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A Model for Assessing Staff Resilience to Improve Organizational Resilience in Emergency Departments

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A MODEL FOR ASSESSING STAFF RESILIENCE TO IMPROVE
ORGANIZATIONAL RESILIENCE IN EMERGENCY DEPARTMENTS

by

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ABSTRACT

Organizational Resilience is defined as the ability of an organization to anticipate sudden disruptions, effectively respond, and adapt in a changing environment to deliver its objectives, as well as successfully recover. In order to increase resilience at an organizational level, it is important to understand how individuals collectively contribute to resilience capability of an organization. Emergency Departments (EDs) are considered to be particularly well suited to investigating resilience capability due to their highly unpredictable and complex operating environment. Further, the resilience capability of EDs and their staff is suggested to be essential to successful delivery of safe, high-quality, and timely medical care to all patients in cases of mass disruptive events. The purpose of this research is to develop a model of staff resilience to support the improvement of organizational resilience in EDs in the United States. The study was organized into two phases: Initial Model Development based on a Thematic Analysis of existing conceptual models and Preliminary Model Validation via deductive evaluation of published Empirical Case Studies on ED response to mass casualty events. As a result of the first phase, Initial Model was proposed that consists of five dimensions of resilience: Triggers, Factors Affecting Resilience, Resilience Capability, Characteristics of ED Complexity and Outcomes. The results of the second phase determined that the Initial Model was comprehensive and only minor additions were made. Further, recommendations for improving case studies on ED responses were developed. The results of the study provide a model that demonstrates how ED staff supports the organizational resilience capability of the EDs. This research contributes to the general knowledge base of resilience as a critical organizational capability in EDs when dealing with unexpected disruptions as well as provides guidance for EDs in the United States when seeking to become more resilient.

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ED   Emergency Department

OR   Organizational Resilience

TA   Thematic Analysis

IV   Independent Variable

DV   Dependent Variable

CHAPTER ONE: INTRODUCTION

Emergency Departments (EDs) in the United States are open, dynamic, high-risk systems that serve a critical public service mission by providing emergency care at any time to any patients seeking emergency care regardless of their financial ability (Son et al., 2019). The key objective of EDs as organizations is to provide immediate, safe, high-quality medical examination and stabilization care to patients with medical emergencies.

Emergency Department is a societal system (i.e., a formal set of inter-relationships and norms among individuals, groups, and institutions that constitute a whole unit such as an organization) that operates within a hospital, which can be considered a higher-order societal system located within the national Healthcare ecosystem. ED operations are critical to the success of the hospitals and, therefore, the whole system of Healthcare delivery (Acuna et al., 2020). Within the Emergency Department societal system, there exist organismic systems (i.e., distinct biological individuals who tend to interact and fulfill their own purpose while providing a function within the societal systems to which they belong) such as ED staff members. An Emergency Department has levels of societal systems contained within and the lowest level are roles or positions, which are filled by organismic systems (staff members). ED staff members, as individuals (i.e., organismic systems), fill those societal roles. Finally, at the lowest level exists a mechanistic system (i.e., technical systems that perform functions such as tools, equipment, and infrastructure), the components of which usually have a specific function and are used either by the ED organization or its staff members. Electronic Health Systems, emergency rooms, medical

equipment and supplies are all components of mechanistic systems in Emergency Departments. The systems model within which an Emergency Department exists is illustrated in Figure 1.
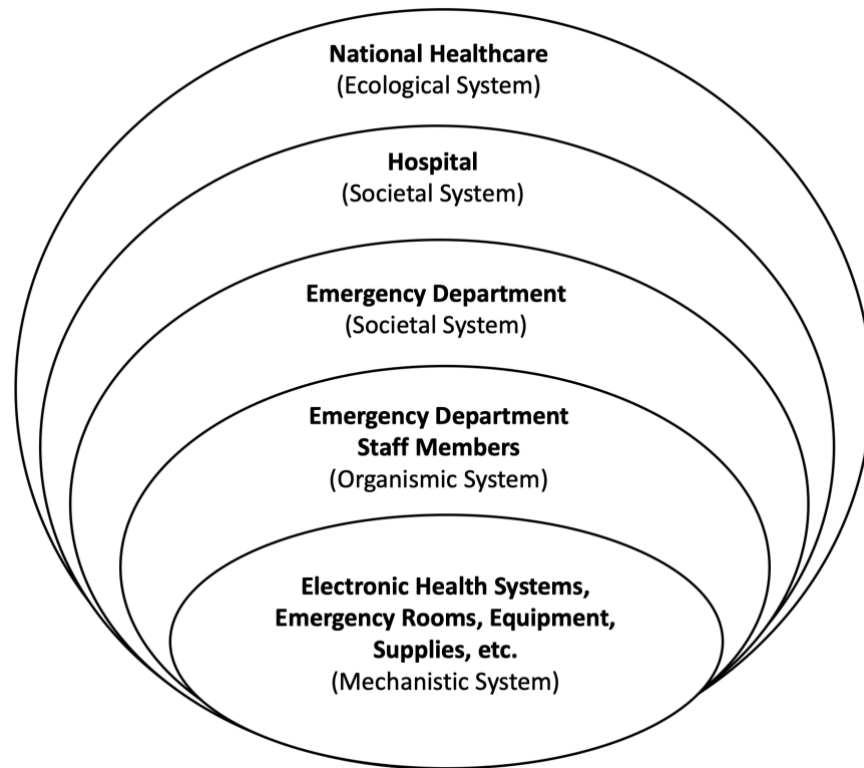
Figure 1. Systems Model

The performance of Emergency Department as a societal system significantly depends on the performance and decisions of the members of Emergency Departments staff. They play a critical role in organization's ability to overcome challenges and meet the organization's goals (de Oliveira et al., 2016). The ED staff includes registered nurses and nurse practitioners, ED technicians, emergency medicine residents, attending physicians, interns, and physician assistants. Their ability to make decisions and perform procedures under pressure often determines the quality of the care delivery and even patient health outcomes. It is important to clarify that not all members of the ED

staff are employees of the Emergency Department. For instance, physicians are sometimes independent contractors and not employees of the hospitals, however, they are considered to be staff members due to their active role in the ED operational environment.

Due to the nature of Emergency Department operating environments, these organizations often experience complexities that became a part of everyday dynamics. These everyday complexities are also often referred to as chronic events. Overcrowding is one of the most common examples and results from an imbalance between the supply (i.e., organization's operating boundary) and Healthcare demand. An overcrowding phenomenon happens when the number of patients and associated needs exceed resources available at that time, such as space, ED staff, medical supplies, and equipment (Boyle, et al., 2012). The imbalance in such a critical and socially responsible system results in delayed waiting times and treatment, lower patient health outcomes, decreased effectiveness of treatment, burnout, and stress among Emergency Department staff as well as poor image of the hospital within which ED operates (Davis, et al, 2020; Son, et al, 2019). Additionally, EDs often experience challenges caused by process changes that impact an organization from higher-order societal systems as well as technological changes occur at the mechanistic systems level that contribute to the everyday complexities of Emergency Department environments (Fairbanks, et al., 2014).

While day-to-day challenges in the Emergency Departments persist, these organizations are further compounded by sudden influx of patients caused by unexpected disruptions such as mass casualty events including natural disasters, mass shootings, terrorist attacks, pandemics, and other adverse events (Son, et al, 2019). In this case, Emergency Departments are challenged to provide timely and safe emergency care to all the patients while dealing with both routine complexities and

complications caused directly by the mass casualty events. These sudden disruptions also have a significant effect on the Emergency Department staff as organismic systems as well as their societal role in the ED. While their role could be operationally impacted, ED staff members as human individuals may be also psychologically or physically affected. During normal circumstances, due to the everyday complexities of ED environment, working in emergency care is already emotionally distressing. Sudden disruptions such as mass casualty events further compound staff's emotional distress and affect their decision-making (Rangachari & Woods, 2020; Son et al., 2020).

One the most recent and ongoing global disruptions is the COVID-19 pandemic that led to excessive patient load with different levels of health conditions. Emergency Departments across the world, including in the US, were unable to provide timely emergency care to all the incoming patients due to the lack of workspace, necessary equipment, or medical staff. Emergency Departments and their staff were coping with a lethal virus under highly stressful conditions with PPE shortages and a lack of evidence-based treatment (Rangachari & Woods, 2020). Therefore, a sustained performance in a such high-risk and socially responsible system as an Emergency Department, that always operates under uncertainty, is critical in order to provide high-quality and timely care to all the patients (Son, et al., 2019).

1.1 Resilience in Emergency Departments

It is suggested that Organizational Resilience (OR) is an essential capability for successful delivery of safe, high-quality, and timely medical care to all the patients in the Emergency Department in cases of mass disruptive events (Rangachari & Woods, 2020; Lengnick-Hall et al., 2011). It is the ability of an organization to anticipate disruptions, effectively adapt in a changing environment to

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deliver its objectives, and successfully recover from the unexpected adverse events (Duchek, 2020). While Healthcare systems are generally considered to be a proper venue to study resilience, Emergency Departments are particularly well suited to investigate it due to their highly unpredictable environment (Son, et al., 2019).

Any resilient organization should be able to anticipate potential disruptions and to effectively cope and adapt in uncertain environments at three different levels – organization, team, and employees (Britt & Sawhney, 2020). Capability for resilient performance at all three levels affects the likelihood of an organization to demonstrate resilience during a sudden disruption (Britt & Sawhney, 2020). Emergency Departments as societal systems consist of multiple layers of lower-order societal subsystems with many organismic systems (i.e., units, teams, individuals who fill societal roles). Therefore, resilience in Emergency Departments, is described as a capability of individual ED staff members, teams, and the whole Emergency Department as an organization (Rangachari & Woods, 2020).

Emergency department staff plays a critical role in meeting the ED's objectives. Performance of ED staff members (i.e., organismic systems) affects the overall capability of Emergency Departments (i.e., societal systems). An understanding of resilient individuals helps in defining resilient organizations because actions and interactions among staff members of an organization affect the collective capacity for resilience (Lengnick-Hall et al., 2011). Emergency Department staff members, as organismic systems functioning within the ED societal system, interact and fulfill their own purposes (i.e., their organismic role) while providing a function in the ED organization (i.e., their societal role). Therefore, in order to increase resilience of the entire Emergency Department, it is imperative to investigate how individual Emergency Department

staff members can anticipate, respond, adapt, and recover from sudden disruptions enabling the organization to be resilient (Lengnick-Hall et al., 2011).

