to address ambiguities, complexities, and

dynamism of individuals and groups in an organization" (Sahni & Sinha, 2016, p. 375). Wang and Geale (2016) affirm that narrative analysis, gathering participant stories, identifying core themes, and interpreting how these themes reflect broader contexts, allows for the understanding of experience. They continue than nuances form narrative might not be possible through conventional quantitative methods for complex real-world dynamics.

I coded the interviews and focus group alone. Bradley et al. (2007) explain that "coding provides the analyst with a formal system to organize the data" (p. 1761). They recommend thoroughly reading and understanding all aspects of the interviews before beginning formal coding. Bradley et al. (2007) also advise examining the data, applying codes representing key concepts or themes, refining codes as necessary, and using them to construct a taxonomy to obtain a structured report.

I conducted my analysis by coding the narrative responses into categories based on recurring patterns and ideas that aligned with the research objectives (Braun & Clarke, 2006). I followed Connolly's (2003) three-phase process. In the generative phase, I reviewed the data to isolate relevant themes such as "adaptive resilience," "leadership and decision making," and "communication and engagement." In the interpretive phase, I reconfigured the data to observe patterns and identify relationships, such as "change management" and "organizational challenges." I reviewed and rechecked the interviews before progressing to the final theorizing phase, where I explained each theme. "Future preparedness", for instance, can enhance organizational resilience. I refined the categories, removed redundancy, and linked the work to my research question (Connolly, 2003).

I began with a list of themes from each interview and noted overlaps during the revision process. By way of illustration, "complexity and adaptation" and "adaptive resilience" both described BCEHS's ability to adapt to COVID-19 and climate change. I categorized themes into broader groups:

1. Adaptive management: I combined “impact of crisis on work” with “change management,” including ideas like remote work, altered organizational priorities, change fatigue, and the need for continuity during the pandemic.
2. Disaster impact on work: I merged “communication and decision making” with “leadership and decision making” to emphasize effective leadership in steering changes during crises.
3. Leadership and communication: I addressed “organizational challenges and adaptation,” “systemic changes,” and “challenges and barriers” related to maintaining BCEHS strategies during disasters and improving resilience and capacity.
4. Systemic challenges and adaptation: I linked “future preparedness and organizational learning” with “process and detail orientation,” using lessons from COVID-19 to shape strategies for better preparedness and adaptability.
5. Preparedness and organizational learning: I applied lessons from current crises to enhance future strategies.

Survey Data Analysis

Qualitative Data. For the open-ended survey questions, I conducted consensus coding with two people. I independently developed a codebook based on the BRT and resilient organizations (Seville, 2016). This alignment ensured consistency and thematic analysis (DeCuir-Gunby et al., 2011). Two coders independently applied the codes to the narrative survey responses (Morrow, 2020). We held four consensus meetings to align our interpretations and refine the codebook while addressing positive and negative aspects. These sessions resolved coding discrepancies and allowed emerging themes to be added iteratively (MacPhail et al., 2016). This process, involving coding and consensus meetings, represented analysis through multiple analytical lenses (Campbell et al., 2013).

Quantitative Data. I analyzed quantitative survey data using statistical methods to identify patterns and relationships. Data from the survey was exported into a CSV file and organized in Excel. I sorted them in Excel so that the columns contained the demographic information, each question on the Likert scale, and places where the narrative was recorded when a free text box was available. The rows listed the individual participants. All participants who did not agree with the consent statement (n = 1) were deleted.

This process involved entering the Likert data into an Excel table file, which I then moved into SPSS. To obtain the consolidated score, I created a formula [Average(k2:p2)] for the average of the scores and a formula [countif(k99:p66, 'n/a')] to obtain the "I don't know" data. The free text information was examined, and identifying information was deleted. The data were cleaned and standardized, including consolidating variations of terms like "COVID-19" to "COVID" and "forest fires" to "wildfires," and, similarly, all mention of "opioids," "ODs," and the "opioid crisis" fell under "opioid crisis."

After cleaning and categorizing the data, the next step involved preparing it for more statistical analysis using SPSS. I used the following procedures to obtain the statistical information, mainly from SPSS, but I also used Excel in some cases.

Data Preparation and Analysis. The data were prepared for SPSS by assigning numerical values to text data. The following statistical analyses were performed:

1. Confidence intervals (CIs) were calculated to indicate where the population values were likely to reside.
2. *T*-tests were used to compare mean values between groups to identify statistically significant differences.
3. Chi-square tests were used to assess relationships between categorical variables and to identify patterns.

4. Descriptive statistics were determined to provide a comprehensive view of data distribution.

Descriptive Statistics and Frequency Analysis. Demographic variables, such as gender, age, position, and working experience were analyzed. Likert-scale data were analyzed using SPSS functions to include mean and standard deviation. I chose the output and selected two decimal levels. For the number of individuals who answered "do not know" in column A, I conducted a frequency descriptive statistics option. I counted the number of "do not know" responses using Excel, and divided the count by *n*.

Frequency Distribution and Percentage Analysis. For "duration organization can function without infrastructure elements," I constructed a frequency distribution in SPSS but added the option to show the mean value. For the "crisis experience table," I used a frequency distribution; I chose "analysis compares means" in the "dependent list" variable and set the severity rating. In "independent," I placed the crisis variable. Then, in "options," I chose "mean" and "standard deviation." To obtain the final rating, I placed all the data into two columns and labelled them "all" by copying and pasting the data from the main dataset of all five ratings on top of each other in the column. For "all," I again used SPSS so that the analysis compared means, and I chose means in the dependent list variable in SPSS. I placed the severity rating in SPSS as "independent," and I placed the crisis variable. Then, in SPSS, I selected the "options sub-menu" and picked the mean and standard deviation. For the percentages, I divided the number of people by 163.

Comparative Analysis and Statistical Testing. Comparative analysis compared different subsets of data by using *t*-tests to check for statistical significance between groups such as leaders and frontline staff. When I obtained *p*-values in the table that concerned the aggregate scores between positions and differed between the two groups, I checked whether any differences existed between such terms as "leaders" and "frontline." I selected the

analysis in SPSS, chose "compare means," and then chose "independent sample *t*-test." I then selected "grouping variable" and picked "2" for leaders and "1" for frontline. I took the *p*-value from the "2-sided *p*" to show any statistical significance.

Categorical Chi-Square Differential Analysis Test. Using SPSS, I identified the business risks between positions (relationship between two categorical variables). I used "analysis," "descriptive," and "cross-tab" for the columns, and "staffing" and "pandemic" for the rows. I then selected "choose statistics" and clicked on chi-square. For the cells, I checked "observed," "colours," and "round cell counts." I then took the asymptotic significance 2-sided (described as "*p*-value"). Chi-square tests identified business risks between positions.

Confidence Intervals. CIs for means were calculated using SPSS's descriptive statistics function to adjust confidence levels to 95%. CIs provide a range within which we can be 95% confident that the true population mean lies and gives the reader insights into the variability and uncertainty of the data for interpretation. This comprehensive analysis ensured that the data were accurately interpreted and aligned with the research objectives to provide insights into organizational resilience during climate change and disasters.

Triangulation was employed by comparing the thematic results from Phase 1 interviews, the group perspectives gathered in Phase 2's focus group, and the quantitative findings from the Phase 3 survey. Where overlapping themes emerged (e.g., staffing shortages, leadership communication issues), these were noted as consistent insights.

Ethical Considerations

The data for this dissertation were gathered through human subjects who voluntarily completed an anonymous online survey and participated in interviews and a focus group. Ethical considerations remained paramount throughout the research process, which adhered to Royal Roads University's (RRU) policies on ethical research and the Tri-Council Policy Statement on ethical conduct for research involving humans.

Recruitment and Informed Consent

As previously discussed, the participants were recruited for the interviews and the focus group using a purposive method that targeted subject matter experts within BCEHS. Given my role as an employee of BCEHS, this fact was disclosed to the participants in written materials and during verbal communications (verbal only for the focus group). This disclosure aimed to ensure transparency and mitigate any perceived coercion (McDermid et al., 2014).

As I was conducting research within my organization, there were ethical considerations, such as power dynamics, and ensuring participant confidentiality. I took measures such as maintaining transparency, emphasizing voluntary participation, and anonymizing data in regard to participant identities. None of the three participants in the interviews or the focus group was under my supervision, nor did they supervise me. Still, I recognized that being colleagues in the same organization could add some perceived pressure. To address this, participants were informed that their participation was entirely voluntary and that they could withdraw at any time without any consequences. These facts were clearly stated in the written and verbal informed consent processes (Guillemin & Gillam, 2004). Prior to any data collection, the participants provided their consent to participate in the interviews and the focus group. For the survey, consent was obtained through the survey software tool, which required participants to agree to the ethics statement before accessing the survey. I had no way of knowing who took the survey.

Ethics Approval and Oversight

All interactions with human subjects complied with RRU's policies and the Tri-Council Policy Statement. The research application underwent a thorough review by project supervisors and was approved by the RRU research ethics board. Additionally, a letter of

permission was sought and granted from the BCEHS research committee, which is included in the appendices.

Data Collection and Anonymity

Interviews (n = 3) were conducted with non-union staff within the organization, that focused on BCEHS's functions. I ensured that no identifiable information, such as names, specific job titles, or work locations, was included in the data analysis. The survey design and execution involved collecting non-identifying demographic data. The surveys were conducted using CheckBox survey software, which is known for its professional, flexible features and robust security measures, with servers located in Canada. No personal data were collected through the survey questions or any functions of the survey software.

Data Security and Confidentiality

After the data collection, identifiable information was removed from the raw data and stored on a USB stick, which was kept in a locked drawer at a secure location. This USB stick will be physically destroyed following the completion of the research to ensure confidentiality.

Ethical Alignment

These ethical considerations ensured that the methods used for data collection aligned with ethical standards and the research objectives. By maintaining transparency, obtaining informed consent, and securing the data, the research respected participants' rights and upheld the integrity of the study. Important for any research is the issue of rigour, which includes transparency, credibility, dependability, confirmability, transferability, and reflexivity for a qualitative study (Bernard, 1998; Dick, 1999; Given, 2008; Greenwood & Levin, 1998; Langlois et al., 2014; Melrose, 2001).

Chapter 4: Findings and Results

The findings of this research chapter are divided into two parts. Part 1 describes the findings from the presurvey interviews (n = 3) and the focus group (n = 3). Due to the small number of participants who were in both groups, the results have been amalgamated. Part 2 describes the findings from the survey (n = 163), which are presented in two sections. Section 1 offers the quantitative Likert-scale question responses, while Section 2 shows the questionnaire sections in the same survey for the qualitative narrative data collection. The following thematic analysis combined the findings from the interviews and the focus group, which were conducted with the same three participants. Combining these findings provides a more comprehensive understanding of the participants' perspectives and overlapping themes are presented

Part 1: Presurvey Interviews and Focus Group

The interviews revealed barriers to organizational resilience. The participants discussed the challenges faced by BCEHS during the COVID-19 pandemic and the factors that led to the organization's current state. During the interviews, the participants were asked questions, and were asked about their created timeline. The focus group discussion centered on various themes, predominantly, responses to COVID-19, changes regarding work and communication, and leadership dynamics of the BCEHS organizational culture and work environment, such as moving from an in-office environment to remote work. The group discussed adjustments made by BCEHS, and changes in organization and clinical practices due to COVID-19. The focus included in-person meetings, virtual meetings, and email updates to keep people informed. Moreover, personal impacts and adaptations were discussed, including changes in work-life boundaries and how these posed both challenges and opportunities for adaptation. These impacts provided a contextual lens through which to better understand the findings from the survey.

The following themes were identified when analyzing these interviews and the focus group. The participants identified barriers such as resistance to new approaches, barriers to effective leadership and decision making, and outdated operational structures. Themes included barriers to communication, a lack of proactive learning culture, overlapping crises and complexity, and facilitators of resilience.

Theme 1: Resistance to New Approaches

Participant 3 identified several examples of organizational resistance to new approaches as a barrier to effective decision making:

> I think clinging on to the way we've always done things or the way we have to—
>
> We've always done things, we've always made decisions, we always have to—
>
> Instead of being willing to try it and tweak it to say, to try and get it right completely the first time, there's that—Ego certainly gets in the way of being that open to—
>
> Maybe I don't have it right for the first time, that's certainly a limitation.

In response to change, Participant 3 also mentioned that some paramedics have the attitude, "Oh, I've done it this way for 40 years; nothing's going to make me change that now" (Personal communication, 2021).

These ideas were important in moving toward an understanding that BCEHS personnel continually manage change. However, Participant 2 also mentioned that some people want certainty: "Tell me what to do. Put it in front of me. That's what I'm going to do" (Personal communication, 2021).

Theme 2: Barriers to Effective Leadership and Decision Making

Another theme focused on decision making. Regarding leadership and the lack of historical knowledge as leaders changed, it was noted by all participants that, when senior

leadership changed, particularly in executive positions, they did not have a full understanding of the historical and cultural context of BCEHS. In a disaster, the participants emphasized the fact that a full understanding of the organization's function is imperative. One participant even stated that a disaster is "not the time to learn" (Personal communication, 2021) because BCEHS is a complex organization facing challenges that were novel and required in-depth knowledge. "It is not the time to learn" became a key phrase in understanding the leadership challenges that were discussed. Within this theme, several subthemes emerged.

Leadership Numbers. All participants identified leadership as one of the main issues affecting BCEHS's ability to cope effectively with disasters. These issues included changes in roles, a lack of empowerment, exhaustion, a lack of experience, and change fatigue. During the early COVID-19 pandemic, and following the 2021 heat dome, a significant change in leadership occurred at the highest level, including the transition of the Chief Operations Officer (Daflos, 2021; Little, 2021). This leadership transition may have affected the organization's ability to respond effectively to multiple crises. Discussion in the focus group suggested a lack of empowered leadership and decision-making authority at the lower levels after the executive group of leadership within BCEHS made it difficult for the other leaders in the organization to continue current projects and progress during the pandemic.

Leadership Fatigue. Participant 2 identified a need for more people in management roles to perform the work. This notion was combined with high levels of exhaustion among the organization's leadership which made it difficult to complete initiatives, especially given the additional demands and pressures of the COVID-19 pandemic. Participant 2 also noted a recent history of change fatigue within BCEHS, with frequent changes in leadership and with these new or different approaches.

Leadership Effectiveness. Concerns were expressed about new leaders' leadership effectiveness during the pandemic. The factors included these leaders not being

knowledgeable about their roles if they were new to BCEHS. From the focus group, the idea arose that effective leadership enables people to feel safe and empowered, so challenging questions regarding established practices should be allowed, and even encouraged. Leadership should involve future preparedness and learning, with a progressive perspective on learning from the current situation, to improve disaster responses in preparedness and organizational structures—the resilience of supply chain during COVID-19 is a good example of such adaptation. More work is required for future pandemics.

Theme 3: Outdated Operational Structures

Outdated operational structures were identified as a barrier to adaptation and progress, as some antiquated BCEHS systems existed. An example was given by Participant 3, who noted problems "for things like scheduling and staffing and all the nightmares that it continues to cause, and it's been years that it's caused these problems, and yet they keep trying to push a square peg into a round hole" (Personal communication, 2021). This barrier also included inadequate communication channels for people such as paramedics who might not check or use their email often;

> I know that a lot of paramedics spend very little time on their government email and their corporate email, and, therefore, that's our number one tool that people rely on. I'm not sure how many of them are calling in to hear about the updates with these. That seems to be a vehicle that some of them are more comfortable taking the time because they can keep driving or keep moving through their day and listen to the phone calls and at least know that they need to go look something up (Personal communication, 2021).

Participant 3 added that, in pressure situations, such as when out-of-hospital care and interfacility transfers are affected, certain actions should be built into internal procedures and pressures mitigated without requiring instruction from someone senior to remove the

bureaucracy. Moreover, in response, Participant 3 stated that, "[Plans] would have scalability and flexibility in terms of actions associated and triggers" (Personal communication, 2021). This idea links back to the importance of ensuring consistency in a structured system that is already in place to promote iterative adjustments.

Participant 1 indicated that the need for enforceable key performance indicators (KPIs) was a barrier to understanding how BCEHS should perform. If the KPI stated that "BCEHS will maintain a level of service" (Personal communication, 2021), then, when that measure was not met, action could be taken to mitigate the risk, such as bringing in more staff on overtime. In Participant 1's view, the type of disaster event was unimportant in monitoring the BCEHS health system as "it does not matter what creates the system's pressures" (Personal communication, 2021). Most importantly, this participant suggested the need to identify pressure on the system and added that BCEHS must be able to manage such pressure with targeted mitigative actions. Participant 3 stated that BCEHS could reduce the risks of emergent pressures by implementing appropriate monitoring and consistently understood methods of responding, monitoring, and assessing (Personal communication, 2021).

Participant 1 stated that, for adaptation to occur, where disaster risks are part of the organization as climate change disasters become more frequent, situational awareness and a state of knowing are required;

> The end state that I would imagine is that it's part of the way that we behave as an organization [BCEHS], the way we monitor risk, the way we respond to risk, the way we measure risks, and that we're constantly adjusting to what's happening as a normal state (Personal communication, 2021).

It was also stated that the BCEHS planning process could have been proactive, with plans for events such as pandemics pre-established so staff at all levels of BCEHS understood what actions were required.

Theme 4: Barriers to Communication

All participants suggested that poor communication within the organization was due to silos, where parts of the organization did not coordinate with other program areas in BCEHS during disasters. Moreover, consistency was lacking in messages and methods of distribution, which may have contributed to the challenges BCEHS faced historically in how the information is distributed.

Participant 2 offered an example of communication issues related to reactive changes in practice resulting from policy and clinical practice changes and the challenges of how information was communicated:

> I think, with the volume of [paramedic medical] practice changes, it was really difficult…to just keep on top of what was the most recent practice. I'm not sure that the actual delivery mechanism was very well thought out for our different workforce or for the different types of workforces that we have to make it easy for people to know the most current practice that should be learned (Personal communication, 2021).

Theme 5: Barriers: Lack of Proactive Learning Culture

Another theme in the barriers category was the lack of a proactive learning culture, which included dimensions of planning or the lack of proactive planning. Participant 1 described it as "the lifting of the curtain and finding there's really nothing in behind it" (Personal communication, 2021). Participant 1 said that reading past practices regarding effective planning lacked substantive support.

Learning From Past Experiences. Past disasters were discussed, as BCEHS has a history of not managing large-scale disasters well. In the individual interviews, Participant 2 recounted that BCEHS had experienced disruption and had a history of not coping with disasters;

> [In] 2017, there was a wildfire in BC. It was, at that time, the largest wildfire in recorded BC history. What happened is there was a lot of disruption to BC Ambulances' ability to do prehospital care. In 2017, we had multiple stations closed, our transportation corridors [highways] closed, there were fuel shortages, and places like Williams Lake were actually evacuated with the hospital shutdown. That event was not run very well by our organization. Our existing infrastructure at the time on how we would deal with such a disaster was done poorly (Personal communication, 2021).

Lack of Applying Lessons Learned. Participant 2 also noted that the 2017 wildfire prompted an after-action review to measure BCEHS's performance against emergency management standards—namely, the Canadian Standards Association (CSAZ 1600) standards for emergency management and business continuity—to learn more about the lived experiences of paramedics during the wildfires. The focus group participants stated that the lesson and a report from the 2017 after-action review written in 2018 had recommendations yet to be enacted, while key vulnerabilities identified in the report remained either unaddressed or inadequately addressed.

Organizational changes and adaptations to risks such as climate change have not been widely adopted, which was viewed as a problem in adapting. Focus group participant 1 shared a sense that British Columbia's Climate Change Secretariat, led by the NDP-Green coalition, was pushing the agenda of reducing carbon emissions and increasing efforts to combat climate change, which had led to increased pressure on BCEHS to incorporate language and report on its efforts to meet those goals. The participants acknowledged a growing awareness that climate change was already occurring, so steps should be taken to address the impacts, including disasters. The participants believed this approach would create internal pressure to make disasters and climate change high priorities.

Theme 6: Overlapping Crises and Complexity

Adapting to new risks and disasters that overlap is challenging. BCEHS's old method of managing emergencies was criticized as outdated, with moderate risks of overlapping disasters and crises. Participant 1 commented on the need for a future approach;

> There's a [need for a] systems approach to disasters and climate change, as opposed to a separate special only-used-when-necessary emergency operations centre style of managing disasters…Because climate change and COVID are probably two good examples of something endemic…we monitor risks, the way we respond to risks, the way we measure risks, and that we're constantly adjusting to what's happening as a normal state (Personal communication, 2021).

Participant 2 stated that it takes time to socialize new ideas about climate change-related disasters at BCEHS;

> It's so complex, it's such a big story; also, people do need to hear it a few times, and they need that whole picture painted because it's just a reframing for people, which I think some people understand. But, for some people, it's like, "Ugh, it's a whole new thing." Well, no, it's not. It's actually just a reframe (Personal communication, 2021).

With the complexity and overlapping crisis, there was a common understanding that a linear approach was not working, so a complex and wicked-problem approach was needed. The participants discussed the need for BCEHS to become more agile, given that disasters were becoming more frequent. Participant 1 stated that consistency is important in emergency management, since disasters will become part of daily BCEHS operations (Personal communication, 2021).

Impact of the Pandemic. Participant 1 commented on the early impact of the COVID-19 pandemic on the organization and its ability to adapt to novel and disruptive changes, such as COVID;

> [The BCEHS is] still in a place where we have not realized the full impact of this pandemic. Even though there hasn't been a big impact on patient surge, it's still a big consideration for protecting our paramedics and making sure our workforce doesn't get sick, for lots of different reasons. Everything from a moral, ethical way of thinking …We've got to keep the system going because it's part of the health care system (Personal communication, 2021).

Facilitators of Resilience. The presurvey interviews and focus group also included positive comments about BCEHS's response and leadership and its ability to adapt to the host of overlapping disasters (i.e., the COVID-19 pandemic and the opioid crisis), including the following from Participant 2;

> The speed at which decisions were being made, I've never seen the entire time I've been in this organization. Things that seemed impossible and insurmountable were suddenly "tackle-able." You just get the right people at the table in a speedy amount of time, and, suddenly, you can come up with some solutions. That's been great. I think that's also had some positive impacts on morale, where there was one stonewall after another regarding why different things couldn't change. I feel there's been some appreciation for the number of things that have changed (Personal communication, 2021).

Participant 2 also noticed that the entire organization is not resistant to changes;

> On the corporate services side, there is probably a little bit more energy, enthusiasm, and new ideas, partially because of the demographic that is starting to come in. There's the younger generation coming through, people from other organizations (Personal communication, 2021).

In summary, the consensus among these interviewees was that (a) BCEHS must be a part of a whole health system and the government response to manage disasters and adapt to

climate change and, (b) all parts of the government should be involved via central coordination to ensure better removal of silos in disaster management, including the Ministry of Health, Emergency Management British Columbia, and response agencies (i.e., police, fire, and ambulance), with better coordinated and connected planning (Howes et al, 2015).