1.2 Research Gap and Potential Contribution

The literature on resilience in Emergency Departments primarily focuses on investigating this capability at an organizational level, while the study of resilience at individual level remains a significant gap (Allen & Palk, 2018). While a number of articles focus on describing the challenges ED staff members face during both chronic and acute events (i.e., unexpected disruptions), there are no generally accepted conceptual frameworks or models and the foundation of knowledge in the area of staff resilience in Emergency Departments appears to be an early stage of development (Son et al., 2019). Furthermore, most of the literature on resilience in Emergency Departments involves empirical case-studies, describing situations when emergency departments are dealing with an unexpected disruption, such as a large influx of patients due to events such as natural disasters, mass shootings, or terrorist attacks. The case studies do not explicitly address resilience of staff members but describe actions and adjustments happening within the department that are directly associated with ED staff members including their level of control over the situation, their psychological state, decisions they make, the impact of those decisions on the procedures and patient health outcomes, and highlighting the importance of their role in preparing, responding, and recovering from the event.

Creating a conceptual model of ED staff resilience that demonstrates how resilience of staff as individuals contribute to the resilience capability of the whole Emergency Department addresses an apparent gap in the literature and makes a potential contribution to this area. Investigating how

emergency department staff resilience can be assessed could potentially improve it at both organismic systems level (e.g., reducing emotional distress) and societal systems level (i.e., decreasing the impact of unexpected disruptions on their decision-making and procedures and allow them to provide timely, safe, and high-quality care to all the patients). Furthermore, due to a direct relationship between individual and organizational resilience, the development of a conceptual model of staff resilience can potentially contribute to the area of Emergency Department resilience at organizational level since an understanding of resilient individuals would help in defining strategies for building resilient organizations.

1.3 Overview of Thesis

The purpose of this study was to develop a conceptual model of Emergency Department staff resilience in order to improve resilience at the organizational level. Chapter 2 provides a review of the related literature including a discussion of resilience capability in organizations, comparison of resilience to related concepts, and discussion of resilience at three main stages (i.e., anticipation, adaptation, and recovery) as well as across three different levels (i.e., organizational, team, and individual). In addition, the review discusses the complex nature of Emergency Department organizations, and finally, describes resilience in Emergency Departments at individual and organizational levels. Chapter 3 then discusses the methodological approach of this research, including the research questions and approach. This chapter also includes a detailed description of two main study design phases: Initial Model Development using Thematic Analysis; and Preliminary Model Validation using published Empirical Case Studies. The results of the Initial Model Development phase are documented in the first section of Chapter 4, which includes an Initial Model of staff resilience. The second section of Chapter 4 summarizes the results of the

Preliminary Model Validation using deductive evaluation of published Case Studies on Emergency Department response to mass casualty events. This chapter also emphasizes the gaps and inconsistencies that existed in the initial model, weaknesses in the Case Studies, and changes that were made to the Initial Model based on the results of the analysis. Discussion of the results and contributions, including implications for both research and practice, are discussed in Chapter 5 and, finally, the conclusions, study limitations, and future work are summarized in Chapter 6.

CHAPTER TWO: LITERATURE REVIEW

This section presents a review of literature related to resilience in organizational contexts, emergency department operations, and resilience capabilities at the organizational level. In addition, the importance of demonstrating resilience at individual level and apparent lack of focus in this area is discussed. First, the definition of resilience concepts and related organizational capabilities are described as well as the three main levels of resilience. Second, the review describes the current Emergency Department system in the US Healthcare ecosystem, important features of their operations, and the importance of ED staff members. Further, the relationship between everyday complexities that exist in EDs and unexpected significant events that further disrupt ED services is discussed. The literature review also explores the need for Emergency Departments to become more resilient and how these organizations currently demonstrate resilience capability at organizational level. This section concludes with a discussion of key gaps in ED staff resilience research and the importance of investigating resilience in Emergency Departments at individual level to facilitate resilience of the ED as an organization.

2.1 Resilience in Organizations

Change is an inevitable feature of organizational life. While organizations must deal with everyday challenges and dynamics, they are also frequently affected by unexpected events such as natural disasters, pandemics, terrorist attacks, wars, economic changes, and technological changes. These sudden disruptions can be internal (i.e., arising from within an organization) or external (i.e., emerging beyond the boundary of an organization but affecting its operations). The disruptions also often differ depending on the type and scale of event as well as its duration and frequency (Duchek, 2020). In order for organizations to be capable of not only surviving these unexpected

events, but also efficiently adapting to sudden changes, reaching their goals and prospering during uncertain times, they need to develop a resilience capability (Duchek, 2020).

2.1.1 Definition of Resilience and Related Concepts

Resilience is often compared to certain related concepts, such as agility, flexibility, and robustness. While these organizational capabilities have common features with resilience, there exist some distinctive elements among them. Flexibility is the ability, on a relatively low cost, to quickly adjust to foreseen as well as unforeseen changes in the organizational environment and agility is the ability to quickly recognize opportunities and develop competitive direction changes to pursue these opportunities (Lengnick-Hall et al., 2011). While flexibility and agility are critical to deal with mainly day-to-day or, in other words, chronic dynamics and changes, resilience has been defined as an important capability for dealing with unexpected or acute disruptions. Robustness, defined as an ability to maintain functions despite foreseen and unforeseen changes in the system without adapting, is also often associated with resilience (Duchek, 2020). The main characteristic that distinguishes resilience and robustness is presence of adaptability in resilience (another organizational capability often used to characterize resilience) that allows organizations to come out of crisis stronger than before. The comparison between these constructs is illustrated in *Figure 2*.
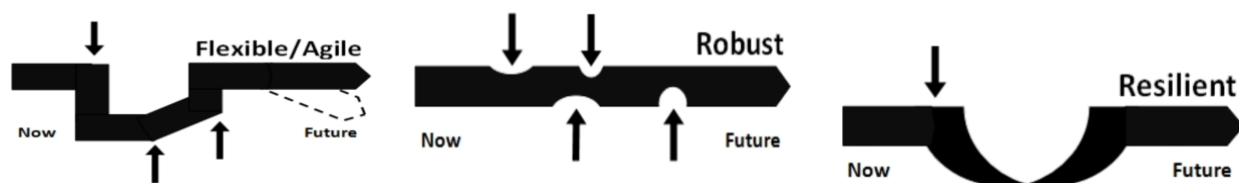
Figure 2. The Concepts of Flexibility/Agility, Robustness and Resilience

Reprinted from Husdal, J. (2009). *Supply Chain Disruptions in Sparse Transportation Networks: Does Location Matter?* (No. 09-0305).

Organizational attributes such as flexibility, agility and robustness contribute to an organization's ability to be resilient, however, it is not enough for an organization to have only these three capabilities to achieve resilience (Lengnick-Hall et al., 2011). There has been significant development in research on resilience in organizational contexts since the beginning of the 21st century and there exists a well-defined general understanding of resilience. However, its formal definition still varies across different literature (Duchek, 2020). In this study, the concept of resilience in organizational context has been defined as the ability of an organization to anticipate mass disruptive events, effectively respond and adapt in a changing environment to deliver its objectives, and successfully recover and emerge from a challenging event stronger than before the disruption (Duchek, 2020; Lengnick-Hall et al., 2011; Kuntz et al., 2017) There are three defined stages of resilience: anticipation, response/adaptation, and recovery (Figure 3).
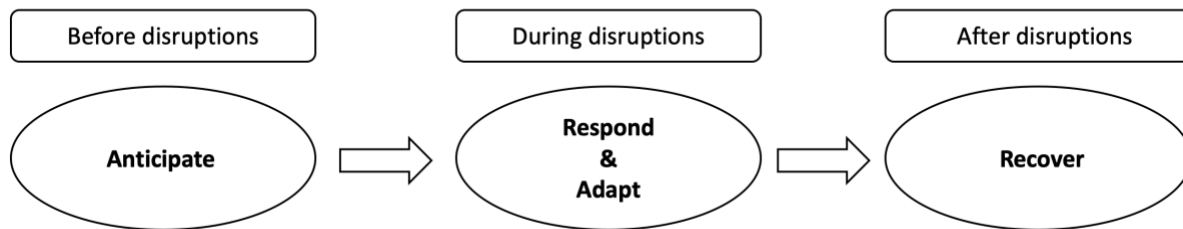
Figure 3. Three stages of Resilience

A resilient organization should be able to anticipate potential disruptions, effectively cope as well as adapt in uncertain environment, and recover from the event by returning to the original state.

2.1.2. Levels of Resilience

The ability of organizations to demonstrate overall resilience is influenced by resilience at three different levels (i.e., organization, team, and employees), as shown in Figure 4. (Britt & Sawhney, 2020). The relationship between resilience of employees, teams and organizational resilience reflects a typical framework of interaction between systems and subsystems (Lengnick-Hall et al., 2011).

Figure 4. Three Levels of Resilience

Organizational Resilience is a capability of several components of a system that can collectively anticipate and prepare for potential unforeseen events, adapt to internal and external disruptions, maintain integrity as a system, transform challenges into opportunities and successfully recover (Witmer & Mellinger, 2016). *Team Resilience* can be defined as the capacity that teams have to adapt, overcome difficulties, and emerge strengthened (Rodríguez-Sánchez & Perea, 2015). *Individual Resilience*, also sometimes referred as *Employee* or *Staff Resilience*, is a capacity of individuals that is supported and facilitated by organizations to anticipate, positively cope, adapt and even succeed in uncertain environment during unexpected disruptions (Kuntz et al., 2017).

Presence of resilient characteristics at all three levels affects the likelihood of an organization to demonstrate resilience during a sudden disruption (Britt & Sawhney, 2020). Furthermore, improving resilience at a lower level can increase resilience at higher levels: employees who exhibit resilience characteristics contribute to the ability to demonstrate resilience at the team as well as organization levels, and teams that are resilient contribute to an organization's capacity for resilience (Britt & Sawhney, 2020). It is important to mention that resilience at individual level has organismic and societal roles. The organismic role of individual resilience represents their resilience as individuals and personal outcomes that are often associated with their quality of life, while societal role focuses on how individuals contribute to resilience capability of an organization.