Survey Results

Below are the findings from the survey data; a demographic description is followed by the survey results (see the Appendices for all questions).

Survey Questions

Section 1: Demographics.

This section gathered demographic information about the respondents to understand their backgrounds and positions within the organization. It included the following questions:

- Gender/age/position level: The respondents selected the level that best described their position within the organization.
- Job title/tenure: The respondents selected how long they had worked in their industry (<1 year, 1–3 years, 4–10 years, 11–20 years, or 21+ years).

Section 2: Resilience Indicators.

Section 2a: Leadership and Culture. This part evaluated the adaptive capacity created by the organization's leadership and culture based on five indicators:

Leadership. This indicator assessed crisis leadership, decision making, strategy evaluation, and management behaviour.

Staff Engagement. This indicator measured staff involvement, responsibility, commitment, morale, and crisis response understanding.

Situational Awareness. This indicator measured vigilance, communication of issues, and awareness of organizational performance and risks.

Decision Making. This indicator evaluated the authority and process for decision making during normal and crisis situations.

Innovation and Creativity. This indicator assessed encouragement and reward for using knowledge and creative problem-solving.

Section 2b: Networks. This part examined the relationships and resources that the organization could leverage during a crisis, based on four indicators:

Effective Partnerships. This indicator evaluated the planning and management of relationships and resource access during crises.

Leveraging Knowledge. This indicator looked at the availability and distribution of critical information and expertise.

Breaking Silos. This indicator measured the minimization of barriers that hinder communication and collaboration.

Internal Resources. This indicator assessed the management and availability of resources during normal and crisis situations.

Section 2c: Change-Ready. This part evaluated the organization's planning and direction to be ready for change, based on four indicators:

Unity of Purpose. This indicator measured the organization-wide awareness of priorities and minimum operating requirements during a crisis.

Proactive Posture. This indicator assessed readiness to respond to early warning signals and unexpected changes.

Planning Strategies. This indicator evaluated the development and assessment of plans to manage vulnerabilities.

Stress Testing Plans. This indicator measured the frequency and effectiveness of plan rehearsals and simulations.

Section 3: Risk Identification and Crisis Experience.

This section identified risks from a list with multiple-choice answers:

- Has your organization experienced a crisis in the last 5 years? (multiple-choice: yes, no, don't know)
- Describe the crisis (open-ended)
- Rate severity (choose option from a 6-point scale).

Survey Responses

Section 1: Demographics

Table 9 shows the demographic characteristics of the study respondents. The table includes the distribution of respondents by sex, age, position within the organization, and years of service. This demographic data help contextualize the findings of the study by illustrating the participants' composition.

Table 9

Demographic Characteristics of Study Respondents

Demographic characteristics	Frequency (%)
Sex	
Male	101 (62.0%)
Age	
21–30	26 (16.0%)
31–40	50 (30.7%)
41–50	44 (27.0%)
Position within organization	
Frontline	141 (86.5%)
Years working at BCEHS	
10 years or less	80 (49.1%)

Note. $n = 163$

The total number of personnel at BCEHS was reported in 2021 as 4,338 (BCEHS, 2021). The online survey had 163 participants.

Gender Distribution. The survey had a gender distribution of 62.0% male and 38.0% female but did not include options for nonbinary or other gender identities, limiting diverse perspectives within BCEHS.

Age Distribution. The largest group was aged 31-40 years (30.7%), with participation from younger and older staff.

Position within Organization and Response Rate. The majority were frontline personnel (86.5%), with leaders comprising 13.5%. The overall response rate was 3.76%, with a higher response rate from leaders (8.8%) than frontline staff (3.45%). This disparity might reflect leaders' perceptions of relevance to strategic decision making or a greater desire to participate in a survey. By volume, most respondents were frontline staff, but with a lower response rate than leaders. Frontline staff have an operational perspective on adaptation and disaster resilience.

Years Working at BCEHS. Distribution among respondents was almost evenly split, with 49.1% having worked at BCEHS for 10 years or less and 50.9% for 11 years or more. This split offers a balanced perspective.

Data Tables for Survey

I represented the data in a series of tables (Boone & Boone, 2012). The tables with CIs used the 95% CI for the mean scores. I also assessed the "do not know" (DNK) responses in addition to CI estimates of the uncertainty or margin of error sample statistic in the given data. A 95% CI was calculated, which indicated that the results would likely extrapolate to the general population of BCEHS. The DNK responses highlighted varying levels of awareness when evaluating the questions, and I included the DNK finding next to each question with DNK as a choice. I also displayed the DNK summary for the question category.

High DKN values could indicate a lack of awareness, understanding, or education. The meaning of DNK was not explored. Low DNK responses likely indicated understanding or agreement among respondents, but, again, the meaning of DNK was not explored.

- The number (%) of individuals with the DNK response showed the percentage of respondents who selected at least one DNK. This metric helped identify how many people lacked familiarity with the topic.
- The number (%) of DNK responses to questions indicated someone selecting multiple DNK responses within the same block of questions in that category.

In tables with means, I also displayed the standard deviation (*SD*) to show the variability and difference from the mean score. A low *SD* suggested that responses agreeing with answers close to the mean answers were clustered together, so more agreement existed among the respondents. Conversely, a high *SD* implied variability in responses to the survey question, so the more significant the spread of scores from the mean, the lower the agreement with the mean.

In tables with an aggregate, as shown in Table 10, I combined the mean scores and *SDs* for a category of question (e.g., the aggregates of the means of the six questions and the *SDs*). I show the data sets in a single figure to give the mean and *SD* for the entire table (see the Appendix for the survey instrument).

Section 2: Resilience Indicators

Section 2a: Leadership and Culture. The following 11 tables relate to the attributes of organizational resilience. Table 10 describes responses to six questions focused on leadership with the mean, the CI, and DKN responses. For leadership, narrow CIs indicated consistent perceptions of leadership, and the few DNK responses showed a general familiarity with leadership dynamics. Leadership with an aggregate mean of **5.64** and *SD* of

1.50 indicated disagreement on leadership effectiveness. The DNK for 10.4% of respondents and 1.8% of all responses suggested a firm grasp of leadership qualities.

Table 10

Leadership with Mean and SD, CI, and Do Not Know Responses

Leadership Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± *SD*	95% CI	Number (%) of "Do Not Know" Responses
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
There would be good leadership from within our organization if we were struck by a crisis.	1.8%	8.0%	11.0%	9.8%	9.2%	20.9%	22.1%	16.6%	5.52 ± 1.98	5.21 to 5.83	1 (0.6%)
In a crisis, staff accept that management may need to make some decisions with little consultation.	4.3%	23.3%	23.3%	16.6%	12.9%	11.0%	4.3%	3.7%	3.80 ± 1.76	3.52 to 4.07	1 (0.6%)
Our managers monitor staff workloads and reduce them when they become excessive.	1.2%	2.5%	5.5%	7.4%	6.1%	12.3%	25.2%	38.0%	6.49 ± 1.78	6.21 to 6.77	3 (1.8%)
Our management thinks and acts strategically to ensure that we are always ahead of the curve.	1.2%	3.7%	5.5%	4.9%	6.1%	16.0%	27.0%	35.0%	6.44 ± 1.78	6.16 to 6.71	1 (0.6%)
Management in our organization leads by example.	3.1%	3.7%	7.4%	8.0%	10.4%	17.2%	21.5%	28.2%	5.99 ± 1.96	5.69 to 6.30	1 (0.6%)

Our organization regularly reevaluates what we are trying to achieve.	2.5%	6.1%	8.0%	6.7%	14.7%	16.6%	22.7%	16.0%	5.63 ± 1.93	5.32 to 5.94	11 (6.7%)
Aggregate mean and *SD* for the six questions									5.64 ± 1.50		
									Number (%) of individuals with "do not know" response		17 (10.4%)
									Number (%) of "do not know" responses to questions		18 (1.8%)

Table 11, below, describes responses to five questions related to staff engagement. In this table, narrow CIs denoted consistency in organizational support and morale perceptions, and low DNK responses suggested a known perception of staff engagement. Staff engagement had a mean of **5.32** and an *SD* of **1.24**, which showed moderate disagreement about staff engagement. A low DNK rate (3.1% of individuals, 0.6% of responses) indicated a high level of respondent knowledge.

Table 11

Staff Engagement with Mean, CI, and Do Not Know Responses

Staff Engagement Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± SD	95% CI	Number (%) of "Do Not Know" Responses
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
People in our organization feel responsible for the organization's effectiveness.	4.3%	16.6%	17.2%	19.0%	11.7%	16.0%	7.4%	6.7%	4.30 ± 1.92	4.00 to 4.60	2 (1.2%)
People in our organization are committed to working on a problem until it is resolved.	4.3%	9.2%	18.4%	20.2%	15.3%	22.1%	4.9%	4.9%	4.44 ± 1.74	4.17 to 4.72	1 (0.6%)

Our organization's culture is very supportive of staff.	0.6%	2.5%	11.0%	11.7%	13.5%	16.0%	20.9%	23.9%	5.86 ± 1.82	5.58 to 6.14	0 (0.0%)
Our organization has high staff morale.	0.6%	1.8%	1.8%	4.9%	6.1%	12.3%	22.7%	48.5%	6.89 ± 1.52	6.65 to 7.12	2 (1.2%)
Staff know what they need to do to respond to a crisis.	1.2%	9.8%	12.9%	15.3%	14.1%	17.8%	16.6%	12.3%	5.12 ± 1.92	4.83 to 5.42	0 (0.0%)
Aggerate mean and SD for the five questions									5.32 ± 1.24		
Number (%) of individuals with "do not know" response											5 (3.1%)
Number (%) of "do not know" responses to questions											5 (0.6%)

Table 12, below, describes the responses to five questions related to situational awareness. This table shows wider CIs, which reflected varied opinions on proactive monitoring and learning, although the few DNK responses indicated a reasonable situational awareness. Scores for situational awareness were a mean of **5.56**, with an *SD* of **1.44**, which indicated moderate disagreement. The DNK percentages (9.8% of individuals and 1.7% of responses) indicated an understanding of situational awareness.

Table 12

Situational Awareness with Mean, CI, and Do Not Know Responses

Situational Awareness Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± *SD*	95% CI	Number (%) of "Do Not Know" Responses
	1	2	3	4	5	6	7	8			

We proactively monitor our industry to have an early warning of emerging issues.	1.2%	4.9%	8.6%	11.7%	6.7%	19.6%	25.2%	19.0%	5.81 ± 1.87	5.52 to 6.10	5 (3.1%)
We learn lessons from the past and make sure those lessons are carried through to the future.	0.0%	6.1%	6.7%	14.7%	11.0%	13.5%	23.9%	22.7%	5.84 ± 1.86	5.55 to 6.13	2 (1.2%)
Staff interact often enough to know what's going on in our organization.	0.6%	7.4%	14.1%	11.0%	17.2%	18.4%	21.5%	9.2%	5.25 ± 1.81	4.97 to 5.53	1 (0.6%)
Our managers actively listen to problems.	1.8%	6.1%	9.8%	17.8%	10.4%	13.5%	20.9%	19.0%	5.49 ± 1.98	5.19 to 5.80	1 (0.6%)
We are mindful of how the success of one area of our organization depends on the success of another.	0.6%	6.1%	10.4%	18.4%	13.5%	17.2%	16.0%	12.9%	5.29 ± 1.82	5.00 to 5.58	8 (4.9%)
Staff feel able to raise problems with senior management.	2.5%	3.7%	13.5%	11.7%	9.2%	14.7%	21.5%	23.3%	5.68 ± 2.01	5.37 to 5.99	0 (0.0%)
Aggregate mean and *SD* for the six questions									5.56 ± 1.44		
Number (%) of individuals with "do not know" response											16 (9.8%)
Number (%) of "do not know" responses to questions											17 (1.7%)

The following table presents the responses to three questions related to decision making within the organization. The narrow confidence intervals (CIs) observed suggest a consensus among participants regarding decision-making processes. The mean score for decision making was **4.40**, with a standard deviation (*SD*) of **1.46**, indicating slight agreement on the effectiveness of these processes. The minimal "do not know" (DNK) responses (3.1% of individuals and 1.0% of responses) reflect a general confidence and understanding of decision making within the organization.

Table 13

Decision Making with Mean, CI, and Do Not Know Responses

Decision-Making Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± *SD*	95% CI	Number (%) of "Do Not Know" Responses
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
Should problems occur, staff have direct access to someone with authority to make decisions.	8.6%	14.1%	27.0%	20.9%	8.6%	9.8%	5.5%	4.9%	3.83 ± 1.84	3.55 to 4.12	1 (0.6%)
We can make tough decisions quickly.	8.0%	18.4%	25.2%	20.2%	9.8%	8.6%	4.3%	5.5%	3.76 ± 1.84	3.48 to 4.05	0 (0.0%)
In our organization, the most qualified people make decisions regardless of seniority.	0.6%	8.0%	10.4%	10.4%	9.8%	17.2%	20.2%	20.9%	5.64 ± 1.98	5.33 to 5.95	4 (2.5%)
	Aggregate mean and *SD* for the three questions								4.40 ± 1.46		

Number (%) of individuals with "do not know" response	5 (3.1%)
Number (%) of "do not know" responses to questions	5 (1.0%)

Table 14 illustrates the responses to three questions concerning innovation and creativity. Moderate agreement is observed in the CIs, suggesting some shared perceptions on innovation efforts. The mean score was **5.21** with an *SD* of **1.62**, positioning responses toward slight disagreement regarding innovation and creativity. The few DNK responses (6.7% of individuals and 2.5% of responses) indicate a general awareness but also some uncertainty in this area.

Table 14

Innovation and Creativity with Mean, CI, and Do Not Know Responses

Innovation and Creativity Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± *SD*	95% CI	Number (%) of "Do Not Know" Responses
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
Staff are actively encouraged to challenge and develop themselves through their work.	0.0%	8.6%	19.0%	12.3%	17.8%	16.6%	9.2%	16.0%	5.07 ± 1.91	4.77 to 5.36	1 (0.6%)
We are known for our ability to use knowledge in novel ways.	4.9%	10.4%	16.6%	17.8%	12.3%	12.9%	9.8%	11.7%	4.64 ± 2.05	4.32 to 4.97	6 (3.7%)
Staff are rewarded for thinking outside the box.	0.0%	4.9%	9.8%	9.8%	13.5%	14.1%	14.1%	30.7%	5.93 ± 1.92	5.63 to 6.23	5 (3.1%)
Aggregate mean and *SD* for the three questions									5.21 ± 1.62		

Number (%) of individuals with "do not know" response	11 (6.7%)
Number (%) of "do not know" responses to questions	12 (2.5%)

The table below details the responses to five questions related to networking and external collaboration. The wider CIs reflect diverse opinions on networking practices within the organization. Higher DNK responses suggest a potential lack of knowledge or engagement in external networking activities. The mean score was **4.96** with an *SD* of **1.71**, indicating neutral perceptions among participants. The significant DNK rates (40.5% of individuals and 19.4% of responses) highlight considerable uncertainty or lack of knowledge regarding networking.

Table 15

Networks with Mean, CI, and Do Not Know Responses

Network Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± *SD*	95% CI	Number (%) of "Do Not Know" Responses
	1	2	3	4	5	6	7	8			
In a crisis, we have agreements with other organizations to access resources from them.	1.8%	9.8%	9.8%	15.3%	4.9%	9.8%	8.6%	7.4%	4.66 ± 2.03	4.28 to 5.05	53 (32.5%)
We have planned for what support we could provide to the community in a crisis.	0.0%	5.5%	5.5%	10.4%	7.4%	14.1%	17.2%	19.0%	5.85 ± 1.88	5.52 to 6.18	34 (20.9%)

We build relationships with others we might have to work with in a crisis.	3.1%	12.3%	14.1%	16.0%	11.0%	9.8%	11.7%	10.4%	4.67 ± 2.06	4.33 to 5.01	19 (11.7%)
We understand how we are connected to other organizations and actively manage those links.	1.8%	8.6%	9.8%	11.7%	16.0%	14.7%	11.7%	13.5%	5.16 ± 1.97	4.84 to 5.49	20 (12.3%)
We understand how Government actions would affect our ability to respond in a crisis.	5.5%	9.2%	12.3%	11.7%	11.7%	8.6%	10.4%	11.0%	4.71 ± 2.17	4.34 to 5.08	32 (19.6%)
Aggregate mean and *SD* for the five questions									4.96 ± 1.71		
Number (%) of individuals with "do not know" response											66 (40.5%)
Number (%) of "do not know" responses to questions											158 (19.4%)

The table below presents the responses to five questions about leveraging knowledge within the organization. Moderate CIs regarding the availability of critical information suggest some agreement among participants. The mean score was **4.86** with an *SD* of **1.55**, indicating neutral perceptions on the organization's ability to leverage knowledge. The moderate DNK responses (25.2% of individuals and 6.5% of responses) point to a fair understanding but also highlight areas of uncertainty.

Table 16

Leveraging Knowledge with Mean, CI, and Do Not Know Responses

Leveraging Knowledge Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± *SD*	95% CI	Number (%) of "Do Not Know" Responses
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
Staff have the information and knowledge they need to respond to unexpected problems.	2.5%	7.4%	20.2%	19.6%	14.7%	16.0%	11.7%	6.7%	4.67 ± 1.80	4.39 to 4.95	2 (1.2%)
If something out of the ordinary happens, staff know who has the expertise to respond.	1.8%	11.7%	20.2%	11.0%	18.4%	16.0%	11.0%	8.0%	4.68 ± 1.89	4.38 to 4.97	3 (1.8%)
Critical information is available by different means and from different locations.	3.1%	8.6%	18.4%	17.8%	14.7%	6.1%	11.0%	11.0%	4.66 ± 1.99	4.33 to 4.98	15 (9.2%)
If key people were unavailable, there are always others who could fill their role.	2.5%	8.6%	11.0%	16.6%	13.5%	11.7%	12.3%	14.1%	5.05 ± 2.02	4.72 to 5.38	16 (9.8%)
We readily obtain expert assistance when there's a problem.	1.8%	8.0%	11.0%	15.3%	10.4%	15.3%	12.9%	14.7%	5.18 ± 2.00	4.86 to 5.51	17 (10.4%)
	Aggregate mean and *SD* for the five questions								4.86 ± 1.55		
						Number (%) of individuals with "do not know" response					41 (25.2%)

Number (%) of "do not know" responses to questions	53 (6.5%)

Table 17 summarizes responses to four questions on breaking down silos within the organization. The CIs reflect consistent perceptions, and the few DNK responses indicate a good understanding of interdepartmental collaboration. The mean score was **4.93** with an *SD* of **1.42**, suggesting neutral perceptions toward breaking silos. The low DNK percentages (5.5% of individuals and 1.8% of responses) demonstrate general awareness of efforts to reduce organizational barriers.

Table 17

Breaking Silos with Mean, CI, and Do Not Know Responses

Questions on Breaking Silos	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± *SD*	95% CI	Number (%) of "Do Not Know" Responses
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
Staff are encouraged to move between different departments or try different roles to gain experience.	0.0%	1.2%	8.6%	10.4%	9.2%	15.3%	22.7%	30.7%	6.24 ± 1.72	5.97 to 6.51	3 (1.8%)
There is a sense of teamwork and camaraderie in our organization.	3.1%	15.3%	20.9%	12.9%	11.0%	13.5%	12.3%	11.0%	4.58 ± 2.08	4.26 to 4.90	0 (0.0%)
There are few barriers stopping us from working well with other organizations.	1.8%	9.8%	16.6%	12.3%	12.9%	15.3%	12.3%	16.6%	5.08 ± 2.05	4.75 to 5.40	4 (2.5%)

We work with others, regardless of departmental or organizational boundaries, to get the job done.	8.6%	20.9%	25.2%	12.3%	8.6%	8.0%	6.1%	7.4%	3.79 ± 2.03	3.47 to 4.11	5 (3.1%)
Aggregate mean and *SD* for the four questions									4.93 ± 1.42		
Number (%) of individuals with "do not know" response											9 (5.5%)
Number (%) of "do not know" responses to questions											12 (1.8%)

Table 18 displays the responses to three questions regarding internal resources. The narrow CIs suggest consistent perceptions of resource availability among participants. The mean score was **6.15** with an *SD* of **1.65**, indicating disagreement on the sufficiency of internal resources. The presence of some DNK responses (8.0% of individuals and 3.5% of responses) suggests that a few respondents were unsure about resource adequacy.

Table 18

Internal Resources with Mean, CI, and Do Not Know Responses

Internal Resources Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± *SD*	95% CI	Number (%) of "Do Not Know" Responses
	1	2	3	4	5	6	7	8			
We have sufficient internal resources to operate successfully during business-as-usual.	0.0%	6.7%	9.8%	7.4%	9.8%	11.7%	19.0%	34.4%	6.07 ± 2.00	5.76 to 6.38	2 (1.2%)

Our organization maintains sufficient resources to absorb unexpected change.	0.6%	2.5%	3.7%	6.1%	4.9%	13.5%	19.0%	47.2%	6.74 ± 1.67	6.48 to 7.00	4 (2.5%)
When a problem occurs, it is easier to get approval for additional resources to get the job done.	1.8%	8.0%	7.4%	11.0%	8.6%	14.7%	12.9%	28.8%	5.75 ± 2.12	5.41 to 6.09	11 (6.7%)
Aggregate mean and *SD* for the three questions									6.15 ± 1.65		
Number (%) of individuals with "do not know" response											13 (8.0%)
Number (%) of "do not know" responses to questions											17 (3.5%)

Section 2c: Change-Ready. The following tables relate to the attributes of being ready for change. The next one presents responses to five questions related to the organization's readiness for change. The mixed perceptions shown in the CIs indicate varied opinions on change readiness. The mean score was **5.64** with an *SD* of **1.61**, reflecting moderate disagreement regarding preparedness for change. The moderate DNK percentages (19.6% of individuals and 7.5% of responses) signal considerable uncertainty or lack of knowledge about change processes.

Table 19

Change-Ready with Mean, CI, and Do Not Know Responses

Change-Ready Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± *SD*	95% CI	Number (%) of "Do Not Know" Responses
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**			
We have clearly defined priorities for what is important during and after a crisis.	1.2%	8.0%	5.5%	11.0%	14.7%	16.0%	17.2%	17.2%	5.56 ± 1.93	5.25 to 5.87	15 (9.2%)
Our priorities for recovery would be sufficient to provide direction for staff in a crisis.	1.2%	3.7%	8.0%	8.6%	12.9%	17.8%	14.7%	22.1%	5.82 ± 1.87	5.51 to 6.13	18 (11.0%)
We understand the minimum level of resources our organization needs to operate.	1.2%	4.9%	10.4%	11.0%	7.4%	9.8%	15.3%	31.3%	5.91 ± 2.08	5.57 to 6.24	14 (8.6%)
We are mindful of how a crisis in our organization would impact others.	6.1%	11.7%	16.0%	11.7%	6.7%	12.9%	6.1%	22.1%	4.88 ± 2.35	4.50 to 5.25	11 (6.7%)
Our organization consistently demonstrates commitment to its values.	1.2%	2.5%	7.4%	9.8%	11.7%	16.6%	17.8%	31.3%	6.11 ± 1.84	5.83 to 6.40	3 (1.8%)
	Aggregate mean and *SD* for the five questions								5.64 ± 1.61		
									Number (%) of individuals with "do not know" response		32 (19.6%)
									Number (%) of "do not know" responses to questions		61 (7.5%)

Table 20 outlines the responses to eight questions concerning the organization's proactive posture. The moderate CIs suggest some disagreement among participants on the proactive stance of the organization. The mean score was **5.34** with an *SD* of **1.71**, indicating slight disagreement on proactive capabilities. The DNK metrics (39.3% of individuals and 9.2% of responses) highlight significant uncertainty about proactive strategies.

Table 20

Proactive Posture with Mean, CI, and Do Not Know Responses

Proactive Posture Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± SD	95% CI	Number (%) of "Do Not Know" Responses
	1	2	3	4	5	6	7	8			
We have a focus on being able to respond to the unexpected.	6.1%	12.3%	14.1%	11.0%	15.3%	11.7%	12.9%	15.3%	4.83 ± 2.20	4.48 to 5.17	2 (1.2%)
We are able to collaborate with others in our industry to manage unexpected challenges.	1.8%	10.4%	19.6%	16.6%	9.8%	17.8%	9.2%	9.2%	4.68 ± 1.92	4.37 to 4.98	9 (5.5%)
We are able to shift rapidly from business-as-usual to respond to crises.	6.7%	9.8%	8.6%	11.0%	9.2%	11.0%	14.7%	26.4%	5.36 ± 2.35	4.99 to 5.73	4 (2.5%)
Whenever our organization suffers a close call, we use it for self-evaluation rather than confirmation	3.7%	4.9%	5.5%	10.4%	9.8%	17.2%	12.3%	27.6%	5.81 ± 2.08	5.47 to 6.14	14 (8.6%)

of our success.											
We are regarded as an active respondent in industry and sector groups.	4.3%	4.9%	10.4%	8.0%	8.0%	10.4%	10.4%	17.8%	5.32 ± 2.23	4.92 to 5.72	42 (25.8%)
Our organization readily responds to changes in our business environment.	1.2%	6.7%	5.5%	11.7%	11.0%	14.7%	19.6%	20.9%	5.75 ± 1.94	5.44 to 6.07	14 (8.6%)
In a crisis, we seek opportunities for our organization.	2.5%	5.5%	6.7%	9.8%	6.1%	11.7%	18.4%	22.1%	5.79 ± 2.09	5.43 to 6.14	28 (17.2%)
We tend to be optimistic and find positives from most situations.	1.2%	8.0%	10.4%	10.4%	13.5%	14.7%	11.7%	25.8%	5.58 ± 2.06	5.25 to 5.90	7 (4.3%)
	Aggregate mean and *SD* for the eight questions								5.34 ± 1.71		
						Number (%) of individuals with "do not know" response					64 (39.3%)
						Number (%) of "do not know" responses to questions					120 (9.2%)

The next table addresses responses to eight questions about planning strategies within the organization. While the CIs indicate some shared understanding, the higher DNK responses suggest a need for improved communication regarding planning. The mean score was **5.70** with an *SD* of **1.56**, suggesting moderate disagreement on the effectiveness of planning strategies. The high DNK rates (51.5% of individuals and 13.3% of responses) emphasize substantial uncertainty in this area.

Table 21

Planning Strategies with Mean, CI, and Do Not Know Responses

Planning Strategies Questions	"Strongly Agree" (1) to "Strongly Disagree" (8)								Mean ± *SD*	95% CI	Number (%) of "Do Not Know" Responses
	1	2	3	4	5	6	7	8			
Our organization plans for the short- and medium-term.	3.1%	11.7%	20.2%	15.3%	10.4%	14.1%	6.7%	12.9%	4.61 ± 2.05	4.28 to 4.94	9 (5.5%)
We plan our strategy carefully before taking action.	0.6%	6.7%	4.3%	14.7%	12.9%	20.9%	16.6%	16.6%	5.62 ± 1.81	5.33 to 5.91	11 (6.7%)
Given how others depend on us, the way we plan for the unexpected is appropriate.	0.6%	2.5%	6.1%	3.7%	9.8%	12.9%	25.8%	33.1%	6.46 ± 1.70	6.19 to 6.73	9 (5.5%)
We are mindful of how a crisis could affect us.	3.7%	9.2%	13.5%	10.4%	10.4%	11.0%	14.1%	23.9%	5.32 ± 2.24	4.97 to 5.68	6 (3.7%)
We actively plan with our suppliers how to manage disruptions.	2.5%	3.1%	9.2%	4.9%	6.7%	6.7%	9.8%	14.1%	5.46 ± 2.18	5.01 to 5.91	70 (42.9%)
We actively plan with our customers how to manage disruptions.	0.0%	1.8%	3.7%	4.3%	6.7%	9.8%	17.8%	28.2%	6.56 ± 1.65	6.26 to 6.86	45 (27.6%)
We actively plan how to support our staff during times of crisis.	0.0%	3.7%	5.5%	6.7%	8.6%	9.8%	19.6%	39.3%	6.48 ± 1.80	6.19 to 6.77	11 (6.7%)

We have a good understanding of how an event impacting the community may impact our ability to respond.	2.5%	11.0%	12.9%	7.4%	11.0%	9.8%	13.5%	24.5%	5.37 ± 2.26	5.01 to 5.73	12 (7.4%)
Aggregate mean and *SD* for the eight questions									5.70 ± 1.56		
Number (%) of individuals with "do not know" response											84 (51.5%)
Number (%) of "do not know" responses to questions											173 (13.3%)

Comparison Between Positions Within Organization. Table 22, below, presents the scale scores for each category, highlighting the statistical significance of the differences observed between frontline respondents and leaders and compares the scale scores between frontline staff and leaders. I conducted independent sample t-tests to determine if significant differences existed between the two groups in areas such as leadership, staff engagement, situational awareness, decision making, innovation and creativity, networks, leveraging knowledge, breaking silos, internal resources, change-readiness, proactive posture, and planning strategies. T-tests are appropriate for comparing the means of two independent groups to assess whether any observed differences are statistically significant (Noack, 2018). The results indicate that frontline respondents had more statistically significant scores than leaders in all categories ($p < .05$), suggesting that frontline staff perceive these aspects more positively than leaders do and indicates leaders' higher risk.

The use of independent sample t-tests was appropriate for this analysis because it allowed for the comparison of mean scores between two independent groups—frontline staff

and leaders—to assess whether any observed differences were statistically significant (and they were).

Table 22

Scale Scores Between Positions

Scale	Frontline, $n = 141$ Mean ± *SD*	Leaders, $n = 22$ Mean ± *SD*	Independent Sample *T*-test Results
Leadership	5.88 ± 1.40	4.10 ± 1.24	$t(161) = 5.63, p < .001$
Staff engagement	5.43 ± 1.24	4.63 ± 1.04	$t(161) = 2.87, p = .005$
Situational awareness	5.77 ± 1.36	4.23 ± 1.21	$t(161) = 5.01, p < .001$
Decision making	4.53 ± 1.48	3.56 ± 0.99	$t(161) = 2.96, p = .004$
Innovation and creativity	5.40 ± 1.59	3.99 ± 1.29	$t(161) = 3.96, p < .001$
Networks	5.10 ± 1.69	4.12 ± 1.62	$t(161) = 2.53, p = .012$
Leveraging knowledge	4.97 ± 1.55	4.15 ± 1.40	$t(161) = 2.34, p = .020$
Breaking silos	5.02 ± 1.43	4.30 ± 1.23	$t(161) = 2.24, p = .026$
Internal resources	6.35 ± 1.57	4.92 ± 1.66	$t(161) = 3.92, p < .001$
Change-ready	5.85 ± 1.56	4.31 ± 1.32	$t(161) = 4.40, p < .001$
Proactive posture	5.54 ± 1.67	4.11 ± 1.48	$t(161) = 3.79, p < .001$
Planning strategies	5.90 ± 1.50	4.45 ± 1.35	$t(161) = 4.26, p < .001$

Note. $n = 163$.

Respondents were asked to identify the overall highest risks that could lead to a crisis in the organization. Frontline respondents' and leaders' responses were compared for the most frequently identified risks (see Table 22). I used a chi-square test to determine whether a significant association existed between two categorical variables and to compare the frequency of business risks between frontline personnel ($n = 141$) and leaders ($n = 22$). The test risks examined included staffing issues, loss of critical services, earthquakes, severe weather, and pandemics.

Comparison Between Levels of Experience. I performed a *t*-test to compare the means of 12 different scale scores between the two groups based on their experience levels at BCEHS. The lack of significant differences between experience levels suggests that perceptions of organizational resilience attributes are consistent, regardless of time at job. I compared, in Table 23, the scores between respondents with different levels of experience within the organization; those with 10 years or less, and those with 11 years or more. The analysis revealed no statistically significant differences between the two experience groups in any category ($p > .05$), the categories being leadership, staff engagement, situational awareness, decision making, innovation and creativity, networks, leveraging knowledge, breaking silos, internal resources, change-readiness, proactive posture, and planning strategies. This suggests that years of experience did not significantly influence respondents' perceptions of the organizational attributes assessed.

I used independent sample t-tests in this context to compare the means of two independent groups based on their years of experience. A *p*-value exceeding .05 suggested that the difference in means between the two groups was not statistically significant, which indicated that the level of experience did not significantly affect the scale scores in this sample, and they are all over .05.

Table 23

Scale Scores Between Experience Levels

Scale	10 Years or Less, $n = 80$ Mean ± *SD*	11 Years or More, $n = 83$ Mean ± *SD*	Independent Sample *T*-test Results
Leadership	5.73 ± 1.50	5.56 ± 1.51	$t(161) = 0.72$, $p = .473$
Staff engagement	5.40 ± 1.34	5.25 ± 1.14	$t(161) = 0.75$, $p = .455$
Situational awareness	5.66 ± 1.45	5.46 ± 1.43	$t(161) = 0.89$, $p = .374$
Decision making	4.56 ± 1.43	4.23 ± 1.48	$t(161) = 1.46$, $p = .147$
Innovation and creativity	5.27 ± 1.62	5.16 ± 1.64	$t(161) = 0.43$, $p = .667$

Networks	4.91 ± 1.74	5.01 ± 1.69	$t(161) = 0.35$, $p = .729$
Leveraging knowledge	4.85 ± 1.49	4.87 ± 1.62	$t(161) = 0.07$, $p = .948$
Breaking silos	4.85 ± 1.40	5.00 ± 1.45	$t(161) = 0.67$, $p = .505$
Internal resources	6.07 ± 1.60	6.23 ± 1.70	$t(161) = 0.65$, $p = .515$
Change-ready	5.64 ± 1.59	5.65 ± 1.65	$t(161) = 0.07$, $p = .943$
Proactive posture	5.40 ± 1.63	5.29 ± 1.79	$t(161) = 0.41$, $p = .682$
Planning strategies	5.69 ± 1.53	5.71 ± 1.60	$t(161) = 0.06$, $p = .952$

Note. $n = 163$.

Section 3: Risk Identification and Crisis Experience

This section identified risks from a list with multiple-choice answers:

- Has your organization experienced a crisis in the last 5 years? (multiple-choice: yes, no, don't know)
- Describe the crisis (open-ended)
- Rate severity (choose option from a 6-point scale)

Table 24 focuses on respondents' perceptions of risk. Respondents were asked to identify the overall highest risks that could lead to a crisis in their organization. Each respondent could choose their top five risks from a list of 23 risks. Table 24 summarizes these identified risks. Most respondents identified the following five risks: staffing issues (88.3%), loss of critical services (58.3%), earthquake (51.5%), severe weather (49.7%), and pandemic (48.5%).

Table 24

Summary of Risks Identified by Respondents

"Think of the overall highest risks that could lead to a crisis for your organization. Please tick the top five."	Selected as Top Five Risks: Frequency (%)
Climate change	44 (27.0%)
Pandemic	79 (48.5%)

Loss of critical services (e.g., electricity, water, gas, or telecommunications)	95 (58.3%)
Reputation damage	32 (19.6%)
Fraud	1 (0.6%)
Major accident (e.g., bus crash) or fire	19 (11.7%)
Regulatory changes	9 (5.5%)
Failure of a key supplier	24 (14.7%)
Staffing issues	144 (88.3%)
Financial crisis	21 (12.9%)
Information security breach	12 (7.4%)
Technological change	8 (4.9%)
Contamination (e.g., toxic chemical spill)	3 (1.8%)
Litigation	3 (1.8%)
Terrorism	28 (17.2%)
Flooding	26 (16.0%)
Wildfire	47 (28.8%)
Drought (water shortage)	3 (1.8%)
Severe weather (e.g., heat, tornado)	81 (49.7%)
Tsunami	25 (15.3%)
Volcanic activity	4 (2.5%)
Landslide	9 (5.5%)
Earthquake	84 (51.5%)

Note. $n = 163$

The respondents identified risks to their organization, such as the loss of critical services (e.g., electricity, water, gas, and telecommunications; 58.3%), staffing issues (88.3%), and earthquakes (51.5%). Pandemics (48.5%) and severe weather (e.g., heatwaves

and tornadoes) (49.7%) also ranked high. Climate change issues, such as severe weather, was identified by 27.0%, and the frequency (i.e., the number of times chosen) of identifying climate-related risks such as flooding, wildfires, droughts, and severe weather was 157.

Participants were also asked about the existence of specific risk management roles within their organization. Table 25 presents the frequency of responses indicating the existence of roles, including risk management, crisis management, emergency management, disaster risk reduction, and business continuity. Additionally, the table includes the frequency of respondents who were uncertain about the presence of these roles. Respondents said emergency management (66.9%) and risk management (62.6%) roles existed in their organizations. Other roles, such as crisis management (31.9%), DRR (47.2%), and business continuity (35.6%), were also identified, but to a lesser extent than the others. However, 32.5% of respondents indicated that they did not know of the presence of such roles in their organizations, which indicated uncertainty.

Table 25

Risk Management Roles and Plans Within the Organization

"Question: Our organization currently has people who perform the following roles *(tick all that apply).*"	Frequency (%)
Risk management	102 (62.6%)
Crisis management	52 (31.9%)
Emergency management	109 (66.9%)
Disaster risk reduction	77 (47.2%)
Business continuity	58 (35.6%)
Do not know	53 (32.5%)
None of the above	3 (1.8%)

Awareness of existing organizational plans was assessed, focusing on business continuity, emergency, disaster, and crisis plans. Additionally, respondents evaluated whether these plans are of a sufficient standard to be useful in an emergency.

Fewer than half of the respondents reported the existence of specific plans including emergency plans (37.4%), disaster plans (34.4%), and business continuity plans (23.9%). Even fewer were aware of a crisis plan (14.1%). Almost half (48.5%) indicated they did not know whether such plans existed within their organization. Regarding the adequacy of these plans, nearly half (47.2%) believed that the existing plans were not of a sufficient standard to be useful in an emergency, only 11.0% felt that they were sufficient, and 41.7% were uncertain about their adequacy. Table 26 presents the frequency of responses for both the presence of these plans and the evaluation of their sufficiency.

Table 26

Organizational Plans

"Question: Our organization has the following plans (tick all that apply)."	Frequency (%)
Business continuity plan	39 (23.9%)
Emergency plan	61 (37.4%)
Disaster plan	56 (34.4%)
Crisis plan	23 (14.1%)
None of these	12 (7.4%)
Do not know	79 (48.5%)
"Question: Are your organization's plans of a sufficient standard to be useful in an emergency?"	**Frequency (%)**
No	77 (47.2%)
	18 (11.0%)

Yes	68 (41.7%)
Do not know	

Infrastructure Disruption Preparedness. The responses show a negative perception (closer to *strongly disagree* on the Likert scale) regarding the sufficiency of planning for disruptions to essential infrastructures such as water supply, sewage, electricity, and gas. The responses indicated a general lack of confidence or knowledge in their organizations' preparedness for disruptions. The frequency of testing and practicing emergency plans with disaster and emergency exercises is summarized below.

Participants assessed their organization's preparedness for disruptions to critical infrastructure elements. Table 27 provides the mean scores and standard deviations for each element on a Likert scale from 1 (strongly agree) to 8 (strongly disagree), along with the percentage of "do not know" responses. The high mean scores across all infrastructure elements indicate a general perception of inadequate planning. Additionally, a significant portion of respondents were unsure about their organization's preparedness, particularly for water supply (44.8%), sewage (44.8%), and road networks (45.4%).

Table 27

Infrastructure Preparedness

"Question: Our organization has done sufficient planning for how disruption to the following infrastructure might affect us." Likert scale [values 1–8, ranging from *strongly agree* (1) to *strongly disagree* (8)].	Mean ± *SD*	Number (%) of Individuals With "Do Not Know" Responses
Water supply	7.00 ± 1.45	73 (44.8%)
Sewage	7.21 ± 1.16	73 (44.8%)
Electricity	6.46 ± 2.06	66 (40.5%)

Gas	6.43 ± 1.98	67 (41.1%)
Phone networks (cell and landline)	5.79 ± 2.11	62 (38.0%)
Data networks	5.84 ± 2.22	69 (42.3%)
CAD: Computer-Aided Dispatch	5.38 ± 2.32	61 (37.4%)
Road network	6.65 ± 1.63	74 (45.4%)
Airport	6.66 ± 1.72	92 (56.4%)
Port	6.96 ± 1.52	95 (58.3%)

Note: $n = 163$.

The regularity with which BCEHS rehearses and tests their various plans is in Table 28 and summarizes the frequency for business continuity, emergency, crisis, and disaster plans. The majority of respondents either did not know how often these activities occurred or indicated that they hardly ever happened. For instance, 68.7% were unaware of the frequency of business continuity plan rehearsals, and 27.6% stated that they hardly ever occurred.

Business Continuity Plan. Most respondents (68.7%) were unaware of the frequency of testing and rehearsing, while 27.6% reported that testing and rehearsal hardly ever occurred. A very small percentage (3.7%) indicated that testing and rehearsal occurred annually or twice a year.

Emergency Plan. Over half the respondents (54.0%) did not know the frequency of testing and rehearsal. A significant proportion (42.3%) stated that rehearsal and testing hardly ever occurred. A small number (3.7%) reported annual or biannual rehearsal and testing.

Crisis Plan. A substantial proportion (63.8%) were uncertain about the frequency of rehearsal and testing. More than one-third (34.4%) reported that testing and rehearsal hardly ever occurred. A very small number (1.8%) reported that testing and rehearsal were conducted annually or twice a year.

Disaster Plan. More than half (58.9%) did not know the frequency of testing and rehearsal. A notable proportion (39.3%) reported that testing and rehearsal hardly ever occurred. Like the crisis plan, a minimal fraction (1.8%) indicated annual or biannual rehearsal and testing.

Table 28

Frequency of Rehearsal and Testing of Plans

"Question: How regularly does your organization rehearse and test its plans?"

Plan	Do Not Know	Hardly Ever	Annually or Twice a Year
Business continuity plan	112 (68.7%)	45 (27.6%)	6 (3.7%)
Emergency plan	88 (54.0%)	69 (42.3%)	6 (3.7%)
Crisis plan	104 (63.8%)	56 (34.4%)	3 (1.8%)
Disaster plan	96 (58.9%)	64 (39.3%)	3 (1.8%)

Note. n = 163; reported values are frequencies (%).

Participants evaluated the BCEHS commitment to practicing and testing emergency plans. Table 29, below, presents the mean scores for two questions of commitment to practice, and testing of emergency plans.

Respondents largely disagreed, as indicated by a high mean score of 7.07, with the statement that BCEHS is committed to practicing and testing its emergency plans to ensure their effectiveness. A proportion of respondents (17.8%) were unsure, marking "do not know" in response to this statement.

The respondents largely disagreed concerning the commitment to the emergency plan, as indicated by a high mean score of 7.07, with the statement that BCEHS is committed to practicing and testing its emergency plans to ensure their effectiveness. A notable proportion of respondents (17.8%) were unsure and marked "do not know" in response to this statement.

And the respondents largely disagreed with the notion that staff can take time from their daily roles to practice crisis response with a mean score of 7.13. A minimal number (4.3%) of respondents were uncertain and marked “do not know” for this statement.

Table 29

Commitment to Emergency Plan Practice Question

“Question: To what extent do you agree or disagree with the following statements for your organization?” Likert scale from 1 to 8, with *strongly agree* = 1 to *strongly disagree* = 8.

Evaluation Statements	Mean ± *SD*	Number (%) of Individuals With “Do Not Know” Responses
BCEHS is committed to practicing and testing its emergency plans to ensure they are effective.	7.07 ± 1.30	29 (17.8%)
Staff can take time from their daily roles to practice how to respond to a crisis.	7.13 ± 1.51	7 (4.3%)

Note. *n* = 163.

In Table 30, respondents estimated how long their organization could continue functioning without certain infrastructure services and frequencies for each time frame, from immediate cessation of function to months, along with mean values representing overall perceived resilience. Critical infrastructure elements, such as the road network, fuel/gas, and phone networks were considered essential, with a significant number indicating the organization could not function without them.

On average, people reported that the three most critical infrastructure elements were road network, fuel/gas, and phone network (cell and landline). Ports were reported as the least critical aspect of infrastructure, with 67% of respondents stating that their organization could function for months without a port.

Table 30

Duration Organization Can Function Without Infrastructure Elements

Infrastructure Elements	"Question: How long could your organization continue functioning if normal supply to the following infrastructure services were disrupted?"						Mean
	Could Not Function [0]	Hours [1]	Days [2]	Weeks [3]	Months [4]	Do Not Know	
Water supply	14 (8.6%)	51 (31.3%)	65 (39.9%)	19 (11.7%)	7 (4.3%)	7 (4.3%)	1.71
Sewage	14 (8.6%)	58 (35.6%)	49 (30.1%)	25 (15.3%)	11 (6.7%)	6 (3.7%)	1.75
Electricity	26 (16.0%)	60 (36.8%)	57 (35.0%)	10 (6.1%)	4 (2.5%)	6 (3.7%)	1.40
Fuel/gas	39 (23.9%)	74 (45.4%)	42 (25.8%)	4 (2.5%)	2 (1.2%)	2 (1.2%)	**1.11**
Phone networks (cell and landline)	80 (49.1%)	24 (14.7%)	26 (16.0%)	17 (10.4%)	15 (9.2%)	1 (0.6%)	**1.15**
Data networks	60 (36.8%)	24 (14.7%)	32 (19.6%)	21 (12.9%)	22 (13.5%)	4 (2.5%)	1.50
Computer-aided dispatch (CAD)	31 (19.0%)	24 (14.7%)	35 (21.5%)	21 (12.9%)	49 (30.1%)	3 (1.8%)	2.21
Road network	80 (49.1%)	26 (16.0%)	24 (14.7%)	17 (10.4%)	11 (6.7%)	5 (3.1%)	**1.07**
Airport	23 (14.1%)	8 (4.9%)	38 (23.3%)	31 (19.0%)	58 (35.6%)	5 (3.1%)	2.59
Port	13 (8.0%)	7 (4.3%)	29 (17.8%)	42 (25.8%)	67 (41.1%)	5 (3.1%)	2.91

Note. Reported values are frequencies (%).