An understanding of resilient individuals helps in defining resilient organizations since actions and interactions among staff members of an organization affect the collective capacity for resilience (Lengnick-Hall et al., 2011). Therefore, in order to increase resilience at an organizational level, it is important to focus on how individuals collectively enable the organization to be resilient (Lengnick-Hall et al., 2011). When employees are capable of coping with sudden disruptions and positively adapt to adverse conditions, they are likely to demonstrate effectiveness and high levels of performance even under conditions of stress and change. Therefore, it is in the interest of organizations to identify factors that can help employees be resilient during unexpected disruptions (Caniëls et al., 2019).

<u>2.2 Emergency Departments in the US Healthcare System</u>

Emergency Departments in the United States are complex societal systems that serve a critical role of providing medical services to patients. These Healthcare facilities have traditionally been places

where patients can receive care in life-threatening situations or when unexpected events occur (Acuna et al., 2020). Emergency Departments are focused on the care and management of patients who need to be treated urgently (Acuna et al., 2020). As previously mentioned in this study, EDs as societal systems are positioned within higher-order societal systems (i.e., hospitals) that operate within the Healthcare ecosystem. Therefore, the dynamics of all the emergency services that occur in EDs have a significant impact on the whole system of Healthcare delivery from both financial and medical perspectives (Acuna et al., 2020).

2.2.1. Emergency Department Operations and Role of Staff

ED societal systems also contain lower-level societal systems, such as units, teams, or roles, that consist of organismic systems (i.e., ED staff members) as well as mechanistic systems such as, medical equipment, Electronic Health Systems, and emergency rooms. Organismic systems such as Emergency Department staff members need to be particularly investigated since they play a significant role in organization's ability to overcome challenges and meet goals (de Oliveira et al., 2016). While performance of ED staff members impacts the performance of teams (i.e., societal subsystems) and thus the overall capability of Emergency Departments (i.e., societal systems), the everyday dynamics that exist in ED at organizational level also significantly affect the staff. Emergency Departments are already a high-stress environment due to their life-saving mission, while a large number of patients, staff shortages, and budgetary cuts are only some of the factors that affect both organismic and societal roles of staff and contribute to shortages, work overload, stress, fatigue, and burnout (Johnston et al., 2016).

2.2.2. Current Day-to-Day Complexities and Challenges

Emergency Departments are complex, socially responsible systems that always operate under uncertainty. Various everyday complexities exist in the US Emergency Departments that can sometimes affect the quality of the emergency care that is provided. First, EDs often experience overcrowding (i.e., an imbalance between the supply and demand) that became a part of everyday dynamics and is considered to be a normal occurrence in the current Healthcare system (Boyle, et al., 2012). As a result, this leads to longer wait times, delays in providing emergency care and inability to provide the required level of care (Davis et al., 2020). According to United States Government Accountability Office, the average time that patients spend waiting to be seen by a physician in the Emergency Department in the US is twice the recommended wait time (Davis et al., 2020).

One of the main causes of overcrowding that exists in EDs today is an increase of demand for emergency care in recent years and decrease of the number of available Emergency Departments (Son et al., 2019). In recent years, the number of people who seek emergency care has increased due to several reasons. Some people arrive to the ED while their condition does not require an emergency care (Cimellaro & Piqué, 2016). On the other hand, some people neglect routine health checkups which, in some cases, results in unexpected need for emergency care. Furthermore, Emergency Departments are considered to be the safety net of the Healthcare system regardless of the social and/or economic status of patients (Acuna et al., 2020). Therefore, a disparity between a number of patients and inadequate resources. is one of the main causes of overcrowding that became a part of everyday dynamics.

Process changes are also considered to be one of the main elements of everyday complexities that exist in the Emergency Departments. Since there are other societal systems in the Healthcare ecosystem, such as insurance carriers, public health agencies, pharmaceutical and durable medical equipment providers, Emergency Departments as societal systems and ED staff members as organismic systems that fill the roles in the societal system, can be impacted by some process changes from the higher-order societal systems or ecosystem levels. For example, implementation of new policies, including budget-tightening policies, economic changes, increased cost for equipment and supplies as well as reconstructions or downsizing contribute to complexities of EDs (Cherry & Trainer, 2008). Furthermore, technological changes have become one of the day-to-day complexities that impact Emergency Department functions and its staff from within at the mechanistic level. For instance, failures in Electronic Health Record System, failure of automated dispensing equipment in the ED, failure of automated medication system, and other technological malfunctions are some of the technological changes Emergency Departments might experience during routine operations (Fairbanks et al., 2014; Ben-Assuli, 2015).

2.2.3. Unexpected Disruptions

While previously described day-to-day complexities of Emergency Departments persist, these organizations also face unexpected disruptions such as mass casualty events (i.e., mass shootings, terrorist attacks, natural disasters, pandemics, and other adverse events) that further disturb services and practices (Son et al., 2019). Emergency Departments in the US have long experienced difficulties in meeting these unforeseen Healthcare demands and providing high-quality medical care during a large and sudden influx of patients (Son et al., 2019). Emergency Departments face a challenge of both maintaining their routine practices and services with already existing

underlying complexities and providing emergency care to casualties of unexpected disruptive events. In order for Emergency Departments to be able to provide quality medical care to all the patients while managing disturbances, they need to prepare for unexpected disruptions, adapt in extremely challenging environment and successfully recover.

Resilience was earlier described as a success factor in dealing with unexpected events and crisis (Duchek, 2020; Lengnick-Hall et al., 2011). It is argued that resilience is an appropriate mechanism that should be used by ED organizations when dealing with disruptions like mass casualty events (Son et al., 2019). During unexpected disruptions, these organizations must demonstrate the ability to sustain acceptable levels of performance to provide medical care to all the patients, and therefore they serve as a proper venue to investigate resilience (Son et al., 2019). It is important to note that, while some literature argues that resilience is used to address both chronic and acute disruptions, this study focuses on resilience as a capability that organization demonstrate when facing acute disruptions since, by the definition, resilience is triggered by an unexpected event. Chronic issues such as overcrowding, process changes, and technological changes, need to be handled by Emergency Departments independently of whether any mass casualty event occurs.

2.3 Resilience in Emergency Departments

In Emergency Departments, an example of societal role of staff resilience would be an ED staff member who is resolving safety problems on the frontlines using workarounds and then communicates the safety concerns to managers in order to prevent the problem from reoccurring (Rangachari & Woods, 2020). Resilience at a team level (i.e., societal subsystem within which societal roles of individuals are nested) would be managers encouraging Emergency Department

staff members to communicate their safety concerns to leaders and team members with a purpose of addressing underlying issues and preventing reoccurrence of any problems (Rangachari & Woods, 2020). The organizational level of resilience would include senior leadership commitment to readjustment of available resources that exist at mechanistic systems levels, while maintaining patient safety (Son et al., 2019; Rangachari & Woods, 2020). Therefore, resilience in Emergency Departments can be described as a capability of individual ED staff members, teams, and the whole organization (Rangachari & Woods, 2020).

2.3.1. Organizational Resilience in Emergency Departments

Most of the literature focuses on investigating resilience at organization level. During mass casualty events, Emergency Departments generally manipulate four resources that support performance adjustments: ED staff members, supplies/equipment, space, and sequence (Son et al., 2019). Generally, there exist four defined performance adjustments that are utilized in Emergency Departments: adjustment by matching, extending, sustaining, and transforming (Son et al., 2019). Adjustments by matching, extending, and sustaining are generally applied when the Emergency Department deals with excess demands that can occur on a daily basis, while adjustment by transforming is utilized when extreme emergency occurs such as mass casualty event (Son et al., 2019; Nemeth et al., 2008).

An example of a mass casualty event during which an adjustment by transforming is utilized in the ED that is supported by manipulating the four types of resources could be a terrorist attack in an urban area (Nemeth et al., 2008). In order to cope and adapt to unexpected demand in ED services, additional capabilities sometimes emerge by sacrificing other goals, functions, or tasks (Son et al., 2019). An example of manipulating a space resource could be a trans-hospital strategy

that implies converting non-Emergency Department facilities into a temporary space to provide medical care to causalities during mass disruptive events (Braithwaite et al., 2017). A strategy for managing Emergency Department staff is mobilizing non-ED staff and/or off-duty workforce and sacrificing or degrading other functions (Son et al., 2019). Similar strategies can be also utilized in terms of supplies and equipment. For example, alternating the intended usage for a different need such as using a portable ambulatory flutter valve for a patient with traumatic pneumothorax (Son et al., 2019). Similarly, sacrificing behaviors may be practiced by manipulating the sequence resource (Son et al., 2019). Non-critical tasks such as routine paperwork and charting can be temporarily neglected and emergency care can be provided in the triage area (Son et al., 2019; Fairbanks et al., 2014). Another example of manipulating the sequence factor is prioritizing patients with life-threatening conditions over those with less severe conditions (Son et al., 2019; Nemeth et al., 2008).

Utilizing transformative adjustments creates new capacity and allows immediate emergency care of patients, however, it also creates additional potential disruptions and, in most cases, more work for the ED staff (Fairbanks et al., 2014). For instance, forgoing all care except for life-threatening conditions might negatively affect health condition of patients with less severe cases. Furthermore, neglecting paperwork might create potential operational problems associated with establishing patient identification, tracing patients passage through the system, and later completing paperwork that was disregarded during the disruption (Fairbanks et al., 2014).

2.3.2. Resilience of Emergency Department Staff Members

While the literature predominantly investigates resilience in Emergency Departments at organizational level and uses mainly case-based approaches to illustrate resilience of ED staff, the

study of generalizable patterns of resilience at individual level remains an apparent gap. A resilient organization is where employees are supported in the key elements of anticipation, adaptation, and recovery across the three levels (i.e., individual, team, and organization). This ensures that safety exists at an organizational level, by expecting failures, by learning how to cope and adapt to changing environment, and by restoring safe conditions after an adverse event (Rangachari & Woods, 2020). While Emergency Department staff members already experience challenges at both the organismic (i.e., stress, fatigue, and burnout) and societal (i.e., excessive patient care demands, limited treatment time) roles during routine operations, mass casualty events further compound staff's emotional distress (i.e., organismic role complications) and ability to perform life-or-death decision-making (i.e., societal role complications) (Son et al., 2020).