Participants were asked whether their BCEHS had experienced a crisis or emergency in the last five years and to describe these events. Table 31 includes the frequency of each crisis type and the mean severity rating along with the standard deviation. It summarizes the frequencies and perceived severity (ranking them from 1 to 5, where 1 denoted a situation managed as part of business-as-usual and 5 signified a crisis with the potential to permanently shut down the operations) of the most commonly reported crises. The heat dome (58.9%), COVID-19 pandemic (54.6%), floods (47.2%), and wildfires (42.3%) were the most frequently reported.

Severity assessment and variation exist in the perceived severity across different crises. The heat dome and staffing issues were perceived as highly disruptive, and approached

a rating of very disruptive on the severity scale. For instance, the heat dome consistently elicited a higher severity rating across the first three mentions of crisis experience, suggesting its large impact on the BCEHS. Conversely, the opioid crisis was rated lower on the severity scale, which indicated a moderate level of perceived disruption.

Table 31

Crisis Experience and Severity to the Organization

Question: Has your organization experienced a crisis or emergency in the last 5 years?		
Crisis Experience #1	Frequency (%)	Severity to Organization, Mean ± *SD*
Heat dome	45 (27.6%)	4.40 ± 0.58
COVID	31 (19.0%)	3.90 ± 0.79
Opioid crisis	16 (9.8%)	2.94 ± 1.06
Wildfire	16 (9.8%)	4.13 ± 0.62
Flood	7 (4.3%)	3.86 ± 0.69
Staffing	4 (2.5%)	4.50 ± 0.58
Power outage	3 (1.8%)	3.00 ± 1.00
Extreme weather	2 (1.2%)	3.00 ± 0.00
Other	2 (1.2%)	4.00 ± 0.00
Reputation	2 (1.2%)	4.00 ± 0.00
Crisis Experience #2	**Frequency (%)**	**Severity to Organization, Mean ± *SD***
Flood	31 (19.0%)	4.03 ± 0.60
COVID	26 (16.0%)	3.85 ± 0.61
Heat dome	20 (12.3%)	4.40 ± 0.82
Wildfire	18 (11.0%)	3.56 ± 0.86
Opioid crisis	9 (5.5%)	3.11 ± 0.93
Other	7 (4.3%)	2.86 ± 1.57
Staffing	7 (4.3%)	4.43 ± 0.79
Reputation	1 (0.6%)	3.00 ± 0.00
Crisis Experience #3	**Frequency (%)**	**Severity to Organization, Mean ± *SD***
Heat dome	24 (14.7%)	4.29 ± 0.75
COVID	22 (13.5%)	3.64 ± 0.90
Flood	18 (11.0%)	3.50 ± 0.86
Wildfire	13 (8.0%)	3.31 ± 0.75
Opioid crisis	6 (3.7%)	2.83 ± 0.98
Staffing	6 (3.7%)	4.33 ± 0.82
Other	5 (3.1%)	4.00 ± 0.71
Extreme weather	4 (2.5%)	3.75 ± 0.96
Supply chain	3 (1.8%)	4.00 ± 1.00
Crisis Experience #4	**Frequency (%)**	**Severity to Organization, Mean ± *SD***
Wildfire	17 (10.4%)	3.12 ± 0.99
Staffing	15 (9.2%)	4.40 ± 0.63
Flood	14 (8.6%)	3.71 ± 0.91
COVID	6 (3.7%)	4.17 ± 0.75
Heat dome	6 (3.7%)	4.67 ± 0.52
Opioid crisis	6 (3.7%)	3.67 ± 0.52
Other	5 (3.1%)	3.40 ± 1.34
Crisis Experience #5	**Frequency (%)**	**Severity to Organization, Mean ± *SD***

Staffing	15 (9.2%)	4.53 ± 1.06
Flood	7 (4.3%)	3.71 ± 0.76
Wildfire	5 (3.1%)	3.80 ± 0.84
COVID	4 (2.5%)	4.00 ± 0.82
Supply chain	4 (2.5%)	3.75 ± 0.96
Opioid crisis	2 (1.2%)	3.00 ± 1.41
Other	2 (1.2%)	2.00 ± 1.41
Extreme weather	1 (0.6%)	5.00 ± 0.00
Heat dome	1 (0.6%)	5.00 ± 0.00
All Crisis Experiences Combined	**Frequency (%)**	**Severity to Organization, Mean ± *SD***
Heat dome	96 (58.9%)	4.40 ± 0.67
COVID	89 (54.6%)	3.84 ± 0.77
Flood	77 (47.2%)	3.81 ± 0.76
Wildfire	69 (42.3%)	3.55 ± 0.88
Staffing	47 (28.8%)	4.45 ± 0.80
Opioid crisis	39 (23.9%)	3.08 ± 0.96
Other	21 (12.9%)	3.29 ± 1.31
Extreme weather	7 (4.3%)	3.71 ± 0.95
Supply chain	7 (4.3%)	3.86 ± 0.90
Power outage	3 (1.8%)	3.00 ± 1.00
Reputation	3 (1.8%)	3.67 ± 0.58

I wanted to test if perceptions of business risks differ between frontline staff and leaders, so I conducted a chi-square test of independence. The chi-square test is used to determine if there is an association between two categorical variables (in this case, the position within the organization (frontline staff or leaders) and the identification of specific business risks). This test is used because it compares frequencies in different categories, to determine if the distribution of responses is independent of group membership (Noack, 2018).

Table 32 presents the frequencies of the top identified risks for each group and the results of the chi-square tests. The analysis revealed a significant difference in the identification of the pandemic as a business risk between leaders and frontline staff. Leaders mentioned the pandemic more frequently (72.7%) compared to frontline staff (44.7%), with the chi-square test showing a statistically significant result ($\chi^2(1) = 5.99$, $p = .014$). This suggests that leaders are more likely than frontline staff to perceive the pandemic as a major risk to the organization. Staffing issues, loss of critical services (e.g., electricity, water, gas, telecommunications), earthquake, and severe weather (e.g., heat, tornado) did not show a significant difference in frequency between the two groups, and they had a shared perception.

Table 32

Business Risks Identified by Respondents Between Positions

Business Risk	Frontline, $n = 141$ Frequency (%)	Leaders, $n = 22$ Frequency (%)	Chi-Square Test Results
Staffing issues	126 (89.4%)	18 (81.8%)	$\chi^2(1) = 1.05$, $p = .305$
Loss of critical services (e.g., electricity, water, gas, telecommunications)	82 (58.2%)	13 (59.1%)	$\chi^2(1) = 0.01$, $p = .934$
Earthquake	75 (53.2%)	9 (40.9%)	$\chi^2(1) = 1.15$, $p = .284$
Severe weather (e.g., heat, tornado)	71 (50.4%)	10 (45.5%)	$\chi^2(1) = 0.18$, $p = .669$
Pandemic	63 (44.7%)	16 (72.7%)	$\chi^2(1) = 5.99$, $p = .014$

Note. $n = 163$

Qualitative Survey Findings

In addition to the quantitative questions in the survey, I added three open-ended questions to provide additional context for the quantitative findings. The thematic analysis used the 14 deductive themes identified from the BRT, as described in the methodology section. Overall, the quantitative results have both strength and concern for organizational resilience. Key findings include statistical differences in perceptions between frontline staff and leaders, particularly in areas such as leadership effectiveness, staff engagement, and proactive posture. These results suggest a need for recommendations to address them.

Overview of Themes

Many respondents identified a lack of internal resources as undermining organizational resilience. They noted that the lack of capacity—mainly concerning the insufficient number of paramedics and the ability to mobilize additional staff in a disaster—harmed BCEHS's ability to operate during a crisis due to a lack of sufficient staff to operate in normal daily operations. The frontline staff believed engagement during and before a disaster was important in building resilience. Critical information regarding disasters and plans was viewed as the third largest gap after a lack of internal resources and poor morale

(i.e., critical information should be stored in various formats and media types in easily accessed locations).

In addition, the respondents also reported low morale within BCEHS, including mistrust of executive and management teams and leadership generally. Most low-morale comments were related to a lack of investment in paramedic staffing levels (too low) and a lack of job security for casual staff and on-call "pager pay." Comments were also made about the lack of employee training and development generally, but mainly regarding disasters and agencies. Overlapping disasters, including the heat dome (June 2021), atmospheric river flooding in British Colombia (November 2021), and the ensuing supply chain disruption, COVID-19 (starting in 2020), wildfires (summers 2020 and 2021), and the opioid crisis (2016 to present) were described as factors leading to staffing vulnerabilities and low morale. Some key highlights of the respondents' perceptions follow.

Finally, the survey showed the need for recovery plans for each organizational level. Communication obstacles can lead to fragmented and isolated dynamics. Moreover, social divisiveness and cultural factors in organizations such as BCEHS may intentionally or unintentionally cause silos (Resilient Organisations, n.d.; Seville, 2016).

Theme 1: Internal Resources. *Managing and deploying BCEHS resources such as ambulances, supplies, and personnel, including paramedics and dispatchers, to maintain out-of-hospital care and provide additional capacity during a disaster* (Resilient Organisations, n.d.; Seville, 2016).

Predominant concerns included human resources and staffing adequacy, disaster supplies, equitable pay, and robust disaster-response processes. Examples emphasized a perceived inadequacy in managing demand surges, as evidenced during the heatwave in 2021 (i.e., the heat dome). Statements were prevalent about the inability of BCEHS and the government to meet staffing targets, insufficient staff reserves to respond to a disaster, a lack

of disaster supplies, and a lack of caches of emergency and disaster supplies at strategic locations. Many responses also included a lack of equitable pay. Staffing was included as a human resource in this section. Expressions of dissatisfaction with internal disaster processes and BCEHS's lack of disaster-response capacity, backup plans, and proper communication channels for alerting and situational awareness were common. One respondent noted, "BCEHS was unable to manage demand from increased call volume during the heatwave, leading to workers overexerting themselves to the point of heatstroke" (Personal communication, 2022). Another stated,

> The sudden influx of the heat dome was the closest I've ever seen our organization to complete service failure. Our only saving grace was that the heatwave eased within a matter of days. Had the volume sustained due to extremely elevated temperatures, I feel complete system collapse was imminent (Personal communication, 2022).

Another respondent emphasized the need for modern technology and adequate tools for staff to work effectively in challenging situations:

> The organization needs to move into a modern technological EMS system with clear direction that supports staff in regular daily business and upcoming potential crises. Staff need to be supported with adequate tools so that they can work in challenging situations (Personal communication, 2022).

Overall, the respondents felt that BCEHS was under-resourced in terms of paramedics and management alike, as well as surge supplies, which led to a lack of internal capacity to maintain services. "Significant staffing issues" influenced patient care across the province, and some respondents indicated that an antiquated response model existed in rural and remote communities. Insufficient staff numbers also hindered the ability to provide operational redundancy in the event of a demand surge, such as during a disruptive disaster or pandemic.

Hence, it was strongly emphasized that BCEHS must address these issues and invest in adequate internal resources, particularly paramedic pay, increased staff numbers, surge and disaster supplies, and communications technology.

Theme 2: Morale. Morale issues are a misalignment of values and ethical concerns that affect personal integrity and can lead to a breakdown in trust, increased stress, and a decline in overall morale (Brown & Treviño, 2006; Hogan & Kaiser, 2005). Low morale emerged due to perceived inadequacies in disaster response, climate-change adaptation strategies, and lack of investment in staff. One prominent theme that was not in the original codebook but became the second-highest response from the survey was the issue of low morale among BCEHS's employees. Statements and feelings of mistrust were related to BCEHS's disaster response and climate-change adaptation strategies.

The most common perceptions were a lack of accountability among the executive and leadership team, poor responses to past disasters, insufficient investment in staff (i.e., staff numbers and pay), lack of employee disaster training, poor warning and alerting systems, and lack of surge development in a disaster. These issues contributed to low morale and statements of mistrust or outright anger. One respondent stated,

> I used to be proud of my job. Now, I just tell people I am a first responder. I don't identify as a BCEHS employee if I can avoid it. It's embarrassing how bad our "service" is. I've taken time off for mental health more in the last two years than the entire 19 years previous. Moral injury is real and painful (Personal communication, 2022).

Another respondent expressed a lack of trust and criticized the competence of the leadership, saying,

> I don't know the plans or where to find them. However, I have good evidence that my organization's plans are insufficient. BCEHS managers killed more than 600 people in

> the 2021 heat dome through their negligent failure to plan for a very predictable outcome of climate change, not to mention an extreme weather event that staff were expressing worry to each other about days beforehand. If the plans were sufficient, then the failure was deliberate, and the managers are murderers. Since I think they're incompetent, not murderers, the plans must be insufficient. My belief will be confirmed when it happens again (Personal communication, 2022).

Theme 3: Planning. *Proactive planning addresses foreseeable risks and other vulnerabilities in BCEHS for out-of-hospital care* (Resilient Organisations, n.d.; Seville, 2016).

A deficiency was perceived in disaster planning and climate change adaptation, with concerns over a lack of training and support. The qualitative survey responses indicated that BCEHS had not established disaster planning. Thus, the theme that emerged from the survey was the importance of planning for disasters and the need for climate change adaptation. However, the respondents expressed their beliefs that BCEHS had few to no disaster plans in place, relying instead on a reactive approach to responding to disasters. As one respondent stated outright, "We don't have a plan" (Personal communication, 2022).

Staff at all levels of BCEHS reported a lack of training and support in handling and responding to all types of disasters, leading to a lack of knowledge in their roles. One respondent noted,

> Although we have business continuity plans for the dispatch centres, this is not sufficient, nor are these well-connected and supported plans. We need plans at all levels and kinds within the organization to ensure continuity of operations and to respond effectively and appropriately to a variety of situations. We also need the ability to monitor the pressures on the organization (both short and long-term) (Personal communication, 2022).

Another respondent added,

> My organization is barely able to function at a baseline service delivery level. If we have plans for an emergency, no one at ground level knows what they are or how to access them. Even if we had the ability to access them, what use would they be, given that we can already barely staff 65% of our frontline resources? (Personal communication, 2022).

Theme 4: Proactive Posture. *Early warning is monitored and developed strategically. Behavioural readiness adapts to internal or external pressures affecting BCEHS's ability to provide out-of-hospital care, aiming to mitigate actions early to prevent pressures from escalating into a disaster* (Resilient Organisations, n.d.; Seville, 2016).

Criticism was aimed at the reactive stance during crises, notably during the 2021 heatwave. No positive examples were found of a proactive posture, with the 2021 heatwave being cited the most in criticism. One respondent said,

> We failed to respond adequately to the recent heat dome crisis and did not appear organizationally to take decisive action until approximately three days after the onset of the crisis. I extrapolate this to assume that our organization will be similarly slow to react to any other unforeseen crisis (Personal communication, 2022).

Theme 5: Leadership. *Provides decision making during a disaster and uses an iterative approach to evaluate BCEHS strategies and health system goals* (Resilient Organisations, n.d.; Seville, 2016).

Perceived shortcomings in leadership impacted disaster management and climate change strategies. Poor leadership for frontline staff was a contributing factor to BCEHS's performance in disaster management and climate change strategies, based on the survey. Notably, one respondent stated, "In the last year (heat, pandemic, staffing, etc.), there has

been a complete lack of capacity and direct leadership to the supervisor group to take plans to staff" (Personal communication, 2022). Another respondent contended that,

> Numerous coinciding crises have crippled our organization—the 2021 heat dome, toxic management, and a lack of leadership, in general, have resulted in further staffing shortages, employees off on sick/mental health leave, and an all-time low in morale. Besides all that, the operational readiness of the organization has been decimated by short staffing, equipment shortages, and changing suppliers multiple times in the last few years (Personal communication, 2022).

Another respondent said,

> I am very disturbed by the global trajectory regarding climate change; 2021 brought three major climate events, one of which (heat dome) saw some weeks where the death rate was higher from heat than from the global pandemic that had many of us stop what we were doing (travelling, working, etc.). We saw in the pandemic what an emergency response to a crisis could look like (suspending BAU [business-as-usual]). I constantly see BCEHS and the PHSA talk about flooding, heat domes, atmospheric rivers, and forest fires as "natural disasters" without connecting the dots in any meaningful way. This tells me that leadership is completely out of touch with where we are headed and demonstrates no interest in avoiding the destruction of the climate catastrophe. I think, in addition to greater disaster preparedness, our health agencies need to step up to mitigate the harm of climate change. The first step in risk reduction is to avoid/eliminate the risk, and we need every level of society to participate in that (Personal communication, 2022).

These responses highlighted the importance of effective leadership in disaster management and climate change adaptation efforts to bring a whole-society approach to the entire health system.

Theme 6: External Resources. *Knowledge of what is available in the wider health system, first-responder services, private industry, and government organizations for support of BCEHS. Develop relationships before a disaster and know how to access them* (Resilient Organisations, n.d.; Seville, 2016).

Concerns were expressed over interagency collaboration and resource availability during disaster response. A lack of agency-to-agency collaboration was cited as a factor in poor disaster response. BCEHS works with other first responders (e.g., police and firefighters) and relies on other health care sectors (e.g., hospitals and coroners' services) for support in its operations. However, the respondents reported a lack of cooperation and coordination between these agencies, including among allied partners involved in disaster exercises focused on agency-to-agency cooperation. One respondent noted, "There is a lack of organization with other agencies and lack of resources to respond. [There is also] inadequate training of frontline supervisors and staff on the street" (Personal communication, 2022).

Theme 7: Minimization of Silos. *Communication obstacles are fragmented and isolated and can lead to negative workplace dynamics. Address underlying issues such as social divisiveness or, in organizations such as BCEHS, cultural. Behavioural factors that may cause silos, whether intentionally or unintentionally* (Resilient Organisations, n.d.; Seville, 2016).

A disconnect existed between emergency planners and frontline paramedics, with examples of insufficient organizational support for DRR initiatives. The survey showed that silos exist within BCEHS. One respondent reported, "There is [an] obvious disconnect between emergency planners and frontline paramedics. In fact, I would dare to say most of our frontline paramedics don't know we have an emergency planning department." Another identified progress on plans, noting that,

> The clinical safety plan is definitely getting fleshed out to the point it should be helpful moving forward, but I know many of these other types of plans have been suggested or started by DR3 [DRR and resilience department], but they haven't had enough buy-in or organizational support to be fully formed (Personal communication, 2022).

Thus, the lack of support prevented the broad distribution of this plan and others.

Theme 8: Participation in Exercises. *Plans are rehearsed, not merely recorded, for disaster scenarios* (Resilient Organisations, n.d.; Seville, 2016).

Investment was lacking in disaster and emergency exercises, with examples showcasing unawareness or inaccessibility of disaster-response plans. Participating in and running regular disaster, emergency, crisis, and business continuity exercises was viewed as an effective way to rehearse and understand plans. However, the respondents felt that no investment was made in these exercises or their execution.

Several respondents noted that BCEHS failed to meet standards for exercises. They stated that other agencies (e.g., Millart, police, and airports) conduct them, so they should be prioritized. One respondent stated that,

> Plans (if any) can be difficult to find and are not socialized. While the organization may have a plan, staff will most likely not be able to locate it. Further, if staff can locate it, it cannot be guaranteed that it will be implemented from the ground up (supervisors, operations managers, dispatch), potentially leading to confusion. Lastly, the plans have not been exercised. This can lead to improvisation or deviation of plans during an emergency (Personal communication, 2022).

Theme 9: Situation Monitoring and Reporting. *Staff are encouraged to be vigilant about the organization, its performance, and potential problems. They are rewarded for*

sharing good and bad news about the organization, including early warning signals, which are quickly reported to organizational leaders (Resilient Organisations, n.d.; Seville, 2016).

Concerns existed regarding inadequate reporting and communication during disaster scenarios. Several people commented that BCEHS is poor at reporting issues during a disaster. One stated,

> During the flooding, we had no plans for staff that lived and worked in areas affected by the flooding. There was no communication of road closures, and we were told to "check DriveBC." There was no communication for ambulances to access emergency of flooded areas. Most occurred through word of mouth between frontline staff (Personal communication, 2022).

Theme 10: Staff Engagement. *Engagement and involvement of staff as frontline, management, or support people. They provide knowledge and lived experience, linking their work to BCEHS resilience and empowering staff as problem solvers* (Resilient Organisations, n.d.; Seville, 2016).

The staff desired to contribute to emergency planning and management, with examples of lack of clarity on how to become involved. Some respondents expressed a desire to contribute;

> As a normal PCP [primary car paramedic license level], I have little confidence in our organization's abilities to manage an emergency. I feel, at a station-to-manager level, there is little training in ICS [incident command system], disaster management, and emergencies. I have no idea who would be in charge or what BCEHS's role would be in the evacuation of the Upper Gulf island I work on. I would love to be a part of emergency planning and management with BCEHS, but I have literally no idea how to be involved (Personal communication, 2022).

Theme 11: Decision Making. *All staff at BCEHS are given appropriate authority for decision making in their work during disaster response. Specialized staff employ their expertise in responses and implementation of solutions in a disaster response* (Resilient Organisations, n.d.; Seville, 2016).

Bureaucratic barriers existed that impacted seamless decision making. One respondent lamented bureaucratic systems:

> Silos and barriers within the organization will continue to have negative impacts to all. “Red tape” throughout the organization does not allow for seamless decision making. User input (not permission) is often not asked of the employees, so the unintended consequences are inevitable.

Theme 12: Innovation and Creativity. *BCEHS staff at all levels are recognized and celebrated for novel and creative approaches to problem-solving, applicable to ongoing issues and those exposed or created by disasters* (Resilient Organisations, n.d.; Seville, 2016).

Creativity was lacking, with examples of rules impeding effective responses during crises. Respondent responses did not include many examples of how BCEHS demonstrates creativity. They described how many of the rules governing practice in BCEHS were a hindrance. One respondent stated,

> Flooding in 2021 prevented lots of commuting members of our service from reaching their primary station. Many were denied work in the regions they were stuck in initially—lots of people were told to attempt a 4- to 6-hour-plus commute (one way) to their rural station that they were attached to, to work for $2 an hour kilo pager pay. They eventually sorted things out, but the amount of time it took just to figure something simple like that out is egregious (Personal communication, 2022).

Theme 13: Information and Knowledge. *Information such as plans and procedures is easily accessible in many locations, and frontline and management can find it easily. Expert opinions are available and accessible to everyone* (Resilient Organisations, n.d.; Seville, 2016).

A need existed for better situational awareness, access to disaster plans, and training in disaster-response roles. Situational awareness and a common operating picture of what is occurring during a disaster were important to the respondents. Many also stated the need for better awareness of disaster plans within BCEHS. One respondent highlighted the lack of access to plans and knowledge;

> Not [any access to plans] that we've been made aware of. The various scales of disaster/emergency/crisis vary so much, and our currently limited resources can be so overwhelmed so quickly in various parts of the province, that it feels that nearly anything could be an issue. Because we don't know the different definitions of these [crises], we don't know what we're supposed to do for different scenarios. Example: I once asked a supervisor what happens when "the big one" hits. The response was, "Don't worry about it. The Canadian forces will come for that." I haven't heard a better plan since then. If something were to occur, the only thing I would know to do is a) check our email, b) check the FB [Facebook] ops page, or c) possibly drive to a station, assuming I could get there, which is concerning itself—but [it is] unknown what I would do once I got there. And these would likely be things I'd be completing after knowing my family was safe. For the following question, "stress-testing plans," frontline staff never have time/aren't included in these simulations. The last thing like that I experienced was an MCI [mass casualty incident] course about five years ago that, based on experience, felt like it had very limited value to real-world applications (Personal communication, 2022).

Thus, common statements included the need for access to critical information and expert opinions on disasters. A consensus existed that all staff should be trained to fill key described roles in a disaster or crisis.

Theme 14. Recovery Priorities. *Develop and publish plans on building back better and returning to viable operations following a disaster* (Resilient Organisations, n.d.; Seville, 2016).

Concerns existed regarding a perceived lack of learning from past events and inadequate crisis management strategies, with suggestions for improved recovery planning and leveraging internal expertise. Although BCEHS has been involved in past disasters, some staff believed the organization had not learned from previous mistakes. The respondents suggested mechanisms for gathering information to help learn from previous mistakes, which included developing actionable disaster plans and properly developing expertise and skills to recover from crises and adapt to climate change.

One respondent emphasized the importance of "an organization-wide awareness of what the organization's priorities would be following a crisis, clearly defined at the organization level, as well as an understanding of the organization's minimum operating requirements" (Personal communication, 2022). Another respondent noted the need for improvement in crisis management, stating,

> Most [strategies] are incredibly outdated, and there seems to be no learning from past events, as continued crisis management (like for forest fires, which happen every year) seems to be treated as new and [does] not build on the learnings from previous years. Also, the experts in a certain crisis are not utilized, and BCEHS has a minimal clue about what outside talents/skills the paramedic force holds beyond a medical license (Personal communication, 2022).

Frequency Analysis in the Themes

I conducted a further frequency analysis of the themes to assess whether they expressed negative, neutral, or positive sentiments. The results of this quantitative analysis are presented in rank order of frequency in the themes that emerged from coding the qualitative responses. This list is followed by a description of each sentiment, including key quotes illustrating the most common types of responses within each theme. The chart shows the frequency of coded responses (see the methods chapter for a description of the coding method). A total of 450 codes were applied; 443 were negative or critical comments, and seven had at least one element that was a positive or favourable comment. Within these themes, an additional analysis of positive versus negative sentiments was applied. Across the 14 themes, most comments were coded as negative or critical of the BCEHS organization's resilience capacity. Seven thematic categories included at least one favourable or positive comment.

Table 33, below, presents the codes applied to each theme. This breakdown illustrates how often certain issues were mentioned and whether they were perceived positively or negatively by the participants. The frequency counts provide insight into BCEHS resilience. Each theme is for different elements influencing resilience, and codes were assigned to indicate positive (+) or negative (−) sentiments expressed by the respondents.

The applied codes identify areas where BCEHS faces challenges, particularly in internal resources, morale, and information sharing, as shown by the higher frequencies of negative sentiments. *Internal resources and morale* showed the most frequency, with 109 and 93, respectively and these data suggest that staff perceive a lack of access to necessary equipment, supplies, and staffing, as well as issues affecting workplace culture and trust. There were few positive sentiments with the total positive frequency is 7, and the total negative frequency is 443 recorded, indicating potential areas for BCEHS development. For

instance, only two positive mentions were noted under *planning strategies*, suggesting that, while some disaster plans exist, they may not be widespread or consistently applied.

Table 33

Codes Applied to Themes With an Indication of Positive Sentiment, Negative Sentiment, and Frequency.

Factor	Theme	Definition	Code + positive -negative	Freq.	Positive	Negative
Adaptive capacity	Minimization of silos	Communication obstacles are fragmented and isolated and can lead to negative workplace dynamics. Address underlying issues such as social divisiveness or, in organizations such as BCEHS, cultural. Behavioural factors that may cause silos, whether intentionally or unintentionally. (Resilient Organisations, n.d.; Seville, 2016)	+De silo - greater collaboration = -Silo - Feeling their knowledge is siloed	19	0	19
	Internal resources	Managing and/or deploying the BCEHS resources, such as ambulances, supplies, and personnel, including paramedics and dispatchers. Maintain out-of-hospital care and provide additional capacity when needed during a disaster. (Resilient Organisations, n.d.; Seville, 2016)	+Access to equipment and supplies -Lack of access to equipment +Access staffing -Lack of access to staff	110	1	109
	Staff engagement and involvement	Engagement and involvement of staff as frontline, management, or support people. They can provide the knowledge and lived experience to link their own work and BCEHS resilience empowering staff problem solvers (Resilient Organisations, n.d.; Seville, 2016)	+Engagement Staff are empowered -Lack of engagement +Stockpile of emergency supplies (food, water, safety) - Lack of a stockpile of emergency supplies (food, water, safety)	7	0	7
	Information and knowledge	Information such as plans and procedures is easy to find in many locations, and frontline	- Lack of access to situational	46	0	46

		and management can find it easily. When needed, expert opinions are available. The experts are easy to access, and everyone knows how. (Resilient Organisations, n.d.; Seville, 2016)	awareness information +Access to situational awareness information +Ability to escalate to experts - Lack of ability to escalate to experts			
	Leadership	Disaster leadership exists to provide decision making during a disaster. An iterative approach is used to evaluate BCEHS strategies, health systems, and goals. (Resilient Organisations, n.d.; Seville, 2016)	+Effective leadership - Ineffective leadership	21	0	21
	Innovation and creativity	BCEHS staff at all levels are recognized and celebrated for novel and creative approaches to problem-solving. This applies to long-standing issues and ones exposed or created by disasters. (Resilient Organisations, n.d.; Seville, 2016)	+ Give examples of the ability to use knowledge in novel ways. - Had ideas that were dismissed or ignored	5	0	5
	Decision making	All staff at BCEHS are given appropriate authority regarding decision making for their work in disaster response. Specialized staff are also involved with their subject matter expertise in responses and implementation of solutions in a disaster response. (Resilient Organisations, n.d.; Seville, 2016)	- No authority to act + Authority to act	6	0	6
	Situation monitoring and reporting	Staff are encouraged to be vigilant about the organization, its performance, and potential problems. Staff are rewarded for sharing good and bad news about the organization, including early warning signals, and these are quickly reported to organizational leaders. (Resilient Organisations, n.d.; Seville, 2016)	+ Pathway to share risks and warnings - Lack of pathway to share risks and warnings - Lack of action with warnings/intelligence	13	0	13
Planning	Planning strategies	Proactive planning occurs for likely foreseeable risks, and other risks and strategies are developed for BCEHS vulnerabilities for out-of-	+ Disaster plans are present and effective	55	2	53

		hospital care. (Resilient Organisations, n.d.; Seville, 2016)	- Lack of disaster plans or ineffective plans			
	Participation in exercises	Plans are rehearsed and not merely recorded for disasters. (Resilient Organisations, n.d.; Seville, 2016)	+ Exercises - Lack of exercises	15	0	15
	Proactive posture	Early warning is monitored and developed strategically. Behavioural readiness changes to internal or external pressures that affect BCEHS's ability to provide out-of-hospital care. The goal is to do mitigative action early to prevent pressures from escalating into a disaster (Resilient Organisations, n.d.; Seville, 2016)	+ Proactive readiness - Reactive response	32	0	32
	External resources	Know what is available in the wider health system, first responder, private industry, and government organizations for supporting BCEHS Develop relationships before a disaster and know how to access them (Resilient Organisations, n.d.; Seville, 2016)	+ Clear understanding and direction - Lack of understanding and direction	20	0	20
	Recovery priorities	Develop and publish plans on Build Back Better and return to viable operation following a disaster (Resilient Organisations, n.d.; Seville, 2016)	+ Recovery is prioritized - Recovery plans are lacking	4	0	4
Emerging theme	Morale	Misalignment of values Ethical concerns Toxic work environment Impact on personal integrity	+ Has pride and positive attitude to BCEHS - Expresses mistrust and poor experience(s) related to work environment	96	3	93

Summary of Qualitative Survey Findings

One respondent's feedback effectively encapsulated the main themes identified from the qualitative survey responses. The comments blended criticism and positive actions while summarizing areas of concern and success within the system. In summarizing the qualitative survey findings, one respondent provided a comprehensive overview of both positive and

negative aspects of BCEHS' performance during key events. Their feedback highlighted several critical areas of concern, particularly regarding staffing, planning, and response.

The respondent pointed out several challenges, including the long-term impact of COVID-19 on the health system, stating that "long-term stress on the entire health system [is] causing staff burnout and fatigue" (Personal communication, 2022). They further emphasized staffing issues, noting "unacceptably long response times in both dispatch and PCD…[and] poor patient care and negative outcomes due to unacceptable wait times" (Personal communication, 2022). The heat dome and wildfires were identified as having exposed significant gaps in preparation, with the respondent stating, "our complete response was reactionary, leading to terrible staff morale and serious damage to our reputation in the media."

Despite these criticisms, the same respondent did acknowledge areas of success, particularly during the atmospheric rivers and floods, where they expressed pride in BCEHS's adaptability: "What could have incapacitated our system in the end only caused minor disruption to patient response" (Personal communication, 2022). They also praised the leadership and planning efforts during the Virtual Way flood evacuation, noting that, despite the risks, effective planning allowed the team to "regain access to the building in days instead of what could have been weeks" (Personal communication, 2022). This feedback underscores the need for improvements in staffing and planning, while also recognizing areas where BCEHS demonstrated resilience and strong leadership during crises.

Survey Criticisms

Four criticisms were made of the survey. Two people stated that some of the question wording was too vague and should have focused more on where they worked within the organization, with one noting,

> I personally find most (all) surveys to be slightly ambiguous. As a supervisor (identified at start of survey), maybe a better question would be, "Have you participated in any of the following response plans?" This would advise the level of knowledge and exposure to these plans and would have helped contextualize the answers (Personal communication, 2022).

Moreover, two people said it was hard to answer due to perspective. One commented,

> Many of these questions were challenging to answer because I could do so from different perspectives, i.e., I doubt many of the frontline paramedics are aware of all the planning that goes on in DR3 and executive level. I am aware of many pockets of highly engaged and innovative staff, but also lots of disgruntled and disengaged staff, so it was hard to think of the correct answer organizationally. And questions are difficult to answer because it feels there's such a gap in some things between management and frontline staff. For example, when we're to respond to the phrase, "There is a sense of teamwork and camaraderie in our organization," I want to say yes, I fully agree because the first thing I think about is people grinding away at 0300 on a busy weekend night with 4C weather and rain with half our cars down and the people I work with then are a team that inevitably have good teamwork and camaraderie because we're all going through the same thing together. But then I think about the number of people off on injury or stress leave who can't say the same thing. Or the fact that it feels like we're left to our own to try to solve these problems and so often it doesn't feel like we truly have the help we need to be able to accomplish the bare minimum of our job in a professional manner as one would expect an emergency service to be able to, much less when a

major incident suddenly occurs on top of that (Personal communication, 2022).

The research findings having been outlined, the following chapter provides a critical discussion linking these findings to the literature on HRO and complexity, their broader context, and the title of this research: *Climate adaptation in out-of-hospital settings: Building strategic disaster resilience in ambulance operations*.

Chapter 5: Discussion

High Reliability Organizations

In this study, the concept of HROs and the evidence-based characteristics identified with HROs (Seville, 2016) were utilized to examine BCEHS's organizational resilience as was expressed both historically and in the handling of recent disasters, including the 2021 heat dome in BC and the COVID-19 pandemic as it unfolded in BC during March 2020–2022, when I finished collecting the data (COVID-19 was ongoing at the time of writing).

Application of High Reliability Organization Principles to Research Findings

To systematically analyze the findings from this research, I used the five core principles of high reliability organizations (HROs) as a framework. This approach allowed for a structured examination of how BCEHS aligns with or diverges from these principles, highlighting potential gaps in organizational resilience. This chapter again employs the high reliability organizations (HRO) framework to discuss the qualitative and quantitative findings from the study.

I begin with an overview of the findings, linking each of the core findings to the five principles of HROs (see Table 34), followed by an elaboration of each principle and what it implies in relationship to the study findings.

Table 34

Application of HRO Principles to BCEHS Research Findings

HRO Principle	Definition	Findings from Research
Preoccupation with failure	Continuous focus on identifying and mitigating potential failures and errors (Enya et al., 2018; Roberts, 1989a, 1989b).	BCEHS may lack a consistent focus on mitigating potential failures. Survey results showed limited awareness of existing emergency plans only 42% of respondents were aware of a disaster plan, and 47% believed that existing plans were insufficient. (see Table 26). This suggests a deficiency in proactively addressing potential failures, increasing the risk of failure during disasters due to uninformed or unengaged staff in preparedness efforts.
Reluctance to simplify interpretations	Avoiding oversimplification of complex processes	BCEHS operates within a complex healthcare environment involving allied first responders (e.g., police, fire departments) and health

	(Enya et al., 2018; Roberts, 1989a, 1989b).	facilities (e.g., hospitals, clinics). Oversimplification can lead to poor disaster responses. High percentages of "do not know" responses regarding infrastructure preparedness (see Table 27) imply that staff may not fully understand the complexities of maintaining operations during disruptions, especially in diverse out-of-hospital emergency responses and interfacility transfers during disasters where the whole of health and first responders need to work together. For instance, 60% of respondents indicated they did not know whether infrastructure was sufficient for disaster response.
Sensitivity to operations	Responsiveness to the state of operational systems and environments, maintaining detailed awareness of processes and organizational systems (Enya et al., 2018; Roberts, 1989a, 1989b).	The research indicates gaps in operational sensitivity, as evidenced by the low frequency of rehearsals and testing of disaster plans (see Table 28). Only **1.8%** of respondents reported that disaster plan rehearsals and testing occurred annually or twice a year. The absence of regular drills, disaster exercises, and simulations may hinder BCEHS's ability to remain prepared for disasters like heatwaves. Enhancing sensitivity suggests fostering a culture where frontline staff can communicate concerns upward for needs such as training and exercises, contributing to organizational disaster readiness.
Commitment to resilience	Ability to adapt, recover, and learn from events and errors (Enya et al., 2018; Roberts, 1989a, 1989b).	Although BCEHS has experienced overlapping disasters (e.g., heat dome, COVID-19 pandemic), there appears to be limited organizational learning reflected in improved preparedness. A high level of uncertainty exists regarding BCEHS's proactive posture (see Table 20) and disaster preparedness, particularly in out-of-hospital care. For instance, 25.8% of respondents were unsure about BCEHS's role as an active respondent in external collaborations. Additionally, 17.2% of participants were uncertain about the organization's ability to seek opportunities during crises. These responses suggest that proactive disaster preparedness may not be fully realized, as many frontline staff are unsure of their roles or how the organization adapts to sudden changes.
Deference to expertise	Consulting experts within the organization and basing decisions on expertise and knowledge rather than hierarchical position (Enya et al.,	The findings suggest that BCEHS may not fully leverage the expertise of frontline staff. A significant difference in risk perception between leaders and frontline staff regarding the pandemic (see Table 32) indicates a possible disconnect. Leaders identified the pandemic as a major risk more frequently (72.7%) compared to frontline staff (44.7%), with a statistically

	2018; Roberts, 1989a, 1989b).	significant difference ($\chi^2(1) = 5.99$, $p = .014$) which may reflect a top-down approach rather than collaborative risk assessment, potentially undermining effective crisis management.

Principle 1: Preoccupation With Failure and Staffing.

HROs are characterized by a proactive orientation which involves a persistent focus on potential failures as part of actively seeking to identify and mitigate risks (Enya et al., 2018; Roberts, 1989b; 2018; Roberts, 1989a, 1989b).). Additionally, disaster risk management and actions to prepare for disasters, as stated by Khirekar et al. (2023), include "proactive measures efficient strategies, trained staff, and appropriate tools to ensure patient safety and manage resources during emergencies" (p. 5). Similarly, Agwu et al. (2019) note that "Preoccupation with failure is a characteristic of HROs that enables them to actively seek for signals within their systems that could indicate a potential for failure" (p. 2). However, the BCEHS research respondents recognized that disasters such as the heat dome, COVID-19, and staffing issues reflected an awareness of potential failures, and the findings also suggested partial alignment with the HRO principle of being preoccupied with failures (Roberts, 1989b; Sutcliffe & Weick, 2015).

For BCEHS, although the survey findings described various disasters, participant responses indicated the lack of a proactive increase in staffing levels to meet the disaster demands. The findings revealed that "[low] staffing issues" were identified as the primary perceived risk by 88.3% of respondents in the survey. This finding indicated internal vulnerabilities (Personal communication, 2022; see Table 3) to disasters due to not having the capacity—defined by UNDRR (n.d.), as a "combination of all the strengths, attributes and resources available within an organization" (p. 1)—to manage disaster risks. Although this risk awareness was not specifically identified in the qualitative findings, the respondents did describe a lack of staff capacity during the various disasters.

One respondent stated that “BCEHS was unable to manage demand from increased call volume during the heat wave, leading to workers overexerting themselves to the point of heatstroke” (Personal communication, 2022). This response underscores the idea that the BCEHS system lacks the capacity to scale up to meet the demands of a disaster such as the heat dome of 2021. Another participant remarked that “significant staffing issues” were reported as reoccurring, so much so as to have influenced patient care across BC (Personal communication, 2022). This inability to provide adequate staffing contrasts with the HRO principle of preoccupation with failure and making arrangements and plans for system pressures, for example, by having plans and process to upscale or by employing other ways to increase capacity for ambulance out-of-hospital care before, during, and after a climate disaster, to meet demands of increased uses of ambulance services.

The survey data showed that disasters were widely experienced by BCEHS and were ranked by severity to the organization. The heat dome was experienced by 58.9% of the respondents and ranked highest, and COVID-19 was experienced by 54.6% of the respondents and ranked second highest. The severity ratings for these events (4.40 ± 0.67 for the heat dome and 3.84 ± 0.77 for COVID-19 on a scale of 1 to 5) suggested that, while these crises were rated as severe, the organization’s disaster response and preparedness might not have been pre-emptive and proactive (see Table 31). Also, 68.7% of respondents in the survey did not know how often business continuity plans were rehearsed, and 47.2% believed their organization’s plans were not sufficient (see Tables 28 and 26). HROs would typically have continuous monitoring of system failures and, in the case of BCEHS, monitoring for the ability to provide out-of-hospital patient care, emergency patient responses, and interfacility transfers.

Health care organizations are advised to “plan ahead for phased staff callbacks (e.g., staged callbacks when a disaster is declared so that all staff do not respond at once) and

automatic consideration of staffing needs for 12, 24, and 48 hours post-event, to determine need and coverage and make appropriate plans" (Einav et al., 2014, p. e27S). This structured approach supports a sustainable response to prolonged crises by staggering staff deployment. This planning recognized possible failure of staffing models' more resilient response during emergencies. However, the findings from this research suggest that this proactive approach to staffing was not fully planned for. Integrating a strategy such as that mentioned above could address part of the internal vulnerabilities identified by respondents.

Principle 2: Reluctance to Simplify Interpretations.

HROs avoid oversimplification of complex situations (Enya et al., 2018; Roberts, 1989a; Roberts, 1989a, 1989b) so they do not underestimate risks or overlook subtle indicators of system vulnerabilities and so that "divergent perspectives are brought to bear" (Vogus & Welbourne, 2003, p. 881). For BCEHS, the findings suggest a need for a more comprehensive and nuanced understanding of disasters, particularly in areas such as disaster planning and climate change adaptation, as they are wicked problems characterized by their complexity and interconnectedness (Rittel & Webber, 1973). However, a tendency exists to "tame" problems or oversimplify them as solvable with traditional methods since their "well-defined nature can be implemented through linear processes" (Conklin, 2005, p. 17). As Agwu et al. (2019) maintain, "Reluctance to simplify shows how organisations continuously balance simplification and standardization of processes" (p. 2). The findings suggest that BCEHS may have a tendency to oversimplify complex disaster scenarios. Respondents highlighted a lack of disaster planning and a reactive stance during crises. One respondent stated: "We don't have a plan" (Personal communication, 2022).

This response indicates a potential underestimation of the complexities involved in disaster preparedness and response. Tame problem-solving approaches to wicked problems often fail to grasp the full complexity of the situation and lead to oversimplified solutions that

do not address the systemic issues (Conklin, 2005; Rittel & Webber, 1973). An illustration of this is that 47.2% of survey respondents identified floods as a top risk—3rd behind COVID and then the heat dome—(see Table 31), however, the perception of the organization's ability to withstand such events was questioned when one respondent remarked, "During the flooding, we had no plans for staff that lived and worked in areas affected by the flooding" (Personal communication, 2022).

These responses suggested either a lack of understanding of the multifaceted nature of disaster management or a gap in planning and BCEHS capacity for disasters, such as floods that have interdependence including staff being able to come to work. By contrast, as Dwyer et al. (2023) suggest, HROs, by embracing complexity in planning, "broaden the scope of causation to include organisational and systemic factors" (p. 3). A disaster management organization or emergency response organization such as BCEHS, to be more aligned with HROs, would engage in complex, nuanced analyses of potential disaster risks that could affect operations, build a culture, and create employment where diverse perspectives are valued, resulting in a complex (not simple) operational environment understanding (Vogus & Welbourne, 2003). This approach could help recognize subtleties that might be overlooked due to oversimplified interpretations of potential problems and their causes and impacts, and the assigning of adequate resources and robust strategies to address them.

Principle 3: Sensitivity to Operations

HROs prioritize an understanding of operations' details and workings and use this knowledge to inform strategic decisions and organizational policies (Enya et al., 2018; Roberts, 1989a, 1989b; Weick & Sutcliffe, 2015), so this priority is built into developing adaptive systems capable of adjusting to situations such as highly complex disasters as well as maintaining situational awareness (Dwyer, Karanikas, & Sav, 2023). Agwu et al. (2019) emphasize the fact that "sensitivity to operations is the HRO characteristic that determines

their responsiveness to the details of their operations" (p. 3). In other words, HROs understand "frontline" operations and integrate this knowledge and expertise into decision making (Vogus & Welbourne, 2003), so the realities of actual operations inform decisions.

Frontline staff perceived the organization as more resilient than leaders. The findings from frontline staff reported higher scores in all the Likert-rated sections of the survey (i.e., resilience, staff engagement, situational awareness, decision making, innovation and creativity, networks, leveraging, knowledge, breaking silos, internal resources, change-readiness, proactive posture, and planning strategies), indicating that frontline staff reported higher scores in all the Likert-rated sections of the survey compared to leaders (see Table 22). For instance, in the category of *situational awareness*, frontline staff had a mean score of 5.77 ± 1.36, higher than leaders who scored 4.23 ± 1.21, with all measured scores showing statistical significance ($p < .05$). Compared to the results of BCEHS leaders who responded to the survey, this could indicate a potential disconnect between frontline staff operational realities and leadership perceptions. Concerns were raised about the responsiveness of BCEHS leadership to operational demands, particularly during the 2021 heat dome.