Even during normal circumstances, due to the complexities of ED environment, working in emergency care is recognized to be emotionally distressing (Rangachari & Woods, 2020). With the arrival of COVID-19 pandemic, for example, healthcare workers operated under highly stressful conditions with PPE shortages and a lack of evidence-based treatment, which became a source of additional emotional distress experienced by healthcare workers and ED staff members in particular (Rangachari & Woods, 2020). While emotional distress negatively affects ED staff members as individuals, it also impacts their ability to make rational decisions and therefore can lead to negative patient health outcomes. This particularly occurs in the state of "Free Fall". This is usually described by the ED staff as a situation when during a mass casualty event they are not aware of the numbers, types, or the individual patients in their area of responsibility (Nemeth et al., 2008). This uncontrolled state leads to a higher chance of potential mistakes during decision-

making and execution of procedures and, as a result, negatively impacts the resilience capability at organizational level.

ED staff decision-making during mass casualty events, not only involves specific decisions associated with patient treatment, but also making trade-offs to deal with exceeding demand for emergency care and setting priorities, which requires flexible interpretation of organizational protocols and cooperation with their coworkers (Rangachari & Woods, 2020). An individual ED staff member would need to take interpersonal risks such as trusting other staff members and managers to work towards common objectives and feeling safe in flexible interpretation of protocols to provide safe and timely emergency care (Rangachari & Woods, 2020). Thus, in order for individual Emergency Department staff member to be capable of making these decisions, worker trust and physiological safety (i.e., an individual's perception about outcomes of taking interpersonal risks) are critical (Rangachari & Woods, 2020). Moreover, psychological safety and worker trust, which are elements of societal role of individual resilience, are considered to be pre-requisites for OR that proves an importance of developing resilience at individual level to make an organization resilient (Rangachari & Woods, 2020).

Therefore, in order to increase resilience of the entire Emergency Department system, it is critical to focus on how individual ED staff members can anticipate, respond, adapt and recover from mass casualty events to enable the organization to be resilient (Lengnick-Hall et al., 2011). It is also essential to understand the importance of advancing resilience from individual to team and organizational level since resilience solely at individual level is a reactive stage. In this case, individual staff members deal with failures that are likely to reoccur without any systems learning that could potentially lead to organization being easily overwhelmed, therefore restricting

resilience capability during any mass casualty event (Rangachari & Woods, 2020). OR emerges

from systems, such as communication structures developed by leaders, to learn from anticipation,

coping and adaptation as well as recovery strategies of individual workers (Rangachari & Woods,

2020).

CHAPTER THREE: METHODOLOGY

The purpose of this research is to develop a model of staff resilience to support the improvement of organizational resilience in Emergency Departments in the US. While the literature indicates the importance of resilience at the individual level for the resilience of the entire organization, existing studies predominantly focus on investigating OR in the Emergency Department with a case-based approach and the study of resilience of its staff remains an apparent gap.

3.1 Research Questions

In order to address the gap in the literature and investigate the resilience of Emergency Department staff members, the following research questions have been defined to guide the study:

1. What are the characteristics of resilient Emergency Department staff members?
2. What are the motivating factors for making Emergency Department staff members resilient?
3. What are the factors that affect the ability of Emergency Department staff members to become resilient?
4. What unexpected events do Emergency Department staff members need to be resilient against?
5. What are the outcomes of improving resilience among Emergency Department staff members?
6. How does staff resilience affect organizational resilience in the Emergency Departments?

These research questions were intended to identify different dimensions of staff resilience in the Emergency Department as well as investigate how staff resilience contributes to organizational resilience in the EDs. In order to answer the defined research questions, the purpose of this particular study is to propose the Pre-Validated model of staff resilience, which will be fully validated in future research as described in Chapter 6.

3.2 Research Design Overview

The study was conducted in two phases: *Initial Model Development* based on Inductive Thematic

Analysis and *Preliminary Model Validation* through Deductive Evaluation of published Empirical

Case Studies (see Figure 5).
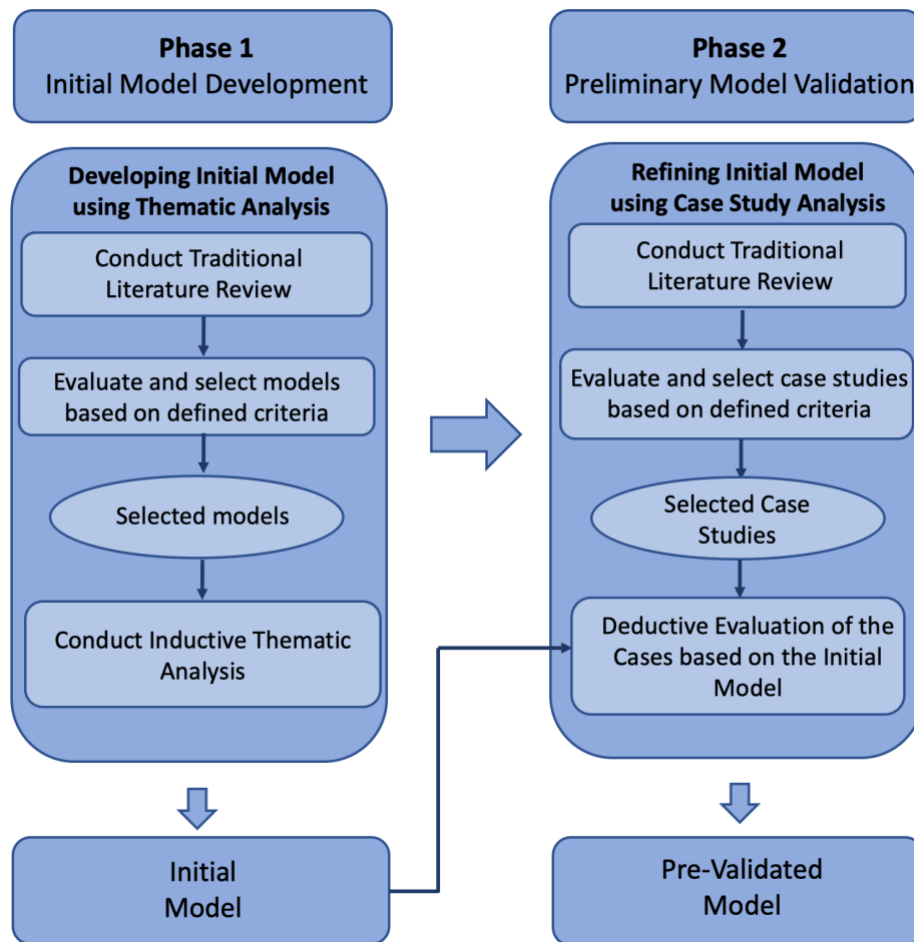
Figure 5. Research Design

The final output of this study is the Pre-Validated Model of ED staff resilience that has been based

on the existing in the literature models of organizational and staff resilience and then informed by

published Empirical Case Studies specifically focused on Emergency Department response to

unexpected disruptions in the US. A more detailed description of each phase of the study is offered in the following subsections.

3.2.1 Phase 1 – Initial Model Development

The purpose of Phase 1 of the study was to develop the Initial Model of ED staff resilience in order to identify the dimensions of staff resilience, establish relationships between them and demonstrate how staff resilience contributes to organizational resilience in the Emergency Departments. First, a traditional literature review was conducted to identify published models of organizational and staff resilience. The Initial Model was then developed based on analysis of the identified models of organizational and staff resilience, which included models focused on General organizational resilience, Healthcare, and Emergency Departments. A preliminary review of the available models showed that research on ED resilience were less mature and many of the published models were narrowly focused. Therefore, the models identified in the Healthcare and General levels were included in the analysis to ensure its comprehensiveness and rigor. The elements of the selected models were inductively synthesized using Thematic Analysis (TA) to design the Initial Model.

Traditional Literature Review

A Traditional Literature Review was conducted to identify articles that contain models related to the area of organizational resilience across three levels (i.e., All organizations, Healthcare organizations and Emergency Department organizations). In addition, models of staff resilience across three similar levels (i.e., All staff, Healthcare staff and Emergency Department staff) have been investigated for inclusion in the study. Both models of staff resilience and models of organizational resilience were considered for the development of the Initial Model to ensure its

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comprehensiveness and investigate the relationship between staff and organizational resilience. Furthermore, as mentioned earlier, the models from both of these areas (i.e., organizational and staff) were also identified across General and Healthcare levels since the existing in the literature models of resilience at Emergency Department level are less mature (i.e., less comprehensive and rigorous, unvalidated). The framework used to identify OR models as well as staff resilience models at each of three dimensions is presented in Figure 6.
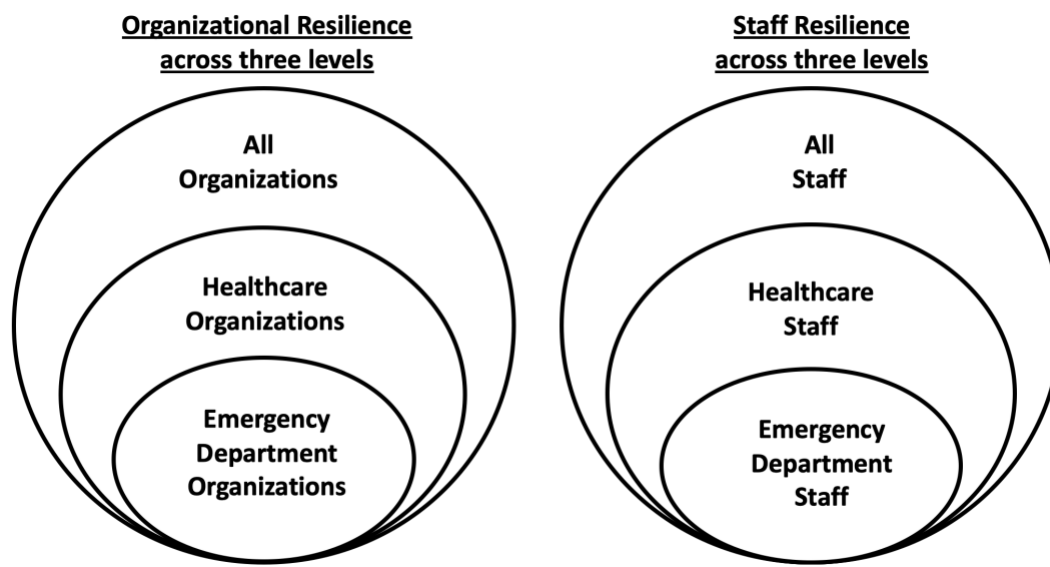
Figure 6. Thematic Analysis Framework

Google Scholar, Web of Science and ProQuest search platforms were utilized to ensure that the models are a part of high-quality academic work and are extracted from a broad range of disciplines and research areas. Furthermore, the search strategy included utilization of search terms, Boolean operators, limiters, and a set of inclusion criteria to ensure a rigorous approach to identify relevant literature. First, the objective (i.e., a model of staff or organizational resilience across General, Healthcare or Emergency Department levels) was broken into three distinct concepts and a set of search terms associated with each concept was developed. The first set of search terms was

associated with the Target Construct (i.e., resilience capability). Two separate categories for this set of search terms were developed: search terms associated with resilience capability of organizations and terms related to resilience capability of staff. While certain search terms from both categories overlapped, two separate sets of search terms associated with resilience capability were developed to ensure that the distinctive elements that exist between these areas (i.e., organization and staff) are captured. The second set of search terms was related to the Target Context (i.e., General, Healthcare or Emergency Department levels). Two separate categories for this set of search terms were also developed (i.e., for organization and for staff). Finally, the third set of search terms was developed that is associated with the Target Finding (i.e., Conceptual Model). These search terms were the same across organization and staff areas. All sets of search concepts and associated final search terms are summarized in Table 1. It is important to mention that while other search terms were also tested, the terms presented in the table were found to provide the most rigorous search and are suggested for other researchers to use.

Target Construct		Target Context		Target Finding
Organization	**Staff**	**Organization**	**Staff**	**Organization & Staff**
resilience resilient performance organizational resilience business resilience strategic resilience	resilience resilient performance individual resilience workplace resilience professional resilience psychological resilience	organization emergency response organization healthcare hospital emergency department emergency room emergency medicine	staff employee individual worker emergency response staff emergency response worker healthcare staff hospital staff emergency department staff emergency room staff nurses physicians doctors	model conceptual model framework conceptual framework pattern strategy

Table 1. Phase 1: Search Terms

The search terms were used and logically combined using Boolean operators (i.e., AND, OR) to find the most appropriate material across both organizational and staff areas. For example, the operator AND was used to combine the search terms that belong to different categories (i.e., Target Context, Target Construct, Target Finding), while Boolean operator OR was used between the search terms that are associated with the same concept. These logically combined search terms were set to be identified in the titles or abstracts. Further, the limiters applied to the search results included English language, Scholarly journals or Thesis and Dissertations as a Source Type and Last 15 years as a Publication Date. The identified models were evaluated and selected according to the following primary inclusion criteria: the presence of variables/factors associated with resilience, alignment with the focus of the study, alignment with all or some of the research questions of the study, and a recent publication date (i.e., less than 15 years) of the article from where the model was extracted. The secondary inclusion criteria included the number of citations per year, impact factor of the journal at the time the article was published, comprehensiveness, rigor, operationalization of key constructs, and validation. Models of organizational and staff resilience across three levels (General, Healthcare, and Emergency Departments) that met the primary inclusion criteria as well as all or some of the components of secondary inclusion criteria were selected and included in the analysis. Any identified gaps in the models (e.g., lack of ED staff models or absence of certain dimensions in the models) were emphasized in chapters 4 (i.e., Results) and 5 (i.e., Discussion).

Inductive Thematic Analysis

After the models were selected, Thematic Analysis was applied to inductively synthesize elements of the models and develop the Initial Model of ED staff resilience. Thematic Analysis is an iterative

process of identifying, analyzing, interpreting, and establishing patterns or themes within a set of qualitative data (Clarke et al., 2015; Ando et al., 2014). TA involved three consequent coding techniques (i.e., open coding, axial coding, and selective coding), which are described in the following sub-sections.

Open Coding

This initial stage of coding involved a process of identifying as well as extracting initial concepts and insights (Williams & Moser, 2019; Ando et al., 2014). Each model was first reviewed independently and key concepts and elements from each model were extracted. Furthermore, formal definitions of all identified elements of the models as well as the categories they belong to were recorded the way they were defined by the authors of the papers. As a result of open coding, a total of 459 raw codes were extracted from the models.

Axial Coding

During the axial coding stage, the codes extracted during the open coding phase were compared and categorized into conceptual groups based on the guiding framework (Strauss & Corbin, 1998). The extracted data were categorized into different dimensions of resilience such as characteristics of resilience, motivating factors, factors affecting resilience, triggers, and outcomes. Characteristics of resilience include the indicators of presence or absence of staff resilience capability such as the ability of staff to successfully anticipate, respond, adapt, and recover in a changing environment. Motivating factors include the reasons why EDs and ED staff need to be resilient. Triggers are the unexpected disruptive events that ED staff need to be resilient against. The outcomes of resilience are the results and benefits of having resilient staff in an organization. Factors affecting resilience are a set of variables, the presence or absence of which impacts

individual's or organization's ability to be resilient. Any other observed dimensions were also included as needed during the synthesis.

The relationships between the main categories were also established. Furthermore, code definitions and structure (i.e., hierarchical category system) were developed and refined (Ando et al., 2014). These matched and categorized codes were then integrated into a single codebook – a table containing all established categories, corresponding to each category codes with their formal definitions, the frequency of each variable as well as the sources (i.e., papers from which models were extracted) that contained those variables.

Selective Coding

During the Selective coding stage, the raw data from the publications containing selected models was revisited and compared against the developed initial model (i.e., codebook). The goal of this coding phase was to find and determine any gaps or inconsistencies that might have existed and to refine the code definitions and structures. Furthermore, one of the goals of selective coding stage was to seek expert opinions and feedback on the developed initial model (code definitions and structure) to further refine it. Since Thematic Analysis is an iterative process, iterations between selective and axial coding were conducted to refine the code definitions and structure until saturation was reached, which consists of reaching a point when further iterations between coding stages do not provide any additional codes or themes (Ando et al., 2014).

3.2.2 Phase 2 – Preliminary Model Validation

The purpose of Phase 2 was to evaluate the strength of the Initial Model and determine how well the Model reflects the actual response of Emergency Departments during mass disruptive events.

Therefore, the model was further tested using published Empirical Case Studies that describe the response of Emergency Departments in the US when facing acute events. It is important to mention that even though this study focuses on investigating resilience, the case studies did not necessarily need to explicitly address this attribute. It was critical at this stage that the case studies focus on thoroughly describing the response of Emergency Departments in the US to unexpected disruptive events such as mass casualty events. The Case Studies were first identified and selected as a result of Traditional Literature Review and then deductively evaluated to investigate how well the Initial Model represents the actual response of EDs.

Traditional Literature Review

To find and select Case Studies that describe how Emergency Departments and/or Emergency Department staff deal with mass casualty events in the US, a second Traditional Literature Review was conducted. Google Scholar, ProQuest, and Web of Science search platforms were selected due to their coverage of high-quality academic work across a broad range of disciplines.

To best identify appropriate Case Studies, a search strategy was developed that included search terms, Boolean operators, limiters, and a set of inclusion criteria. The objective of this stage (i.e., identifying case studies of Emergency Department response to mass casualty events) was broken into four distinct concepts and a set of search terms associated with each concept was created. The first set of search terms was related to the Target Context (e.g., Emergency Department organization). The second set of search terms was associated with the Target Construct (i.e., the steps that EDs take during an unexpected disruption). The third set of search terms was associated with Triggers (i.e., types of events that prompt EDs and ED staff to be resilient). This search concept set included general terms that are used to describe adverse events as well as specific terms

(i.e., categories of mass casualty events as well as specific disasters). The final category of search

terms was associated with the Target Finding (i.e., a case study). Boolean operators were utilized

between the search terms to find the most appropriate content. These logically combined search

terms were set to be identified in the titles or abstracts. All these sets of search concepts and

corresponding search terms are summarized in Table 2.

Target Context	Target Construct	Trigger		Target Finding
emergency department emergency room emergency medicine emergency care hospital	response actions strategy performance	**General**	**Specific**	case study
		disruptions unexpected disruptions mass disruptions mass disruptive events adverse events acute events mass casualty events disaster major incident incident	human-caused disasters terrorist attack suicide bombings bombings active shooter shooting accidents natural disasters hurricanes nuclear explosions tornadoes tsunami earthquakes wildfires floods storms pandemics organizational transformation organizational structure	

Table 2. Phase 2: Search Terms

The limiters applied to the search results included English language, United States as a location,

Last 25 years as a Publication Date and Scholarly Journals as a Document Type. The retrieved

Case Studies were evaluated and selected based on primary and secondary inclusion criteria. All

selected Case Studies had to meet primary inclusion criteria as well as some or all of the secondary

inclusion criteria. The following primary selection criteria was defined: focus on the research area

(i.e., the Case Studies must describe a response of an ED to a mass-casualty event in the United

States) and recent publication date (the Case Studies should be published in the last 25 years). The secondary inclusion criteria included rigor, comprehensiveness, impact factor of the journal at the time the case study was published and number of citations per year.

<u>Deductive Evaluation of Case Studies</u>

In order to evaluate selected Case Studies against the Initial Model, a deductive approach was used. The primary purpose of this phase was to determine how well the model represents the evidence provided by the identified cases. If any gaps or inconsistencies were identified in the Initial Model (e.g., absence of certain dimensions of resilience, missing categories or variables, incorrect inter-relationships between dimensions), they were recorded, and the Initial Model was further refined and expanded. The Initial Model was also used to evaluate resilience of each case by investigating each of the dimensions (i.e., Triggers, Factors Affecting Resilience, Motivating Factors, Characteristics of Resilience, and Outcomes) and to identify whether any gaps existed in the identified case studies.