The findings identified concerns about the responsiveness of BCEHS leadership to operational demands. One example of the seriousness of this concern regarding operational limitations was described in the qualitative section of the survey by one participant who described the response to the 2021 heat dome as, "the closest I've ever seen our organization to complete service failure" (Personal communication, 2022). Concepts related to disasters did not seem to be socialized within the BCEHS operational culture which requires continuous engagement. As one respondent mentioned, "Disasters are not integrated into our daily operations; they are treated as anomalies" (Personal communication, 2022). This frontline knowledge of operations is a key aspect of HROs, which suggests that BCEHS has elements of this characteristic in its organizational culture.

Agwu et al. (2019) note that, “Sensitivity to operations is the HRO characteristic that determines their responsiveness to the details of their operations” (p. 3). In the HRO, the importance of leadership being fully knowledgeable informs the operational challenges faced by frontline staff. These findings suggest that leadership may not be fully aware of these challenges. For instance, as one respondent mentioned, “Leadership often overlooks the day-to-day issues we encounter, making it harder for us to perform efficiently during emergencies” (Personal communication, 2022).

According to Agwu et al. (2019), “HROs maintain a big picture of their processes and mix their awareness and alertness with actions unfolding in real time” (p. 10). This indicates that HROs should be sensitive to operational processes to anticipate and respond to potential failures (Enya et al., 2018; Roberts, 1989a, 1989b). The respondents in the pre-survey indicated a need to stabilize leadership and empower other operation leaders, not just executive leaders (at all levels of BCEHS), to make informed decisions and develop complex leadership capacities for managing disasters, as there are many levels of operations within BCEHS beyond the front line, particularly in the operations of middle management.

Principle 4: Commitment to Resilience

The commitment to resilience in HROs is concerned with maintaining service delivery despite unexpected challenges (Sutcliffe & Vogus, 2003), which involves preparing for known risks and developing the capacity to adapt to unforeseen events (Enya et al., 2018; Roberts, 1989a, 1989b). Not all eventualities can be prepared for, but common elements exist in disruption that can be identified and anticipated. According to Agwu et al. (2019), “Commitment to resilience is concerned with the ability of organisations to not only effectively anticipate errors but also to cope with and bounce back from errors” (p. 3). Similarly, Dwyer et al. (2023) note that “an organisation’s ability to identify errors, contain them and return to normal conditions efficiently” (p. 8).

The findings suggest that BCEHS has challenges in resilience, particularly regarding staffing capacity and low morale. Staffing issues were identified as the highest risk by 88.3% of respondents (see Table 23); this is a potential vulnerability in maintaining operational capacity and, thus, resilience. Although staffing has already been mentioned, it applies here, too, as it is interlinked with resilience. Many respondent noted that "significant staffing issues" affected BCEHS's ability to deliver ambulance services. Low morale among staff further undermines resilience. One respondent said, "I've taken time off for mental health more in the last two years than the entire 19 years previous" (Personal communication, 2022).

These sentiments reflect diminished individual and organizational resilience, highlighting the capacity strains and disasters that have overlapped. The findings showed that BCEHS faced challenges in operational resilience, particularly regarding staffing capacity issues and the reported low morale due to ongoing crises, overlapping disasters, and the capacity of BCEHS staff, which resulted in operational stress.

Despite these challenges in staffing and morale, BCEHS's ability to continue functioning during multiple simultaneous crises, such as the heat dome and the COVID-19 pandemic, demonstrates a level of resilience. This resilience, especially in the context of complex and overlapping emergencies, aligns with the HRO principle of Commitment to Resilience, by maintaining service delivery despite unexpected challenges, such as being short-staffed.

HROs have a commitment to building and maintaining resilience through resource allocation, continuous learning, and adaptability (Weick & Sutcliffe, 2015). In Table 17, the mean score of 6.07 ± 2.00 suggests that respondents generally disagreed with the statement that there are sufficient resources during normal operations. The statistic of 34.4% of respondents strongly disagreeing suggests that BCEHS is resourced even during periods when there is no disaster. However, only 1.2% of participants marked "do not know" (DNK),

suggesting that the majority of respondents had formed an opinion on this question, likely indicating a broad awareness of resource limitations.

Therefore, HROs have greater resilience to known stress, which enables them to withstand unanticipated disruptions and recover while maintaining high levels of safety and reliability. Notably, only 32% of respondents felt that the organization provided adequate training for disaster response (see Table 23), highlighting an area for improvement. Climate change will result in increasing numbers of extreme events and even overlapping disasters (FEMA, 2018) which will only exacerbate the stress and the need for adaptability. Therefore, a disaster-planning process, using evidence of risk-based and adaptive approaches, illustrates the impacts BCEHS operations can consider in their commitment to resilience (Bodas et al., 2020).

Build Back Better

The concept within disaster management of "build back better" is now common (Fernandez and Ahmed, 2019) and is particularly relevant in the context of climate change where it implies adaptive approaches to rebuilding. "Build back better" is described as follows: "To be prepared ahead of a disaster is a critical opportunity to Build Back Better, including through integrating disaster risk reduction" (UNDRR, 2015, p. 14). Although not specifically acknowledged in the literature on HROs, the notion of build back better is consistent with the principles of HROs (Agwu et al., 2019). Thus, HROs can be viewed as a mechanism to incorporate lessons experienced in disasters into operational practices at all levels of an organization to prevent or mitigate future occurrences as an HRO approach to maintaining safety and reliability (Sutcliffe & Weick, 2015).

The findings did not explicitly mention "build back better" strategies. However, the qualitative data revealed a perceived lack of learning from past events and inadequate crisis management strategies. One respondent noted, "Most [strategies] are incredibly outdated, and

there seems to be no learning from past events, as continued crisis management (like for forest fires, which happen every year) seems to be treated as new and [does] not build on the learnings from previous years" (Personal communication, 2022). This indicates that the concept of building back better may not be effectively practiced by BCEHS. This is divergence from HRO principles of integrating lessons learned into improved practices.

According to the literature, leadership is a component in HROs in deference to expertise, where decision making is delegated to individuals with the most relevant knowledge, regardless of their hierarchical position (Agwu et al., 2019; Dwyer et al., 2023; Weick & Sutcliffe, 2001). This distributed approach to leadership allows HROs to make effective decisions during emergencies, even when they deviate from standard hierarchical norms (Agwu et al., 2019).

Along with a lack of internal resources, external resource utilization and collaboration were also strong themes, as was the importance of strong crisis leadership, particularly as it related to the 2021 heat wave. Networking was seen as a critical factor in this regard. According to the survey, 68.9% of respondents agreed that increased networking with external agencies would enhance disaster preparedness (Table 14).

Many of the comments related to leadership during the heat wave addressed understanding the organization's vulnerabilities regarding extreme heat. Another strong theme related to participation in exercises at all levels, from frontline to executive, was viewed as having an obvious gap, so practising response activities and validating plans is necessary. One respondent noted, "Our leadership needs to collaborate more with external organizations to address extreme weather events effectively" (Personal communication, 2022) and another participant stated that "joint exercises with other emergency services would greatly improve our readiness and coordination during actual disasters" (Personal communication, 2022).

Principle 5: Deference to Expertise.

For HROs, deference to expertise involves valuing specialized knowledge expertise over a hierarchical position (Sutcliffe & Weick, 2015), so decisions during critical situations such as disasters are informed by relevant and specialized knowledge, and decisions can be made by the appropriate personnel rather than being based on staff seniority or a hierarchy common to command and control-type organizations (Enya et al., 2018; Roberts, 1989a, 1989b). Deference to expertise enables a response regardless of the organizational rank of the individual possessing that knowledge. Agwu et al. (2019) note that "Deference to expertise shows that HROs rely on a hierarchical structure with clearly defined roles and responsibilities during normal operations" (p. 3). HROs prioritize the expertise of individuals with the most relevant knowledge for the current context, regardless of their position in the organizational hierarchy (Cantu et al., 2020) and decisions regarding disasters are made with the best available knowledge and expertise to increase the organization's effectiveness. Dwyer et al. (2023) found that "Deference to expertise was consistently interpreted by all articles and referenced as shifting decision making to the appropriate person or team when required. Methods included training to establish lines of authority during emergencies and empowering workers to make safety related decisions" (p. 7). This approach aligns with the need for flexible, responsive leadership in complex, high-stakes environments, allowing those with the most relevant expertise to guide actions in real-time.

The BCEHS survey indicated a need for better leveraging of internal expertise and more effective leadership in disaster management. Leaders mentioned the pandemic as a business risk more frequently (72.7%) compared to frontline staff (44.7%), with the chi-square test showing statistical significance ($\chi^2(1) = 5.99$, $p = .014$). This disparity suggests that frontline staff may not be fully engaged in risk-assessment processes, or that they had knowledge that was not shared with leadership, but a disconnect is likely.

Concerns were expressed about leadership not utilizing the expertise of frontline staff: "The experts in a certain crisis are not utilized, and BCEHS has minimal clue about what outside talents/skills the paramedic force holds beyond a medical license" (Personal communication, 2022). This critique pointed to a perceived lack of expertise in leadership decisions during critical situations and a potential unwillingness or lack of understanding of the need for more distributed decision making during an emergency.

As described in the findings, there was a perceived disconnect between the expertise of frontline staff and the decisions made by leadership, such that the insights and practice-based expertise of frontline staff were not generally considered by those in leadership and, hence, critical decisions, especially during disasters, might be missed by the best expert. The differences in perceptions between frontline staff and leaders across the survey findings appeared to indicate that frontline staff with lived experience of daily frontline realities could possess critical insights. This deference to the expertise of those most familiar with operational challenges, if operationalized, aligned with the HRO principle of valuing specialized knowledge, especially in disaster situations. In HROs, critical decisions, especially during disasters, are made with input from those with the most relevant knowledge, regardless of rank (Cantu et al., 2020). For BCEHS, deference to expertise may involve creating structures that empower frontline staff to contribute to decision-making processes.

Summary

The analysis of BCEHS, considering HRO principles, reveals challenges and alignments with the characteristics describing an HRO. As Bourrier (2011) states, HROs are not a given, and "choices and allocations are made which greatly influence the potential to be safe and reliable. These decisions have to be questioned and reflected upon constantly" (p. 12). The findings suggest BCEHS faced difficulties in adapting to overlapping disasters, such as the 2021 heat dome and the COVID-19 pandemic. Participants reported that "we failed to

respond adequately to the recent heat dome crisis and did not appear organizationally to take decisive action until approximately three days after the onset of the crisis," demonstrating the struggle (Personal communication, 2022).

The findings illustrated gaps in certain aspects of BCEHS's choices and allocations of resources that had implications for such critical missions as risk management and disaster planning and approach to disaster risk reduction (DRR) and organizational resilience, particularly in proactive planning, resource allocation, and leadership practices. Issues such as these highlight areas where BCEHS diverges from HRO principles. However, BCEHS also demonstrated some HRO qualities that contribute to safety and reliability, such as its ability to respond to multiple complex disasters and continue to function, albeit with unaddressed issues related to inadequate staffing, lack of effective disaster plans, low morale, and underutilization of frontline expertise.

Although gaps were identified in BCEHS's approach to DRR in the context of climate change, the research suggests that the changes required to improve DRR have yet to be implemented in the organization. This may stem, in good measure, from the identified resistance to change and the sentiment that leadership in the organization has adopted an "it has always been done this way" orientation and management style. Thus, a discussion of the challenges and opportunities for BCEHS in adapting to climate-related disasters follows, along with the conclusion of the study. Practical implications and directions for future research are provided.

Challenges and Opportunities

The research highlights several key functions and characteristics that may be important for BCEHS as it moves forward in an increasingly complex and demanding context. These may be considered both as challenges, inasmuch as they will require organizational changes in leadership, resourcing, and other areas, but also as opportunities to

build on some of the existing capacities and capabilities that participants identified as strengths.

Resource Allocation and Staffing

The first important finding related to resources and the importance of ensuring adequate resources to support preoccupation with failure and commitment to resilience, particularly regarding an adequate number of staff, given the relevance of this for organizational resilience. While planning was viewed as important by many respondents to the survey and the presurvey interviews and focus group, many of the comments and responses of participants indicated that the organization's capacity for planning, and especially proactive planning, was undermined by a perceived lack of resource allocation and availability and the impact of such resource limitations on operational stress and employee morale, which was noted to affect the organization's overall resilience.

Addressing staffing shortages and investing in resources are essential steps toward aligning with HRO principles of preoccupation with failure and commitment to resilience. By ensuring sufficient staffing, BCEHS can enhance its capacity. On the other hand, this research also found that, despite the significant challenges, BCEHS has demonstrated its ability to continue functioning during multiple, overlapping crises (e.g., the heat dome and the COVID-19 pandemic). This resilience suggests that the organization has inherent strengths to build upon. One such strength is the commitment of frontline staff, who reported high levels of operational awareness and adaptability despite resource and staffing challenges (Personal communication, 2022). There is potential for further developing BCEHS's organizational resilience by addressing resource and staffing gaps while leveraging the existing commitment and experience of its personnel.

Embracing Complexity in Disaster Response

A second key finding of this research is the way in which the findings challenge the traditional focus of the "emergency management" theory and practice on a single emergency or disaster. The multiple complex disasters identified in the research (e.g., heat dome occurring during the opioid crises and wildfire smoke season) are consistent with the projections of how disasters will unfold in the context of escalating climate change (Ministry of Environment and Climate Change Strategy, 2019). Organizations such as BCEHS that are on the frontline of responding to the health emergency needs of communities in these complex environments will most certainly continue to face multiple overlapping and cascading disasters. This complex, dynamic situation necessitates a broader understanding of resilience that considers not only the ability to "respond" to multiple simultaneous and intersecting individual events, but also to do so with the capacity to adapt to ongoing changes in society and the environment due to climate change and other increasing pressures (e.g., affordability crises, opioid crises, political divisiveness).

Shifting to an orientation that moves away from oversimplification, BCEHS should adopt approaches aligned with multiple principles of HROs.

1. **Improving disaster planning and response integration.** Findings suggest a need to develop plans and systems for monitoring disaster risk that address not only single disaster events but multiple events, with a built-in iterative cycle, as these would need to be assessed regularly, given the uncertainty and changes associated with climate change. Respondents identified a lack of disaster preparedness during the heat dome, highlighting the need for more complex and detailed planning (Personal communication, 2022) and, in the survey, 14.1% indicated that they were aware of a crisis plan (see Table 25).

2. **Leveraging internal expertise and decentralizing decision making**. The results suggested a shift towards deference to expertise so frontline is more included aligning with HROs (Agwu et al., 2019). Rather than relying on a hierarchical decision-making structure, these findings underscore the importance of empowering frontline staff, including dispatchers, paramedics, and others, so that decisions can be made by those with relevant expertise, irrespective of formal organizational position. This includes climate change adaption activates in disaster planning and preparedness.

   For instance, paramedics' incidents cite local conditions, while dispatchers have a wide overview of incoming patient call volumes and available resources. Additionally, paramedics are empowered for clinical and on-scene management decisions, indicating an existing structure for frontline empowerment by intentionally cultivating management and frontline exchanges of expertise for emergent practices that strengthen adaptive capacity in complex disaster environments.

3. **Building on existing strengths**. Despite the challenges outlined in this study, the organization has also demonstrated strengths in operational resilience. As highlighted in qualitative responses, BCEHS staff showed adaptability and a commitment to patient care, even under extreme stress (Personal communication, 2022). The organization can build on its existing strengths by implementing some or all of the suggestions mentioned above (e.g., improving disaster planning and response integration, and leveraging internal expertise through decentralized decision making).

4. ***Enhancing Training and Preparedness.*** In relation to the role of training and preparation in building organizational resilience, the findings suggest that more disaster preparedness exercises and training at all organizational levels are needed for building organizational resilience. Only **1.8%** of respondents reported that disaster plan rehearsals and testing occurred annually or twice a year. (see Table 27),

indicating a gap in training. As Table 28 indicates, respondents largely disagreed with the statement that "BCEHS is committed to practising and testing its emergency plans to ensure they are effective," with a mean score of 7.07 ± 1.30 (on a scale where 1 = strongly agree and 8 = strongly disagree), and 17.8% of respondents marked "do not know."

5. ***Rehearsing the Training.*** The findings also show a need for increased disaster preparedness exercises at all organizational levels. As Table 18 indicates, resource availability is a concern, but training and continuous learning are critical to building resilience by implementing more frequent drills and simulations for adaptability and proactive decision making, for responding to, preparing for, and recovering from dynamic, evolving situations.

Resilient Organizations

Overall, this research provides an understanding of organizational resilience in BCEHS in the context of climate change-induced disasters and concurrent crises. Although focused on BCEHS, it also offers insights that could be applied in other contexts and organizations, as described by Blanchet et al. (2017), in the wider context of the health sector; "health systems are resilient if they exhibit absorptive, adaptive, or transformational capacity in the face of shocks of different intensity" (p. 434).This research examined how ambulance services can enhance organizational resilience through the application of high reliability organization (HRO) principles for climate change disaster risks that exhibit different intensity.

Organizational resilience, in the context of climate change and disasters, is important for adaptation. Government organizations, due to their hierarchical and often rigid structures, can face challenges in adapting to rapid, overlapping disasters. These organizations, which tend to be more bureaucratic and rule-bound, might struggle to implement flexible, adaptive

strategies that are essential for resilience (Barasa et al., 2018). In the healthcare sector, organizational resilience is not just about withstanding shocks, but is also about the ability to transform and adapt to changing circumstances (Barasa et al., 2018). This concept aligns with high reliability organizations which prioritize learning from near misses and adapting strategies based on lessons learned (Agwu et al., 2019; Enya et al., 2018; Roberts, 1989a, 1989b). In contrast, many government organizations may lack the agility to shift quickly from routine operations to crisis management. The findings suggest BCEHS faced difficulties in adapting to overlapping disasters such as the 2021 heat dome and the COVID-19 pandemic. Participants reported that "we failed to respond adequately to the recent heat dome crisis and did not appear organizationally to take decisive action until approximately three days after the onset of the crisis," illustrating the struggle (Personal communication, 2022).

Although not the focus of this study, morale issues and personal resilience were underlying themes in this research. More research could be undertaken to understand more about what affects morale among ambulance service staff at all levels and to identify mitigative efforts that can be employed before, during, and after disasters, as well as what worsens morale. A resilient workforce could improve the organization's ability to respond and recover. Perhaps, factors that contribute to low morale and stress among staff during disasters could also be a problem and was an emerging theme in this research. In the qualitative findings, low morale emerged due to perceived inadequacies in disaster response and lack of investment in staff (Personal communication, 2022).

An aspect of organizational resilience is the availability of resources. According to Barasa et al. (2018), "the availability of resources is considered a key enabler of organizational resilience" (p. 498). In government organizations, resource allocation can be slow, and this hampers the ability to respond and adapt. And rigid governance structures may hinder decision-making processes during disasters, limiting the organization's ability to adapt

and recover (Barasa et al., 2018,). HROs, on the other hand, demonstrate a commitment to resilience by attempting to recover from failures while maintaining safety and operational reliability (Agwu et al., 2019 Enya et al., 2018; Roberts, 1989a, 1989b).

In the context of climate change, organizations such as ambulance services need to adapt not only to singular events but also to multiple, overlapping crises that increase the strain on resources and operational capacity. As Barasa et al. (2018) highlight, "resilience to acute shocks is enhanced by adequate planning and information management" (p. 498). Participants reported inadequate disaster planning in the survey and qualitative findings. One respondent in particular stated, "We don't have a plan," suggesting a lack of adequate preparation and or resources dedicated to planning. Disaster planning and adaptation are important in ongoing societal and environmental changes due to climate change, where organizations need to move away from oversimplification and adopt more nuanced, complex approaches to disaster risk management (Dwyer et al., 2023). These complexities require organizational resilience strategies that include decentralized decision making and a focus on continuous learning, both of which are central to HRO principles (Agwu et al., 2019; Enya et al., 2018; Roberts, 1989a, 1989b).).

While government organizations may struggle with the rigidity of their structures, lessons from HROs and research on organizational resilience provide valuable insights. This research found that a possible decentralized decision making, including improving leadership practices or deference to expertise in emergent leaders, and continuous learning and disaster exercises mean that organizations like BCEHS could better adapt. For instance, respondents indicated that "there is an obvious disconnect" (Personal communication, 2022). This includes the importance of resource availability, leadership practices, and the ability to learn from past experiences in order to adapt to new, unpredictable challenges (Barasa et al., 2018).

Chapter 6: Conclusion

This chapter concludes this dissertation by providing practical implications for BCEHS and recommendations for future research. This research study examined the impacts of climate change-induced disasters and concurrent crises on the operational resilience of BCEHS. The research was motivated by the increasing frequency and severity of climate-related disasters, such as heatwaves and floods, and the implications for health care services already strained by concurrent challenges, such as the COVID-19 pandemic and the ongoing opioid crisis. It is necessary to shift toward disasters being part of operations and built into ongoing processes rather than considering them as anomalies. This chapter includes some recommendations for consideration by BCEHS or other similar ambulance systems and organizations that face similar challenges in order to move towards greater organizational resilience in this context.

Practical Applications of the Findings

The study may contribute to practical outcomes in policy discussions, decision making, and organizational structures in ambulance out-of-hospital care and climate change adaptation. These contributions could influence academic discourse and real-world policy decisions.

The study addressed a gap in the literature concerning organizational resilience in the context of climate-related and other complex emergencies. Its focus on BCEHS provided a case study. The research question was, “What strategies and structures can best support BCEHS’s organizational resilience and adaptive capacity in the context of climate change-induced and other complex disasters?” In response, the following strategies and structures can be implemented to support BCEHS’s organizational resilience and adaptive capacity in the context of climate change-induced and other complex disasters.

Strategic Adaptation to Climate Change

Strategic adaptation to climate change in the context of climate-related disasters is recommended for BCEHS. The escalating severity and frequency of climate-related disasters, such as wildfires, floods, and heat waves, can affect human health (IPCC, 2023). Therefore, factoring climate resilience into health systems, including infrastructure and organizational resilience, workforce training, and risk management that incorporates climate risk, is crucial (Climate Action Secretariat, 2023; WHO, 2023).