CHAPTER FOUR: RESULTS

This chapter presents the results of the two-phase study. In the first section, the results of Traditional Literature Review that identified conceptual models of staff and organizational resilience across General, Healthcare and Emergency Department organizations are summarized. Furthermore, basic observations and statistics of the identified models are presented. The section also provides a detailed description of Thematic Analysis results as well as presents a general diagram of resilience dimensions and their inter-relationships as well as a series of diagrams summarizing each dimension of resilience. The second section presents and discusses the results of Traditional Literature Review that was used to find and select Empirical Case Studies of Emergency Department response to mass casualty events. It also provides the results of Case Study analysis as well as identified gaps and inconsistencies in the Initial Model, gaps in the case studies and presents a revised model of staff resilience.

4.1 Initial Model Development

As a result of first literature review, a total of 25 conceptual models were identified with at least one model per level and area: General Organizational Resilience (n=7, 28%), Healthcare Organizational Resilience (n = 2, 8%), Emergency Department Organizational Resilience (n = 3, 12%), General Staff Resilience (n = 4, 16%), Healthcare Staff Resilience (n = 7, 28%), Emergency Department Staff Resilience (n = 2, 8%). It is important to know that all the citation information as well as frequencies and definitions of variables that were extracted from the models are provided in Appendix A.

The selected models primarily were represented in some form of a conceptual model (n = 23, 92%) or a table (n = 2, 8%). The selected models of resilience have also been identified across various disciplines, including engineering management, operations performance management, systems engineering, business management as well as organizational and industrial psychology. It is important to mention that the models were identified across a broad range of disciplines. The models identified from engineering management, systems engineering, and business management articles tended to focus more on resilience capability of an organization and investigating how resilience of staff, as one of the main resources of an organization, contributes to organizational resilience. Selected models from other disciplines, such as industrial and organizational psychology, primarily analyze resilience of employees as biological individuals and explore how resilience capability of an individual improves his/her life satisfaction and overall quality of life no matter what societal system (e.g., organization) they are in. Therefore, the models extracted from engineering management, systems engineering, and business management articles primarily study the societal role of staff resilience, while the literature on industrial and organizational psychology tends to investigate the organismic role of ED staff resilience. This study looks at both roles of these roles and investigates the distinction between staff resilience as a capability of individuals (i.e., organismic systems) and how staff members as organismic systems that fill societal roles contribute to resilience capability of societal systems (i.e., roles, teams, units, and the ED).

All 25 identified models were developed using literature review. While the majority (n = 16, 64%) of those models was developed purely as a result of literature review, only (n = 9, 36%) also utilized another approach such as case study analysis, field study, expert study, or Delphi study to

further develop, refine, or validate a model. Furthermore, since an important part of the TA stage of this study was the development of definitions for each variable, particular attention was paid to the formal definitions of the terms provided by the authors of selected models. Only 24% (n = 6) of the models included formal definitions of every variable present in the figure of the model. The majority of the models (n = 14, 56%) contained only definitions of certain terms, while 20% (n = 5) of the articles did not provide any description of the variables that were presented in the model. Another important observation was that both staff and organizational resilience models of Emergency Departments tend to be less rigorous and comprehensive compared to staff and organizational resilience models at Healthcare organizations and General organizations levels. These observations indicate low maturity of staff and organizational ED resilience research area and demonstrate the need in creating a model staff resilience.

As a result of Thematic Analysis, five main dimensions were identified: Resilience Capability, Factors Affecting Resilience, Characteristics of Emergency Department Complexity, Triggers and Outcomes. The relationship between main dimensions was established and the corresponding variables for each dimension were grouped into categories. An overall depiction of the primary dimensions of resilience and the inter-relationships between them are discussed which is followed by focused sections for each dimension. It is important to specify that even though Motivating Factors were one of the research questions of this study, as a result of TA, variables corresponding to this dimension were not present in the source documents. The results also identified a dimension that describes the complexity of ED organization and challenging nature of ED staff work environment. The following sections describe the results and analysis of this phase in more detail as well as present the Initial Model of Resilience.

4.1.1 Dimensions of Staff Resilience

The TA results identified five primary dimensions of staff Resilience: Triggers, Resilience Capability, Factors Affecting Resilience, Characteristics of ED Complexity, and Outcomes (Figure 8). Triggers have been defined as mass disruptive events that prompt Emergency Department and its staff to be resilient in order to overcome the challenges of the event. Resilience Capability is an ability of ED organizations to demonstrate resilience, which includes characteristics that indicate whether an organization and its staff are resilient or not. Factors Affecting Resilience include a set of variables, the presence or absence of which impacts organization's ability to be resilient. Characteristics of Emergency Department Complexity include the day-to-day complexity of ED organizations and challenging nature of ED staff work environment, which distinguishes Emergency Departments from other organizations, such as manufacturing organizations. Outcomes are what the Resilience Capability leads to or what an organization and its staff gain as a result of resiliently responding to a mass disruptive event.
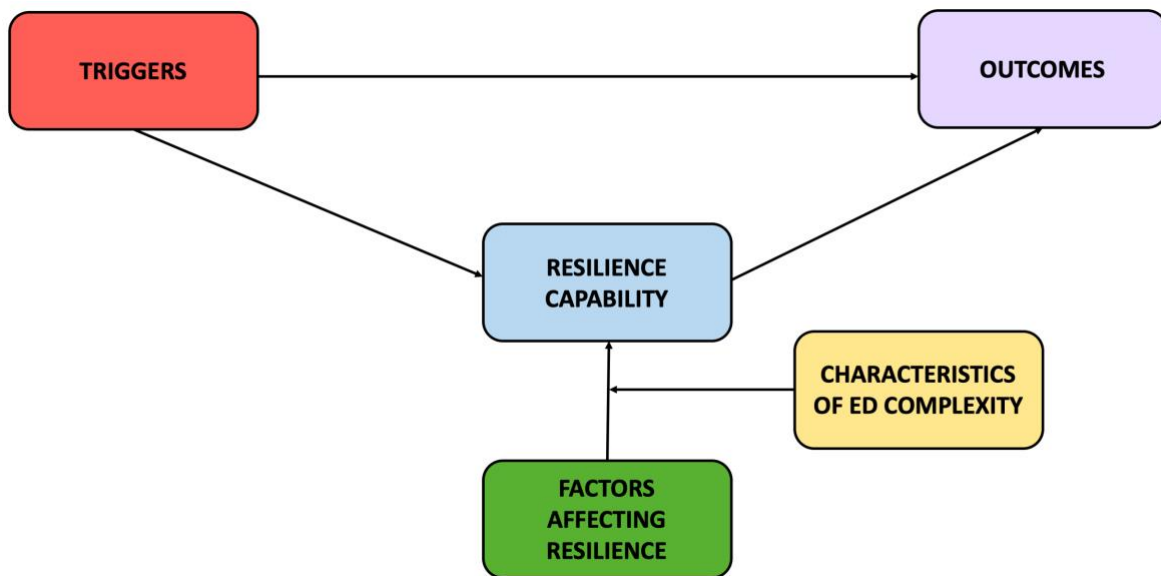
Figure 7. Dimensions of Staff Resilience

Apart from identified dimensions of Resilience, the relationships between them were established. Resilience Capability acts as a mediator between Triggers and Outcomes. By definition, mediators are variables that connect a cause (i.e., independent variable) and an effect (i.e., dependent variable) (Wu & Zumbo, 2008). The mediation model does not represent a direct relationship between independent variables (IV) and dependent variables (DV) (MacKinnon, 2011; Wu & Zumbo, 2008). Instead, the IV, in this case, Triggers, influence the mediator, Resilience Capability, and in turn, the mediator influences the DV, in this case, Outcomes (Wu & Zumbo, 2008). The types of triggers can affect the outcomes for both ED organizations and staff through the mediation of Resilience Capability.

The Characteristics of ED Complexities, on the other hand, act as a moderator between Factors Affecting Resilience and the actual Resilience capability. Moderator is defined as a variable that modifies the strength of an effect between two variables (Wu & Zumbo, 2008). In other words, the strength of the relationship between the factors that can potentially affect capacity of organization or individuals to be resilience and the actual resilience capability depends on the specific characteristics of day-to-day complexity and unique nature of Emergency Department environment.

4.1.2 Triggers

Triggers, as one of the dimensions of resilience, are defined as the unexpected disruptive events that ED staff need to be resilient against. A total of four main categories of Triggers were identified: Human-caused disasters, Natural Disasters and Hazards, Biological Disasters and Organizational Transformation (Figure 9). It is critical to define categories and specific events that

Emergency Departments and staff need to be resilient against, since this dimension distinguishes resilience from other organizational capabilities.
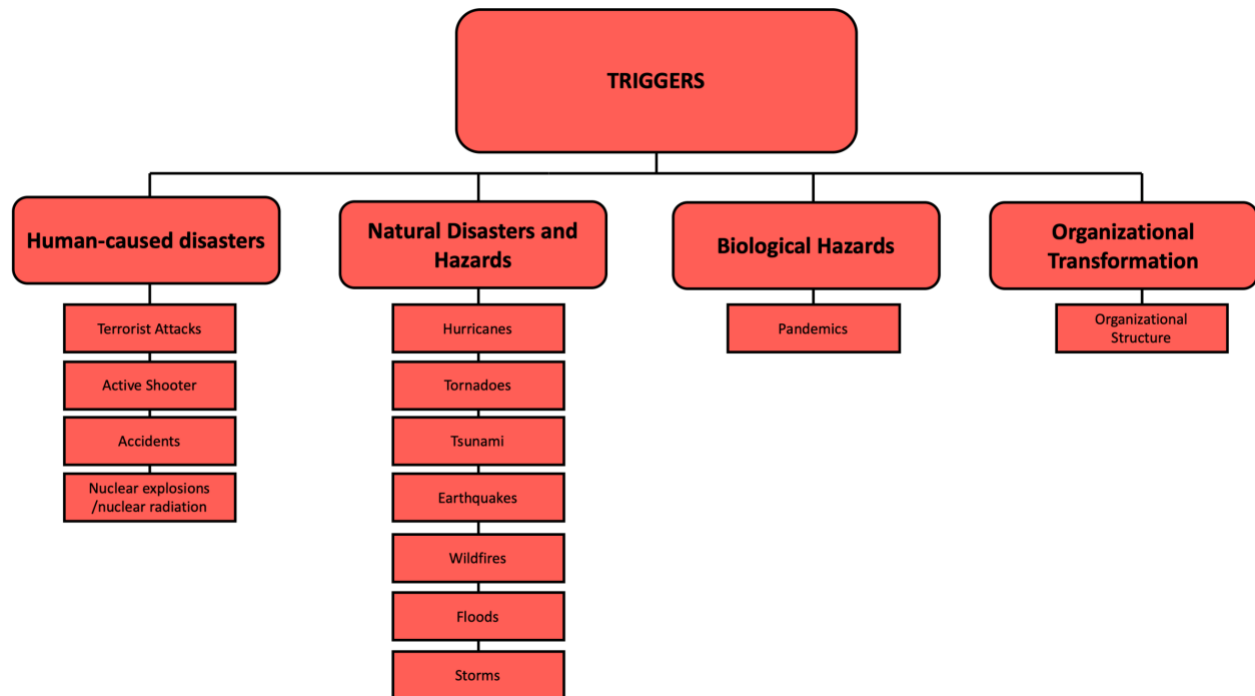
Figure 8. Triggers of Resilience

While all the selected models used for inductive synthesis implied or explicitly specified in the description that the model should be used as a response to unexpected disruptions, only two of them (n = 2, 8%) included specific types of mass casualty events in the actual model. Two of the publications (8%) identified variables that fall under *Human-caused Disasters* and *Natural Disasters* categories. On the other hand, variables such as *Pandemics* as a part of Biological Hazards and *Organizational Structure* existed only in one model (n = 1, 4%). The variables that belong to each of the categories of this dimension are quite objective, yet it is possible that other categories of events that prompt ED organizations to be resilient exist. This was further

investigated in section 4.2 that focuses on analyzing case studies of ED response to mass casualty events.

4.1.3 Factors Affecting Resilience

Factors affecting resilience is a dimension that include a set of variables, the presence or absence of which impacts organization's ability to be resilient. The Factors Affecting Resilience This dimension exists at three main levels: External, Aggregate, and Individual levels (Figure 10).
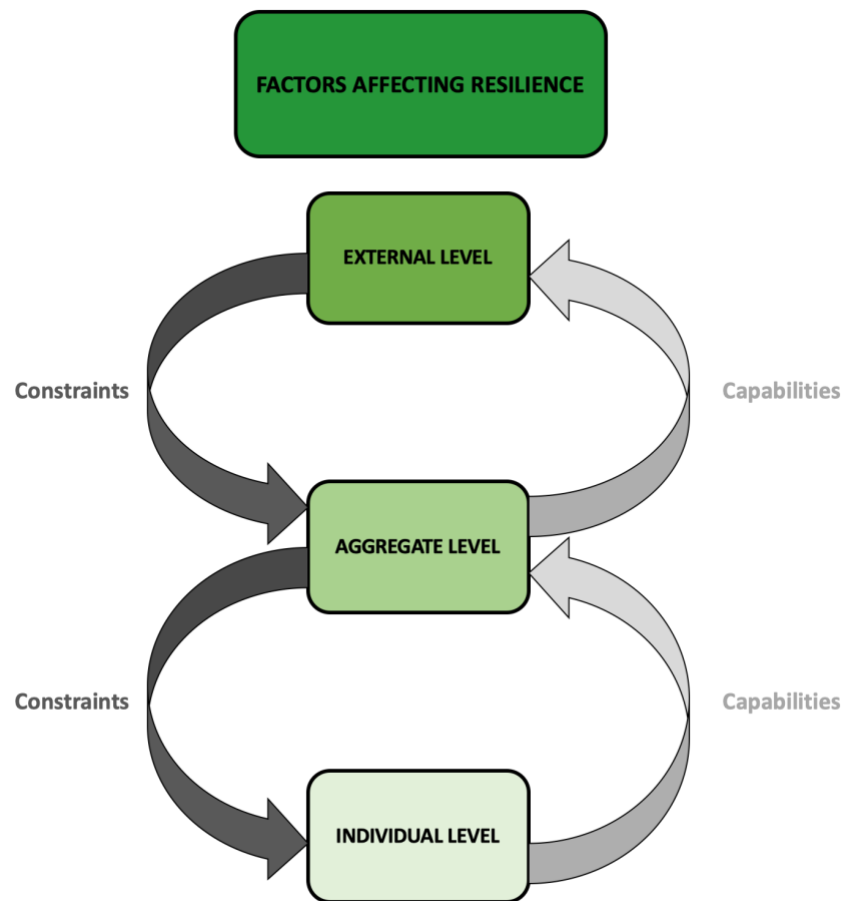
Figure 9. Factors Affecting Resilience: Three main levels.

As previously discussed, Emergency Departments are societal systems. Some argue that societal systems are fractal, meaning that they represent aggregates of lower-order societal subsystems

with multiple organismic systems. The societal system also includes aggregates of their capabilities, while being constrained by higher-order societal systems or ecosystems. This hypothesis was adopted in this study to help explain External, Aggregate, and Individual levels of factors affecting resilience. The External level represents factors that exist beyond the boundary of the Emergency Department and influence operation of ED organizations. These factors include both the factors of higher-order societal systems as well as the factors of ecosystems that they reside in. The Aggregate Level reflects the Emergency Department as well as its nested layers of lower-order societal subsystems with organismic systems (i.e., collection of units, teams, and individuals). The factors at this level represent aggregates of individual-level factors, while being constrained by the factors of external level. The Individual level represents factors associated with individuals, or in this study, ED staff members. Capabilities normally arise from the individual level and aggregate up to higher levels (i.e., aggregate level and external level). At the same time, each level is constrained by the level above it.

External Level

As previously defined, the External Level is represented by the factors of higher-order societal systems and ecosystems (Figure 11). Higher-order societal factors include Hospital factors, since EDs as societal systems operate within hospitals (i.e., higher-order societal systems). Ecosystem factors, on the other hand, consist of two main categories: Healthcare Sector factors and Socio-Cultural factors. It was observed that the external level or the associated with this level factors are rarely present in the identified models of resilience. In fact, the frequency of factors across all external level subcategories ranges from one (4%) to two (8%) instances. This stems from the fact that the studies focus more on the factors that exist within an organization, not recognizing that

the operations of an organization are usually constrained by the external-level factors. For example, a factor at the Hospital Level such as *Documentation and Reporting requirements* (n = 2, 8%) would affect ED operations. Documentation and Reporting requirements that are established by a hospital within which ED operates would also apply to documentation requirements for reimbursement as well as the requirements of reporting of quality measures in the Emergency Department.
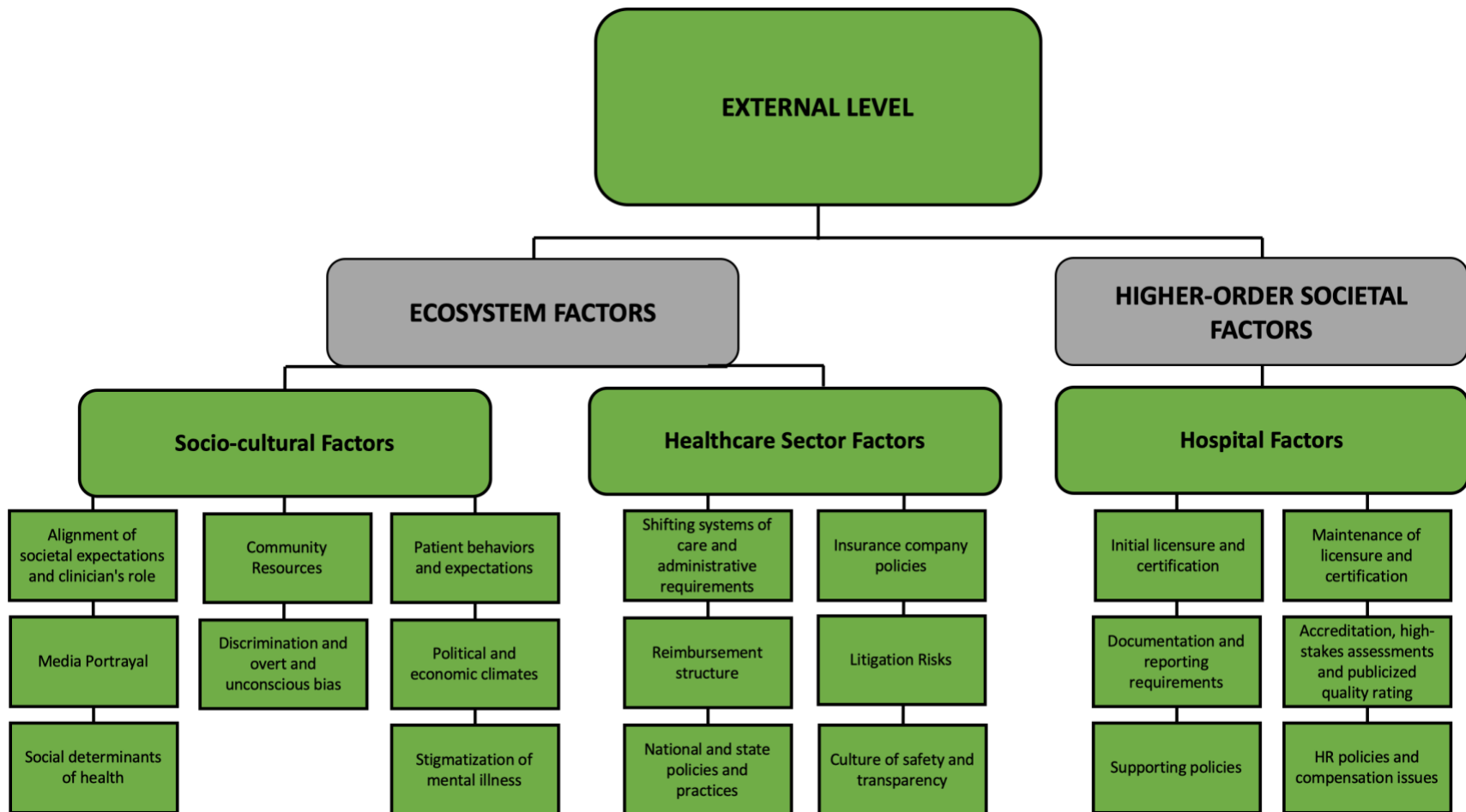
Figure 10. Factors Affecting Resilience: External Level

Another example could be an *Alignment of Societal Expectations and Clinician's role* (n =1, 4%), as one of the Socio-cultural factors, determines society's expectations about current level of Healthcare, modern medicine, understanding of medical conditions and the importance of treatment. This factor can put certain constraints on the level of trust, communication and interaction between a patient and an ED staff member that potentially effects the delivery of medical care and resilience of ED staff. Therefore, the operations and any other dynamics that exist in the Emergency Department would be directly affected and constrained by a number of factors that exist in hospital higher-order societal system as well as Healthcare sector and society (including state, region, country) ecosystems.