For BCEHS, this implication concerns not only the immediate disaster-response activities but also the building of long-term resilience and the capacity and the systems to absorb the impacts of climate-related disasters in order to continue to function. Organizations such as BCEHS must reduce disaster risks by incorporating an understanding of the nature of complex, cascading, and intersecting disasters, and integrating this understanding into daily operations rather than siloing this knowledge within one "arm" of the organization, and/or continuing to work under the premise that disasters happen individually and separately. Thus, BCEHS must ensure that facilities, ambulances, and other physical assets are equipped and built for the complex demands that are characteristic of escalating climate-induced disasters (e.g., extreme weather events, extended, and more extreme wildfire seasons). Further, the organization must ensure that its staff are trained and prepared for these challenges and that there are adequate staffing levels to prevent, or, at least, lessen burnout and low morale. At the organizational level, proactive risk assessments, including integrated disaster- and climate-related risk assessments, must be enacted, and the findings from such assessments be integrated into operational plans and strategies and management models. Given the evolving nature of these demands, BCEHS also needs to adopt an adaptive orientation and management style that can respond to various climate disaster scenarios and the complex of other intersecting disasters, such as the opioid crises currently underway in BC.

Recommendations

1. *Staffing Shortages and Resources for Capacity During Disasters*

HRO Principle: *Preoccupation with failure* involves continuously identifying and addressing potential weaknesses to prevent operational failures. For BCEHS, staffing shortages are a vulnerability that can lead to failure; proactive measures are necessary to maintain core services before, during, and after a disaster.

Operationalization at BCEHS

- Conduct a staffing needs assessment: Evaluate current staffing levels against demand during various disaster scenarios.
- Disaster staffing strategies: Develop a reserve pool of personnel for emergency deployment and introduce phased staffing before, during, and after disasters.
- Allocate resources for surge capacity: Have additional equipment and supplies (e.g., vehicles, medical, and communication supplies) available for disaster.
- Explore innovative staffing models: Expand and introduce alternative care options, such as telemedicine support and community-based initiatives.
- Develop surge capacity plans: Create strategies for scaling up operations, including support roles (scheduling, ambulance cleaning) and essential positions like paramedics, dispatchers, and supervisors.

Related Findings. A high reported prevalence of staffing concerns was evident, with 88.3% of respondents identifying staffing issues as a top risk (Chapter 4, Table 23). Findings suggest that insufficient staffing hindered BCEHS's ability to prepare, respond, and recover effectively from disasters, posing a risk of potential service failures (Chapter 5, Discussion, Principle 1). Persistent staffing issues at the time of research limited the organization's capacity to handle increased service demands from disasters like the heat dome (Chapter 5,

Challenges and Opportunities). Staffing shortages were reported to have contributed to low morale among staff, undermining resilience (Chapter 4, Theme 2).

Develop Comprehensive Disaster Plans for Complexity and Enhance Collaboration with External Complementary Agencies

HRO Principle: *Reluctance to simplify* indicates that the danger of not considering the complexities of operations through oversimplification increases risk. For BCEHS, this principle underscores the need to develop disaster plans for the entire health system that account for coordination with first responders during overlapping disasters, such as complex climate change events, pandemics, opioid crises, and chronic healthcare staff shortages.

Operationalization at BCEHS.

- Disaster plans: Address overlapping and cascading disasters by integrating insights from emergency management, healthcare, and other disciplines across all organizational levels, including frontline staff.
- Conduct risk assessments: Identify and evaluate potential disaster risks to adapt plans to evolving threats.
- Formalize and adopt mutual aid agreements: Establish mutual aid with fire departments and other external agencies such as the military during disasters.
- Create joint disaster protocols: Coordinate with external agencies (health partners, first responders, and non-government organizations) during responses before and after disasters; develop and train together to implement strategies with external partners.

Related Findings. Limited awareness of existing plans was reported, with only 42% of respondents aware of a disaster plan and 47% believing existing plans were insufficient (Chapter 4, Table 25). The need for complex planning approaches due to lack of preparedness for multifaceted disasters was highlighted (Chapter 5, Discussion, Principle 2). High “do not know” responses related to infrastructure preparedness suggest oversimplification of

operational challenges (Chapter 4, Tables 26, 20, 15). Staff comments indicated inadequate preparation; respondents stated, “We don’t have a plan” (Personal communication, 2022; see Chapter 5, Discussion, Principle 2). Insufficient interagency collaboration was reported to have impacted effectiveness (Chapter 4, Theme 6). High uncertainty about networking efforts was noted, with many unsure about networking with external partners (Chapter 4, Table 14). The importance of joint disaster exercises was emphasized (Chapter 5).

3. Increase Training, Preparedness, and Situational Awareness

HRO Principle: *Sensitivity to operations* involves maintaining detailed awareness of operational systems and environments. For BCEHS, enhancing training, education, and preparedness improves staff awareness of processes and readiness to respond, recover, and prepare for operational risks before and after disasters. Data display systems like dashboards provide accessible data on what is happening and where they are, for all staff.

Operationalization at BCEHS.

- Disaster training and education: Develop and offer education focused on various disaster risks (e.g., climate, seismic).
- Rehearse training with drills and exercises: Implement disaster drills and exercises at all organizational levels.
- Improve real-time monitoring systems: Develop metrics and measures that provide near real-time situational awareness of internal capacity and external threats (e.g., staffing levels, available vehicles, supply chain).
- Integrate data into geographical information systems (GIS): Utilize GIS to map disaster impacts and current operating pressures.
- Implement real-time monitoring tools and advanced data analytics: Enable proactive identification of threats and support informed decisions.

Related Findings. Low frequency of plan rehearsals was reported, with only 1.8% of respondents participating in rehearsals of disaster plans (Chapter 4, Table 27). There was a reported need for enhanced situational awareness, emphasizing the importance of accessible disaster plans and real-time information (Chapter 5, Principle 3). High "do not know" responses on infrastructure preparedness indicated a lack of confidence in existing systems (Chapter 4, Table 26). A disconnect between leadership and frontline staff was suggested, indicating gaps in operational sensitivity (Chapter 5, Principle 3). Poor communication during disasters was reported to have led to confusion (Chapter 4, Theme 9). Staff struggled to locate disaster plans, highlighting the need for better access (Chapter 4, Theme 13).

4. Decentralize Decision Making to Leverage Frontline Expertise and Develop Leadership

HRO Principle: *Deference to expertise* involves consulting knowledgeable individuals, regardless of hierarchical position. For BCEHS, decentralizing decision making across all levels leverages frontline staff expertise, and developing adaptive leadership models addresses complex disaster scenarios before, during, and after events.

Operationalization at BCEHS.

- Decentralized decision-making structures: leveraging expertise across the system regardless of position and includes involving frontline staff in decision making during disasters.
- Leadership training on adaptive leadership: Provide or adopt education focused on adaptive decision making across all organizational levels.
- Promote distributed leadership models: Share decision-making authority across levels and establish leadership mentorship programs.

5. **Incorporate frontline expertise into policy development**: Create working groups and committees with appropriate authorities and staff at all levels to develop policies

and disaster plans. A possible mechanism for this might include a frontline advisory or working group that can work with leadership to offer expertise and insights on a regular basis.

Related Findings. A disconnect between leaders and frontline staff was reported: leaders identified the pandemic as a major risk more frequently than frontline staff (Chapter 4, Table 31). The perception of staff showed statistical significance for all measured categories; frontline staff rated leadership, staff engagement, situational awareness, decision making, innovation, creativity, networking, knowledge leverage, breaking silos, internal resources, change-readiness, proactive posture, and planning strategies more positively than leaders, who perceived higher risks ($p < .05$). Underutilization of frontline expertise was suggested, with leadership not fully leveraging frontline knowledge (Chapter 5, Principle 5). Leadership was reported to often overlook frontline challenges: "Leadership often overlooks the day-to-day issues we encounter" (Personal communication, 2022; see Chapter 5, Principle 3). Staff engagement and empowerment were lacking, essential for HRO, but currently insufficient (Chapter 4, Theme 10). Ineffective leadership during crises was noted during the 2021 heat dome (Chapter 4, Theme 5). There was a reported need for leadership to integrate frontline insights, highlighted in leadership discussions (Chapter 4, Table 31).

6. Integrate HRO principles into operations and workforce resilience

HRO Principle: *Commitment to resilience* entails the ability to adapt, recover, and learn from events and errors. For BCEHS, integrating HRO principles into operations and focusing on workforce resilience strengthens the organization's capacity to handle disasters and improves overall adaptability before and during recovery.

Operationalization at BCEHS.

- Embed HRO principles into organizational culture: Incorporate into training, policies, and daily operations.

- Regularly review and update policies: Reflect best practices and address emerging risks.
- Provide ongoing HRO training and development: For disaster preparedness and response, recovery and mitigation.
- Identify and scale successful practices: Expand effective disaster capabilities across the organization.
- Encourage innovation in response strategies: Create avenues for staff to propose and implement solutions.
- Implement and expand employee support programs: Focus on mental health, stress reduction, and morale-building strategies.
- Establish recognition and reward systems: Acknowledge staff contributions before and after disasters.
- Promote open communication and feedback: Build trust, address concerns, and encourage continuous learning.

Related Findings. Partial alignment with HRO principles was observed, with gaps indicating a need for further integration (Chapter 5, Summary). Recognition of operational resilience was demonstrated during multiple crises (Chapter 5). Lack of continuous policy improvement was reported; policies were outdated and did not incorporate lessons from past disasters (Chapter 5). Divergence from HRO principles was evident, with a lack of proactive planning, suggesting the need for HRO integration (Chapter 4, Themes 1–14). Low morale and high burnout were reported, with 96 negative comments related to morale recorded (Chapter 4, Theme 2). Staffing issues were suggested to have impacted morale, increasing stress levels (Chapter 5, Principle 4). Expressions of burnout included staff taking time off for mental health reasons (Chapter 5, Principle 4).

Recommendations for Future Research

1. ***Inclusive Research Practices and Diverse Perspectives***

Future studies could include a broader range of demographics, such as different genders, Indigenous peoples, and diverse sexual orientations, to understand how various perspectives influence experiences of disasters within ambulance services.

Related Findings.

The current study categorized respondents as male (62%) or female (38%) and as frontline staff (86.5%) or leaders (13.5%) (see Demographics in Chapter 4). The survey did not include options for non-binary or other gender identities, which may have limited the diversity of perspectives within BCEHS.

2. ***Enhancing Capacity and Managing Demand During Disasters***

Future studies could explore practical solutions, alternative service models, or ethical decision making in disasters when resources are insufficient even if planned for. Research could focus on increasing capacity or managing the demand on ambulance services during disasters. Potential areas of study include optimizing resources to reduce system strain, evaluating innovative staffing models, telemedicine, automated dispatch systems, community-based initiatives, and the use of AI.

Related Findings.

Staffing concerns were identified as a top risk, with 88.3% of respondents selecting staffing issues as one of the highest risks leading to a crisis (Table 23). Findings suggest that insufficient staffing hindered BCEHS's ability to prepare, respond, and recover effectively from disasters, posing a risk of potential service failures (Chapter 5, Discussion, Principle 1, Chapter 5, Challenges and Opportunities).

3. ***Morale Issues and Disasters***

Further studies could investigate morale among ambulance and health care. Research could focus on factors contributing to low morale and stress among staff during disasters and

interventions that improve upon these issues to build a more resilient workforce before, during, and after disasters.

Related Findings.

Low morale and high burnout were reported, with 96 negative comments related to morale recorded (Theme 2 in Qualitative Findings). Staffing shortages were suggested to result in increased stress levels among staff (Chapter 5, Principle 4). Expressions of mental health issues included staff taking time off due to stress and burnout (Chapter 5, Principle 4). Lack of staff engagement and empowerment—essential elements for resilience—were reported as lacking, affecting morale (Theme 10 in Qualitative Findings).

Limitations of the Study

BCEHS was the sole focus of the research as a single case study, limiting generalizability and the potential for comparison across ambulance organizations. Additionally, the survey was cross-sectional, providing perceptions obtained at a specific point in time. The fact that this study occurred during the COVID-19 pandemic and other disasters may have influenced the perceptions and findings. This context-specific factor means that any changes in BCEHS initiatives implemented after the data were gathered are not considered in this study, impacting its relevance to post-research conditions.

Sample Details

- **Total Population (N):** 4,388 (2021, BCEHS)
- **Sample Size (n):** 163 survey respondents and three (3) interview and focus group participants
- **Response Rate (survey):** 3.7% (163/4,388)

Population (N): 4,388 (total staff at BCEHS), and the sample size (n): 163 survey respondents and three interview participants. This represents approximately 3.7% (163/4,388) of the total staff, which is relatively low for survey-based research.

In this qualitative research, the interviews included only three participants, which is very small for a single case study. Marshall et al. (2013) suggest that qualitative interviews often require 15 to 30 participants to reach data saturation. In this research, the small number of interviews limits the depth and breadth of insights gathered, making it difficult to argue that the findings are robust enough to generalize about the broader BCEHS staff (Marshall et al., 2013).

Additionally, there was potential response bias based on the self-selection of participants. The sample size of 163 survey respondents and three interview and focus study participants out of the 4,388 total BCEHS staff (BCEHS, 2021) represents a 3.7% response rate, which can be considered low (Bartlett et al., 2001). This small percentage could lead to non-response bias, meaning that those who were in this research might not be representative of BCEHS's wider population of staff. Employees experiencing poor morale or a desire to express dissatisfaction may have been more likely to participate. Alternatively, those who are interested enough to want to create change may have been more likely to participate., potentially skewing the result. Although valuable insights were obtained, caution is needed in interpreting the findings.

Recommendations for Implementation

Some recommendations, such as conducting risk assessments on disaster risks, incorporating identified disaster risks into planning, or establishing a policy and planning working group with a wide range of participants from frontline to management, do not require substantial capital investments and can be implemented. By contrast, increasing frontline staffing capacity will need funding from multiple levels of government, including those who have been elected, and adjusting decision-making models for disaster responses would require system-wide changes in management structures.

From a practical standpoint, moving BCEHS toward HRO will involve both small-scale efforts—such as enhanced training, risk assessments, and multi-agency exercises—and larger, more resource-intensive initiatives, including staffing expansion and adopting new governance models for disaster decision making.

Contribution to Scholarship

This study integrates disciplines, complexity, organizational behaviour, disasters and climate change, and ethics, within a pragmatist framework. The synthesis of these various fields represents a scholarly contribution regarding complex challenges in the context of out-of-hospital care ambulance organizations, in relation to disasters. With a mixed-methods design, this approach enables the examination of multifaceted issues in social sciences.

The study contributes to theory by extending the application of pragmatism in interdisciplinary settings while offering new perspectives for understanding organizational resilience and adaptability, particularly in ambulance services and climate change contexts in disasters. It illustrates the importance of experience, adaptability, and the testing of ideas in real-world conditions (Dewey, 1929; James, 1907).

Out-of-hospital ambulance care requires more research on disasters in the context of a changed climate. Pragmatism enables a focus on what works in specific contexts rather than adhering to rigid theoretical frameworks. This study highlights the practical application of organizational resilience and adaptability, offering new theoretical perspectives that extend beyond traditional day-to-day approaches to emergency health services and out-of-hospital care provided by ambulances and dispatch. It provides an understanding of resilience in ambulance services and how organizations can practically adapt to the complexities introduced by climate change and disasters that have typically been atypical.

Final Thoughts

I hope this research has provided new insights into ambulance services' system resilience and adaptive capacity within British Columbia, and within the context of climate change and the related disaster risks. The focus on BCEHS revealed potential operational adjustments and organizational strategies that, if enacted, would likely enhance organizational resilience.

The use of high reliability organization principles and complexity theory in the analysis offers insights into core issues affecting BCEHS and offers ideas on the ways that the organization might improve key dimensions of resilience, such as situational awareness, disaster planning, and disaster preparedness, proactive learning, effective leadership, and adaptive strategies. The application of high reliability organization principles in this study addresses the resistance to simplifying complex issues. As Schipper et al. (2021) note, "for complex scientific findings to be summarized into single sentences for policy briefs…fail[s] to do justice to the messiness of climate change impacts" (p. 2) and "pressure for concrete, urgent, and actionable information often leads researchers to shear away detail, and pick one of a number of alternative messages to unite behind" (p. 2).

As a prior practicing paramedic at BCEHS, and now a leader in disaster management within the organization, I have witnessed the complexities of disasters, and the demands of climate-related risks placed on out-of-hospital care. This research has deepened my appreciation of BCEHS staff and their capacity to operate in ever-challenging conditions of disasters.

Looking ahead, I hope this study's insights and recommendations will contribute to a more resilient and adaptive BCEHS. I also hope that this research will benefit other similar government and ambulance organizations in an increasingly uncertain world where we are rethinking how climate change and disasters are incorporated into ambulance and health systems.

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Appendix A: Interview Guide

Questions on Complexity:
This research focuses on adaptive resilience, which refers to the ability of a complex organization such as BC Emergency Health Services to adapt to complexity, including challenges such as COVID-19 and climate change. How will these changes either benefit or hinder the organization's experience with COVID-19 and future impacts of climate change?

The first step is to take care of the consent forms. Please read and feel free to ask any questions you may have. If you are willing, please sign the consent form, and we will begin. I will now activate the recorder for transcript purposes only, and it will be destroyed after the interview.

Interview Start:
Emerging crises, such as the COVID-19 pandemic, have altered norms in many ways and can impact both personal lives and the organizations we work in. This pandemic and our responses to it serve as examples of complex problems that require complex, adaptive thinking for effective management. Complex problems like the pandemic often lead to nonintuitive, emergent, and sometimes unanticipated consequences in interconnected systems. In this case, these systems include global social, ecological, financial, and political structures.

While the COVID-19 pandemic is not directly caused by climate change, the effects of climate change on species habitats and the increasing migration to and concentration of people in urban areas are significant contributing factors to the emergence of such viruses and pandemics.

This research aims to explore how organizations deal with complexity and the intersecting complex problems that will arise from climate change and other crises, such as the COVID-19 pandemic. The goal is to contribute to a shared understanding of climate and disaster resilience within BCEHS and enhance its adaptive capacity.

Questions:
1. To begin, please share your experiences since the pandemic started.
2. What changes have occurred in your work and within the organization due to COVID-19? Please provide specific examples and elaborate by asking follow-up questions:
    a. What specific changes have taken place?
    b. How have these changes affected your work?
    c. How have these changes impacted you personally?
    d. How have these changes affected the organization?
    e. What observations have you made regarding these changes?
    f. How have both you and the organization adapted to these changes?
3. Have there been any changes or lack of changes that have not been successful? Please explore any unanticipated consequences.

4. Have there been any changes that surprised you? Again, consider unanticipated changes and consequences.

5. Can you provide examples of adaptive responses to COVID-19 that you have witnessed or been involved in during the pandemic? Please break down each example with subsequent prompts:

a. Describe how this response occurred.
b. Who initiated this response?
c. What processes or decisions supported this response?
d. Did anything surprise you about this response?
e. Do you believe this adaptation should continue post-pandemic, and if so, why?
f. What aspects of this response make it adaptive?

6. Generally speaking, based on your experiences, how does BCEHS adapt to change?

a. Is adapting to change a cultural aspect of BCEHS?
i. If yes, please explain.
ii. If no, please explain.
b. How are these changes implemented? (Consider whether they originate from frontline staff or top-down management.)
c. What systems or practices contribute to sustaining these changes?

7. When considering COVID-19 and other complex challenges BCEHS may face, what changes do you believe would enhance the organization's resilience to disasters and climate change?

• Are there recommendations for executive engagement?

8. What do you anticipate will be the long-term consequences of COVID-19 for BCEHS, such as impacts on the organization, changes in practices, funding, policies, or any current consequences you observe?

9. In the context of COVID-19, research suggests that managing the crisis involves integrating real-time learning and an adaptive approach that can respond flexibly to changing circumstances. Would you describe BCEHS as an organization that adopts this approach?

a. If so, provide an example and describe how it worked, including policies, leadership, and other supporting factors.
b. If not, what do you believe prevents or limits this approach in BCEHS?

10. How well does BCEHS deal with uncertainty and surprises, and what improvements could enhance this capability?

11. What, in your opinion, would make a difference in terms of BCEHS's ongoing and future resilience in the context of the pandemic and other complex challenges like climate change?

a. What individual capabilities would contribute to this resilience?
b. What system-wide capabilities would contribute to this resilience?
• What challenges might hinder this resilience?
• Can you describe how your proposed changes would work, including implementation and adaptability to future stresses and challenges?

12. Looking ahead to the extended response to the COVID-19 pandemic, what do you believe still needs to be done? What additional support does the organization require in managing this crisis?

13. Is there any other information you believe would be helpful for me to know that I have not yet asked about? Thank you for your time. I will transcribe this interview and review it along with others. If I require further clarification or have additional questions, may I follow up with you? If so, please provide your up-to-date contact information and preferred form of contact.

Appendix B: Focus Group

Prefocus group questions for approximately 30 minutes, individually

This research is about adaptive resilience—that is, the ability of a complex organization such as BC Emergency Health Services to adapt to complex situations, including COVID-19 and climate change. How will these changes benefit or hinder the organization's lived experience of COVID-19 or the future impacts of climate change?

The first step is to take care of the consent forms. I need to confirm you've signed one. I will turn on the recorder now. The recording is for transcript purposes only, and it will be destroyed after transcription.

Questions for individuals regarding timeline:

1. Looking at your timeline, what do you observe? Is there anything that becomes evident to you?
2. Can you tell me more about why you put these items on your timeline and what they mean?
3. Looking back, in terms of your path from awareness to concern to action, what have you noticed about the process? About yourself in the process?
    a. What specifically would you identify as helping you to understand the need and the direction?
    b. What do you think would support others' understanding of how complex challenges such as COVID and climate change require change in systems, policies, practices?
    c. What do you think prevents others' understanding of how complex challenges such as COVID and climate change require change in systems, policies, and practices?
    d. In an ideal world, from where would BCEHS get more support?

Questions for focus group:
November 6th for 2.5 hours
This research is about adaptive resilience—that is, the ability of a complex organization such as BC Emergency Health Services to adapt to complex situations, including COVID-19 and climate change. How will these changes benefit or hinder the organization's lived experience of COVID-19 or the future impacts of climate change?

1. What do you think has been achieved in the months and years leading to this point that has prepared BCEHS for COVID and the future impacts of climate change?
2. Is there such a thing as an ultimate state you want BCEHS to achieve in order to be prepared for and able to respond effectively to such challenges?
3. How have any of the changes already implemented impacted BCEHS capacity and readiness to meet the challenges of COVID-19? Of climate change?
    a. What might be some measures/indicators of success?
    b. What do you consider as the biggest challenge, and how do you tackle it?
    c. Why is it so important for BC Ambulance to change in regards practice/policy/systems in the context of climate change?

    d. How do you understand systems transformation in the context of climate change?
    e. Looking at the system as a whole, or other public systems, what do you see as the most urgent need or gaps when it comes to being prepared and resilient in the context of climate change?
4. Based on your experience to date, what would you advise other organizations to understand or implement to achieve preparedness and resilience in the context of climate change?
5. What changes have taken place in the work you do and in the organization due to COVID-19? [get specific concrete examples and work a few by asking subsequent prompts]
    a. What specifically has changed?
    b. How has this impacted the work you do?
    c. How has this impacted you personally?
    d. How has this impacted the organization?
    e. What have you observed about this change?
    f. How have you and the organization adapted to these changes?
6. Have there been any changes or lack of changes that haven't gone well? [explore unanticipated changes and/or consequences]
7. What, if any, changes have surprised you? [explore unanticipated changes and/or consequences]
8. What are some examples of adaptive responses to COVID-19 that you have observed or participated in during the pandemic? [unpack with subsequent prompts for each example]
    a. Can you describe how this response happened?
    b. Who prompted this response?
    c. What process or decisions supported this response?
    d. What if anything surprised you about this response?
    e. When you think about this adaptation, do you believe it is something that should be carried forward post pandemic?
    f. What about this response makes it adaptive?

If I have further questions or need some clarification of one of your responses, are you okay with me following up with you?

Appendix C: Timeline Instructions

Case Study for Doctoral Research
In preparation for the in-depth interview.
This research is about adaptive resilience—that is, the ability of a complex organization such as BC Emergency Health Services to adapt to complex situations, including COVID-19 and climate change. How will these changes benefit or hinder the organization's lived experience of COVID-19 or the future impacts of climate change?
The following exercise will inform the focus group questions.
Visual methods and questions
Exercise #1: Timeline mapping
My objective for the timeline mapping exercise is to understand the following:
1. Identify the timeline of change that you observed/participated in—key elements/approx. or actual dates
2. The triggers and process steps that led you from change awareness (awareness of the need) to action
3. To identify what (e.g., policies, systems, people/positions, resources, the way in which you framed it to others) supported or prevented/limited any of the changes or key events you identified
4. Opportunities or barriers to the change
5. Anticipated or actual outcomes of the change

Instructions for Participants
I would like you to draw a timeline map that marks the important decision points starting from when you became aware and concerned about the way in which BC Ambulance was preparing for or responding to complex events such as COVID-19/climate change, until now. Each decision point or change can be mapped on the top of the timeline if viewed as positive—moving in the desired direction; each decision point or change can be mapped on the bottom of the timeline if viewed as negative—preventing a move in the right direction or returning to a practice that is not aligned with the right direction.
Once mapped on the timeline, for each key decision point or change, detail considering the above points #2, #3, and #4.
You can use (draw) one timeline to map all of the above or, if you find it easier, use (draw) three parallel timelines:

1. On the first line, please draw **defining milestones**
   - key points along the journey—from awareness to action/changes
2. On the second line, please draw the **resources, people, systems, policies etc.** that facilitated the evolution
3. On the third line, please indicate when you encountered **opportunities**, **barriers, and challenges**.
4. Identify anticipated or actual outcomes of any significant change/event below the timeline, linking it to the relevant change/event.

Time: Please take time to draw the timeline and send to me prior to the focus group interview for review. The focus group interview will take approximately 2–2.5 hours.

Appendix D: Survey Questions with Introduction and Layout

***Invitation:**
You are being asked to participate in a survey focused on understanding and enhancing organizational resilience in BCEHS. This research is led by Brooks Hogya as part of his doctoral research at Royal Roads University.

Participation:
Participating in this survey is completely voluntary, and you can decide to withdraw without any penalty or repercussions. Your comments and ideas will be anonymous and confidential if you decide to participate. You are also free to decline to answer any particular question in the survey.

Time involved:
Completing the survey should take you approximately 20 minutes.

Confidentiality & Anonymity:
Your survey answers will be gathered in the CheckBox platform and aggregated such that all responses are anonymous. The CheckBox platform maintains strict security protocols and uses a server in Canada. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study. Your answers will inform the development of a report for BCEHS and may be shared in academic publications or conference proceedings; however, no personal or identifying information will be shared in any of these outputs, nor used to attribute any comments to you.

Withdrawal:
You are free to withdraw from this study at any time, however, there are some limits on the withdrawal of the information you share. Information entered and submitted into the CheckBox platform in response to the survey will form part of the aggregated data set and cannot, therefore, be withdrawn.

Benefits:
You will receive no direct benefits from participating in this research study. However, your responses will contribute to a better understanding of resilience in BCEHS and inform recommendations on how resilience might be improved.

Risks:
There are no foreseeable risks involved in participating in this study.

Contact:
If you have any questions or concerns regarding this project or your participation in it, or you have complaints that you wish to address you may contact either:

1) the Research Office at Royal Roads University at 250-391-2600;
2) Brooks Hogya – Brooks.Hogya@royalroads.ca
3) You may also contact Dr. Robin Cox at 250-391-2600, extension 4855 or by email at robin.cox@royalroads.ca at any time.

ELECTRONIC INFORMED CONSENT

Please select your choice below. By indicating that you agree to participate, you are confirming that you:

(1) understand the project and the reason for this survey;
(2) have read the information provided above and understand your rights as they pertain to this research; and
(3) are 18 years of age or older and able to give your informed consent.

It is recommended that you print a copy of this consent form for your records.

- **O** Agree
- **O** Disagree

Are you?

- **O** Male
- **O** Female
- **O** Other:

What is your age?

- **O** 20 or under
- **O** 21-30
- **O** 31-40
- **O** 41-50
- **O** 51-60
- **O** Over 61

Which of these levels best describes your position within your organisation?
(please tick one)

- **O** Frontline - Dispatch
- **O** Frontline - Patient care and delivery
- **O** Supervisor (UC, Charge etc.)
- **O** Senior leader
- **O** Leader (manager, project manager, etc.)
- **O** Staff (admin, support services, etc.)

What is your job title?

[ ]

How long have you worked in healthcare?

- **O** less than 1 year
- **O** 1-3 years

- O 4-10 years
- O 11-20 years
- O More than 21 years

How long have you worked at BCEHS?

- O Less than 1 year
- O 1-3 years
- O 4-10 years
- O 11-20 years
- O More than 21 years

Resilience is the ability of an organisation to survive a crisis and thrive in a world of uncertainty. Resilience consists of three interdependent attributes:

(1) Leadership and Culture
(2) Networks
(3) Change-Ready processes that build Business as Usual (BAU) effectiveness as well as robust and agile response and recovery from crises.

1 Leadership and Culture

The first part of this section asks about the adaptive capacity of the organisation created by its leadership and culture. There are five indicators of organisational resilience that fall under the Leadership and Culture attribute – these are:

- Leadership
- Staff Engagement
- Situation Awareness
- Decision Making
- Innovation and creativity

If you don't know the answer to any of the questions, please choose the “Don’t Know” answer.

Leadership: Strong crisis leadership to provide good management and decision making during times of crisis, as well as continuous evaluation of strategies and work programs against organisational goals.

	To what extent do you agree or disagree with the following statements? Strongly Agree Strongly Disagree 1 2 3 4 5. 6. 7 8	Don't Know
There would be good leadership from within our organisation if we were struck by a crisis		
In a crisis, staff accept that management may need to make some decisions with little consultation		
Our managers monitor staff workloads and reduce them when they become excessive		
Our management think and act strategically to ensure that we are always ahead of the curve		
Management in our organisation lead by example		
Our organisation regularly re-evaluates what it is we are trying to achieve		

Staff Engagement: The engagement and involvement of staff who understand the link between their own work, the organisation's resilience, and its long-term success. Staff are empowered and use their skills to solve problems.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know
People in our organisation feel responsible for the organisation's effectiveness		
People in our organisation are committed to working on a problem until it is resolved.		
Our organisation's culture is to be very supportive of staff		
Our organisation has high staff morale		
Staff know what they need to do to respond to a crisis		

Situation Awareness: Staff are encouraged to be vigilant about the organisation, its performance, and potential problems. Staff are rewarded for sharing good and bad news about the organisation including early warning signals, and these are quickly reported to organisational leaders.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know
We proactively monitor our industry to have an early warning of emerging issues		

We learn lessons from the past and make sure those lessons are carried through to the future		
Staff interact often enough to know what's going on in our organisation		
Our managers actively listen for problems		
We are mindful of how the success of one area of our organisation depends on the success of another		
Staff feel able to raise problems with senior management		

Think of the overall highest risks that could lead to a crisis for your organisation, and please tick the top 5 in the list below:

- ○ Climate change
- ○ Pandemic
- ○ Loss of critical services (e.g. electricity, water, gas, telecommunications)
- ○ Reputation damage
- ○ Fraud
- ○ Major accident (e.g. bus crash) or fire
- ○ Regulatory changes
- ○ Failure of a key supplier
- ○ Staffing issues
- ○ Financial crisis
- ○ Information security breach
- ○ Technological change
- ○ Contamination (e.g. toxic chemical spill)
- ○ Litigation
- ○ Terrorism

- ○ Flooding
- ○ Wildfire
- ○ Drought (water shortage)
- ○ Severe weather (e.g. heat, tornado)
- ○ Tsunami
- ○ Volcanic activity
- ○ Landslides
- ○ Earthquake
- ○ Other:

Decision Making: Staff have the appropriate authority to make decisions related to their work, and authority is clearly delegated to enable a crisis response. Highly skilled staff are involved, or are able to make decisions, where their specific knowledge adds significant value, or where their involvement will aid implementation.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know
Should problems occur, staff have direct access to someone with authority to make decisions		
We can make tough decisions quickly		
In our organisation, the most qualified people make decisions, regardless of seniority		

Innovation and Creativity: Staff are encouraged and rewarded for using their knowledge in novel ways to solve new and existing problems and for utilising innovative and creative approaches to developing solutions.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know
Staff are actively encouraged to challenge and develop themselves through their work		
We are known for our ability to use knowledge in novel ways		
Staff are rewarded for "thinking outside of the box"		

2 Networks

The second part of this section asks about the internal and external relationships fostered and developed by your organisation that it can leverage when needed. There are four indicators of organisational resilience that fall under the Network attribute:

- Effective Partnerships
- Leveraging Knowledge
- Breaking Silos
- Internal Resources

Effective Partnerships: An understanding of the relationships and resources the organisation might need to access from other organisations during a crisis, and planning and management to ensure this access.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know
In a crisis, we have agreements with other organisations to access resources from them		
We have planned for what support we could provide to the community in a crisis		

We build relationships with others we might have to work with in a crisis		
We understand how we are connected to other organisations and actively manage those links		
We understand how government actions would affect our ability to respond in a crisis		

Leveraging Knowledge: Critical information is stored in a number of formats and locations and staff have access to expert opinions when needed. Roles are shared and staff are trained so that someone will always be able to fill key roles.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know
Staff have the information and knowledge they need to respond to unexpected problems		
If something out of the ordinary happens, staff know who has the expertise to respond		
Critical information is available by different means and from different locations		
If key people are unavailable, there are always others who could fill their role		

We readily obtain expert assistance when there's a problem		

Breaking Silos: Minimization of divisive social, cultural, and behavioural barriers, which are most often manifested as communication barriers creating disjointed, disconnected, and detrimental ways of working.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know
Staff are encouraged to move between different departments or try different roles to gain experience		
There is a sense of teamwork and camaraderie in our organisation		
There are few barriers stopping us from working well with other organisations		
We work with others regardless of departmental or organisational boundaries to get the job done		

Internal Resources: The management and mobilisation of the organisation's resources to ensure its ability to operate during business as usual, as well as being able to provide the extra capacity required during a crisis.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know

We have sufficient internal resources to operate successfully during business as usual		
Our organisation maintains sufficient resources to absorb unexpected change		
When a problem occurs, it is easier to get approval for additional resources to get the job done		

3 Change-Ready

The last part of this section asks about the planning undertaken and direction established to enable your organisation to be change ready. There are four indicators of organisational resilience that fall under the Change-Ready attribute:

- Unity of Purpose
- Proactive Posture
- Planning Strategies
- Stress Testing Plans

Unity of Purpose: An organisation-wide awareness of what the organisation's priorities would be following a crisis, clearly defined at the organisation level, as well as an understanding of the organisation's minimum operating requirements.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know
We have clearly defined priorities for what is important during and after a crisis		
Our priorities for recovery would be sufficient to provide direction for staff in a crisis		

We understand the minimum level of resources our organisation needs to operate		
We are mindful of how a crisis in our organisation would impact others		
Our organisation consistently demonstrates commitment to its values		

Proactive Posture: A strategic and behavioural readiness to respond to early warning signals of change in the organisation's internal and external environment before they escalate into crisis.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know
We have a focus on being able to respond to the unexpected		
We are able to collaborate with others in our industry to manage unexpected challenges		
We are able to shift rapidly from business-as-usual to respond to crises		
Whenever our organisation suffers a close call, we use it for self-evaluation rather than confirmation of our success		

We are regarded as an active participant in industry and sector groups		
Our organisation readily responds to changes in our business environment		
In a crisis, we seek opportunities for our organisation		
We tend to be optimistic and find positives from most situations		

Planning Strategies: The development and evaluation of plans and strategies to manage vulnerabilities in relation to the business environment and its stakeholders.

	To what extent do you agree or disagree with the following statements? Strongly Agree 1 2 3 4 5 6 7 8 Strongly Disagree	Don't Know
Our organisation plans for the short- medium-term		
We plan our strategy carefully before taking action		
Given how others depend on us, the way we plan for the unexpected is appropriate		
We are mindful of how a crisis could affect us		
We actively plan with our suppliers how to manage disruptions		

We actively plan with our customers how to manage disruptions		
We actively plan how to support our staff during times of crisis		
We have a good understanding of how an event impacting the community may impact our ability to respond		

Our organisation currently has people who perform the following roles (tick all that apply):

- Risk Management
- Crisis Management
- Emergency Management
- Disaster Risk Reduction
- Business Continuity
- Don't Know
- None of the Above

Our organisation has the following plans (tick all that apply):

- Business Continuity Plan
- Emergency Plan
- Disaster Plan
- Crisis Plan
- None of these
- Don't Know
- Other type of plan:
- None of the Above

Are your organisation's plans of a sufficient standard to be useful in an emergency? (Please tick one)

- Yes
- Don't know
- No

If no, please explain.

Stress Testing Plans (exercises): The participation of staff in simulations or scenarios designed to practice response arrangements and validate plans.

	How regularly does your organisation rehearse and test its plans?					
	N/A	Twice a year	Annually	Every second year	Hardly ever	Don't know
Business Continuity Plan						
Emergency Plan						
Crisis Plan						
Disaster Plan						
Other						

To what extent do you agree or disagree with the following statements?

	Stress Test Strongly Agree Strongly Disagree 1 2 3 4 5 6 7 8	Don't Know
Our organisation is committed to practising and testing its emergency plans to ensure they are effective		
Staff can take time from their day-to-day roles to practice how to respond in a crisis		

How long could your organisation continue functioning if normal supply to the following infrastructure services were disrupted?

	Choose an answer for each.				
	Could not function	Hour	Days	Weeks	Months
Water supply					
Sewage					
Electricity					
Fuel/Gas					
Phone networks (cell and landline)					
Data networks					

CAD					
Road network					
Airport					
Port					

Our organisation has done sufficient planning for how disruption to the following infrastructure might affect us:

	To what extent do you agree or disagree with the following statements? Strongly Agree Strongly Disagree 1 2 3 4 5 6 7 8	Don't Know
Water supply		
Sewage		
Electricity		
Gas		
Phone networks (cell and landline)		
Data networks		
CAD		
Road network		
Airport		
Port		

Crisis Experience:

Remember: a crisis is any non-routine disruption that causes a significant impact to the organisation. This may not necessarily mean the loss of life or property but may stress the organisation and affect its ability to respond and recover from the event. Examples include a power outage, flood, technology change, reputation issue, supply change failure, earthquake, regulatory change, extreme weather, etc.

Has your organisation experienced a crisis or emergency in the last 5 years?

- No
- Don't know
- Yes (please list in the table below)

If yes to above question, please describe (include year) in the table below and on the scale shown, please rate how severe your organisation's crisis(s) was for your organisation.

	Please choose an answer for each.

	We dealt with it as part of business-as-usual	It challenged us but was not overly disruptive	It definitely challenged us and was moderately disruptive	It definitely challenged us and was very disruptive	It could h ave shut us down	Don't know
1						
2						
3						
4						
5						

Please describe from the list above, the impact(s) to BCEHS.

Is there anything else you would like to say?

Thank you for taking the survey.

Appendix E: Code Book for Interviews

Factor	Indicator	Definition	Code	Frequency	Positive	Negative
Adaptive Management	Adaptability in management	The ability of BCEHS to modify strategies or operations.	+ Ability to adjust strategies or operations - Inability or refusal to adjust strategies or operations	8	7	1
Disaster Impact on Work	Changes in work dynamics	Adapted work environment/processes due to external disruptions.	+ Successful adaptation to changes - Struggles or failures in adapting to changes	4	0	4
Leadership and Communication	Leadership effectiveness	Leadership guided BCEHS through crises.	+ Effective leadership and communication - Ineffective leadership and communication	9	4	5
Systemic Challenges and Adaptation	Organizational structure changes	Adapted BCEHS for resilience and capacity.	+ Successful implementation of structural changes - Resistance or failure to implement necessary changes	4	1	3
Preparedness and Organizational Learning	Insight and learning	Use of experiences from current challenges to enhance future strategies.	+ Effective use of insights for improvement - Did not use valuable insights	4	4	0

Appendix F: Refined Codes for Focus Group

Updates and Additions 1. Add a new code—structural adaptation: definition: changes in organizational structure to enhance resilience and capacity. indicator: successful and negative 2. Expand Existing Code—leadership and communication: to maintain transparency and reliability, 3. Refine Disaster Impact on Work Code: changes in work.

Factor	Indicator	Definition	Code	Frequency Positive	Frequency Negative	Total Frequency
Adaptive Management	Adaptability in management	The ability of BCEHS to modify strategies or operations.	+ Ability to adjust - Inability or refusal to adjust	3	1	4
Disaster Impact on Work	Changes in work dynamics	Adapted work environment/processes due to external disruptions.	+ Successful adaptation - Struggles or failures in adapting	3	2	5
Leadership and Communication	Leadership effectiveness	Leadership guides BCEHS through crises.	+ Effective leadership - Ineffective leadership	3	3	6
Systemic Challenges and Adaptation	Organizational structure changes	Adapted BCEHS for resilience and capacity.	+ Successful implementation - Resistance or failure to implement	2	2	4
Preparedness and Organizational Learning	Insight and learning	Use of experiences from current challenges to enhance future strategies.	+ Effective use of insights - Did not use valuable insights	4	0	4
Structural Adaptation	Implementation of structural changes	Changes in organizational structure for resilience and capacity.	+ Successful implementation - Resistance or failure to implement	3	2	5
Leadership and Communication (Expanded)	Adaptation of communication strategies	Leadership adapts communication strategies during disasters to maintain transparency and reliability.	+ Effective adaptation - Ineffective adaptation	2	1	3

Appendix G: Code Book and Frequency Survey—Open-Ended

Factor	Indicator	Definition	Code + positive -negative	Frequency	Positive	Negative
Adaptive capacity	Minimization of silos	Communication obstacles are fragmented and isolated and can lead to negative workplace dynamics. Address underlying issues such as social divisiveness or, in organizations such as BCEHS, cultural. Behavioural factors that may cause silos, whether intentionally or unintentionally. (Resilient Organisations, n.d.; Seville, 2016)	+De silo - greater collaboration = -Silo - Feeling their knowledge is siloed	19	0	19
	Internal resources	Managing and/or deploying the BCEHS resources, such as ambulances, supplies, and personnel, including paramedics and dispatchers. Maintain out-of-hospital care and provide additional capacity when needed during a disaster. (Resilient Organisations, n.d.; Seville, 2016)	+Access to equipment and supplies -Lack of access to equipment +Access staffing -Lack of access to staff	110	1	109
	Staff engagement and involvement	Engagement and involvement of staff as frontline, management, or support people. They can provide the knowledge and lived experience to link their own work and BCEHS resilience empowering staff problem solvers (Resilient Organisations, n.d.; Seville, 2016)	+Engagement Staff are empowered -Lack of engagement +Stockpile of emergency supplies (food, water, safety) - Lack of a stockpile of emergency supplies (food, water, safety)	7	0	7
	Information and knowledge	Information such as plans and procedures is easy to find in many locations, and frontline and management can find it easily. When needed, expert opinions are available. The experts are easy to access, and everyone knows how.	- Lack of access to situational awareness information +Access to situational awareness information	46	0	46

		(Resilient Organisations, n.d.; Seville, 2016)	+Ability to escalate to experts - Lack the ability to escalate to experts			
	Leadership	Disaster leadership exists to provide decision making during a disaster. An iterative approach is used to evaluate BCEHS strategies, health systems, and goals. (Resilient Organisations, n.d.; Seville, 2016)	+Effective leadership - Ineffective leadership	21	0	21
	Innovation and creativity	BCEHS staff at all levels are recognized and celebrated for novel and creative approaches to problem-solving. This applies to long-standing issues and ones exposed or created by disasters. (Resilient Organisations, n.d.; Seville, 2016)	+ Give examples of the ability to use knowledge in novel ways. - Had ideas that were dismissed or ignored	5	0	5
	Decision making	All staff at BCEHS are given appropriate authority regarding decision making for their work in disaster response. Specialized staff are also involved with their subject matter expertise in responses and implementation of solutions in a disaster response. (Resilient Organisations, n.d.; Seville, 2016)	- No authority to act + Authority to act	6	0	6
	Situation monitoring and reporting	Staff are encouraged to be vigilant about the organization, its performance, and potential problems. Staff are rewarded for sharing good and bad news about the organization, including early warning signals, and these are quickly reported to organizational leaders. (Resilient Organisations, n.d.; Seville, 2016)	+ Pathway to share risks and warnings - Lack of pathway to share risks and warnings - Lack of action with warnings/intelligence	13	0	13
Planning	Planning strategies	Proactive planning occurs for likely foreseeable risks, and other risks and strategies are developed for BCEHS vulnerabilities for out-of-hospital care. (Resilient	+ Disaster plans are present and effective - Lack of disaster plans or ineffective plans	55	2	53

		Organisations, n.d.; Seville, 2016)				
	Participation in exercises	Plans are rehearsed and not merely recorded for disasters. (Resilient Organisations, n.d.; Seville, 2016)	+ Exercises - Lack of exercises	15	0	15
	Proactive posture	Early warning is monitored and developed strategically. Behavioural readiness changes to internal or external pressures that affect BCEHS's ability to provide out-of-hospital care. The goal is to do mitigative action early to prevent pressures from escalating into a disaster. (Resilient Organisations, n.d.; Seville, 2016)	+ Proactive readiness - Reactive response	32	0	32
	External resources	Know what is available in the wider health system, first responder, private industry, and government organizations for supporting BCEHS. Develop relationships before a disaster and know how to access them. (Resilient Organisations, n.d.; Seville, 2016)	+ Clear understanding and direction - Lack of understanding and direction	20	0	20
	Recovery Priorities	Develop and publish plans on Build Back Better and return to viable operation following a disaster. (Resilient Organisations, n.d.; Seville, 2016)	+ Recovery is prioritized - Recovery plans are lacking	4	0	4
Emerging theme	Morale	Misalignment of Values: Ethical Concerns: Toxic Work Environment: Impact on Personal Integrity.	+ Has pride and positive attitude to BCEHS - Expresses mistrust and poor experience(s) related to work environment	96	3	93