Aggregate Level

The Aggregate Level represents a collection of individuals, teams, units, or departments that make up an organization as well as an aggregation of their capabilities. This level, however, is constrained by the factors of external level, as discussed in the previous section. Aggregate level is represented by the societal factors and consists of two main categories: Workplace climate and Operational Setting (Figure 12). The Aggregate level of factors that affect resilience was represented in a large number of models, since the existing studies mostly focus on this particular level of resilience and organizational factors that affect it.

Workplace climate represents a set of factors that define an organizational culture as well as the behaviors and interactions between staff members, teams, or units. Therefore, the category of Workplace Climate was further broken into the following subcategories: factors that define organization's Learning and Practice Environment, Workplace Collaboration as well as Workplace Support. Learning and Practice Environment represents a set of factors that define whether an

organization supports and promotes learning, professional development, and mentorship. The factors with the highest frequency in this subcategory are: *Knowledge sharing culture* (n = 6, 24%), *Organizational Learning* (n = 5, 20%) and *Learning Culture* (n = 4, 16%). These factors define whether an organization focuses on creating the opportunities for mutual learning through the process of creating, retaining as well as sharing knowledge and skills within an organization and its teams, units, and departments.

Workplace Collaboration subcategory focuses on the factors that define how well individuals, teams and other organizational units interact in order to achieve a common goal. The factors that were found to be particularly important due to their high frequency are *Leadership* (n = 7, 28%), *Implicit Communication* (n = 5, 20%), *Explicit Communication* (n = 5, 20%), *Collaboration* (n = 3, 12%), *Professional Relationships* (n = 3, 12%), *Staff Participation and Involvement* (n = 3, 12%). The high frequency of these specific factors indicates that strong leadership and staff management as well as effective communication are the foundation of a successful workplace collaboration.

Workplace support subcategory mainly focuses on determining how well an organization establishes an environment where employees feel safe, welcome, supported, and included. The factors in this group have a relatively low frequency (n = 2, 8%). However, while the majority of the identified models do not include these factors, the articles containing these models explicitly emphasize the importance of workplace support for ED staff.
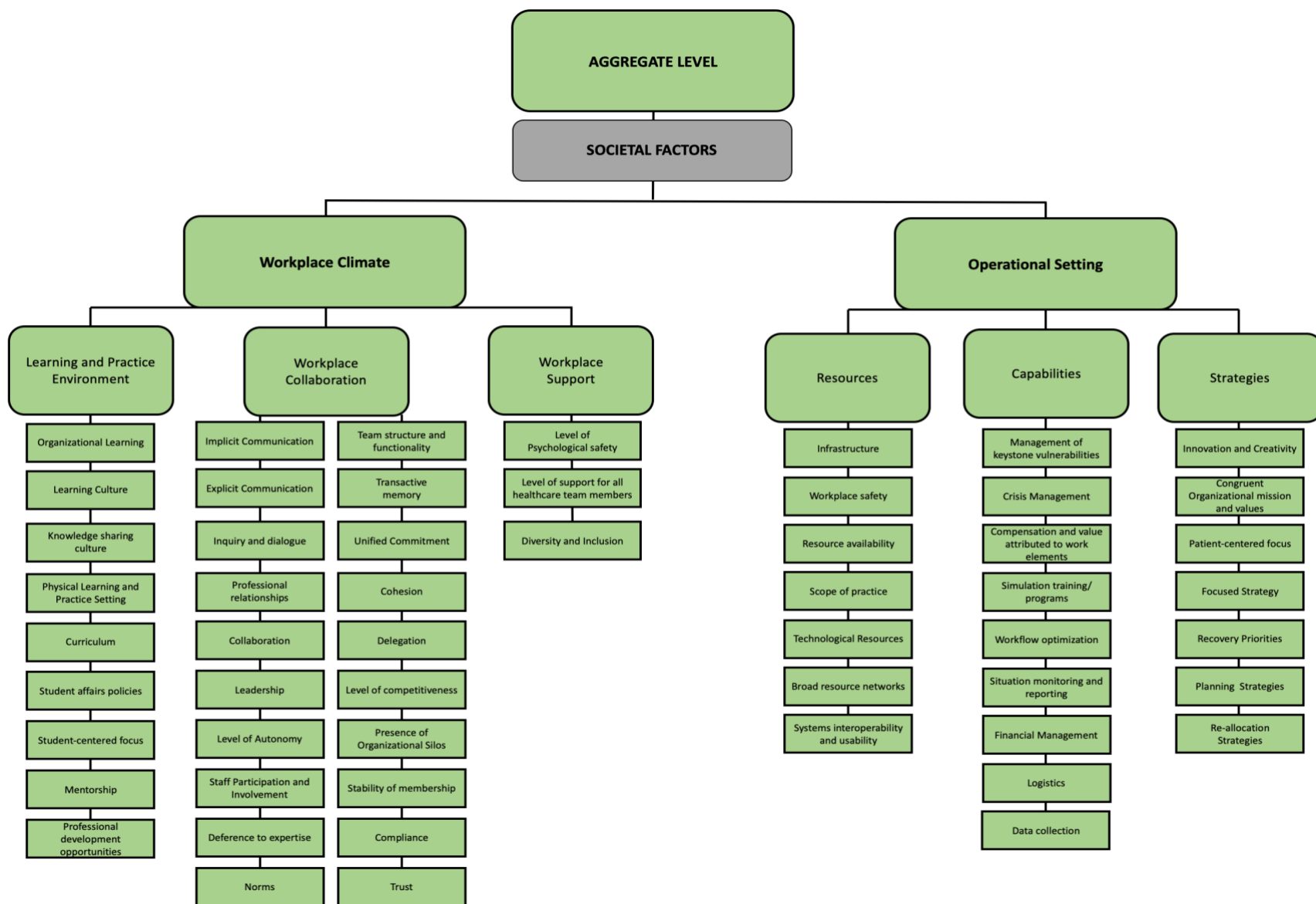
Figure 11. Factors Affecting Resilience: Aggregate Level

Operational Setting category of Aggregate Level focuses on defining resources, capabilities and strategies of an organization needed to successfully deliver its missions. Resources are organization's assets. Such factors as *Resource Availability* (n = 5, 20%)*, Workplace Safety* (n = 3, 12%)*, Technological Resources* (n = 3, 12%) as well as *Systems Interoperability and Usability* (n = 3, 12%) were found to have the highest frequency among organizational resources that affect resilience capability. Factors that belong to the Capabilities subcategory assess organization's ability to successfully utilize its resources. Some of the most commonly hypothesized factors in this subcategory are *Financial Management* (n = 4, 16%)*, Management of keystone vulnerabilities* (n = 3, 12%), as well as *Situation Monitoring and Reporting* (n = 3, 12%) which is an ability to determine what is likely to become a threat for an organization and its operations in the near future. The Strategy subcategory consists of factors that define how EDs allocate their resources to achieve their goals. These factors include organization's mission, primary focus, values, and various strategies. The factors in this subcategory are particularly important for resilience capacity in EDs. A successful utilization and allocation of organization's assets significantly contributes to the ability of an organization to anticipate, respond, and recover from unexpected disruptions.

Individual Level

The Individual Level represents a number of factors associated with individuals that could potentially affect their ability and the ability of an organization they work in to be resilient. Overall, an Individual Level is represented by both Organismic factors and Societal factors (Figure 13). Organismic factors are the variables that are inherent within individual people and would always exist no matter what societal system an individual belongs to such that they would remain unchanged even if an individual changes a societal system. On the other hand, Societal factors,

that are also associated with the role that an individual staff member inhabits, would change depending on the societal system within which a person is exists. While organismic factors always remain the same and societal factors change, individuals would still carry both of these types of variables into a certain Societal System. Therefore, an ED staff member would bring both organismic and societal factors into the Emergency Department (i.e., societal system).

Organismic Factors are represented by Personal Factors that include Personality Traits, Biological Factors, Socio-economic Factors and Cultural Factors. These Personal Factors are not necessarily associated with individual's job duties. Instead, these factors remain the same no matter what organization an individual is in. However, Personal Factors describe qualities and attributes of an individual that can potentially affect his/her ability to demonstrate resilience and contribute to organization's ability to be resilient. The frequency of Personality Traits variables across identified models was relatively (i.e., between n =1, 4% and n = 2, 8%), the models presented a wide range of personality traits. These factors that mainly focus on individual's ability to persevere, believe in his/her abilities and positive outlook. Furthermore, while some of these variables were defined as factors affecting resilience in certain models, other authors defined them as characteristics of staff resilience. This is discussed in more detail in *Characteristics of Staff Resilience* subsection.

Other factors such as Biological, Socio-Economic, and Cultural were also found to frequently studied in relation to resilience. *Physical and Mental Well-being* (n = 3, 12%)*, Relationships and Social Support* (n = 4, 16%), *Family Dynamics* (n = 3, 12%) were among some of the factors that were commonly present in the models and discussed in the articles. While these variables describe factors that occur outside of the work
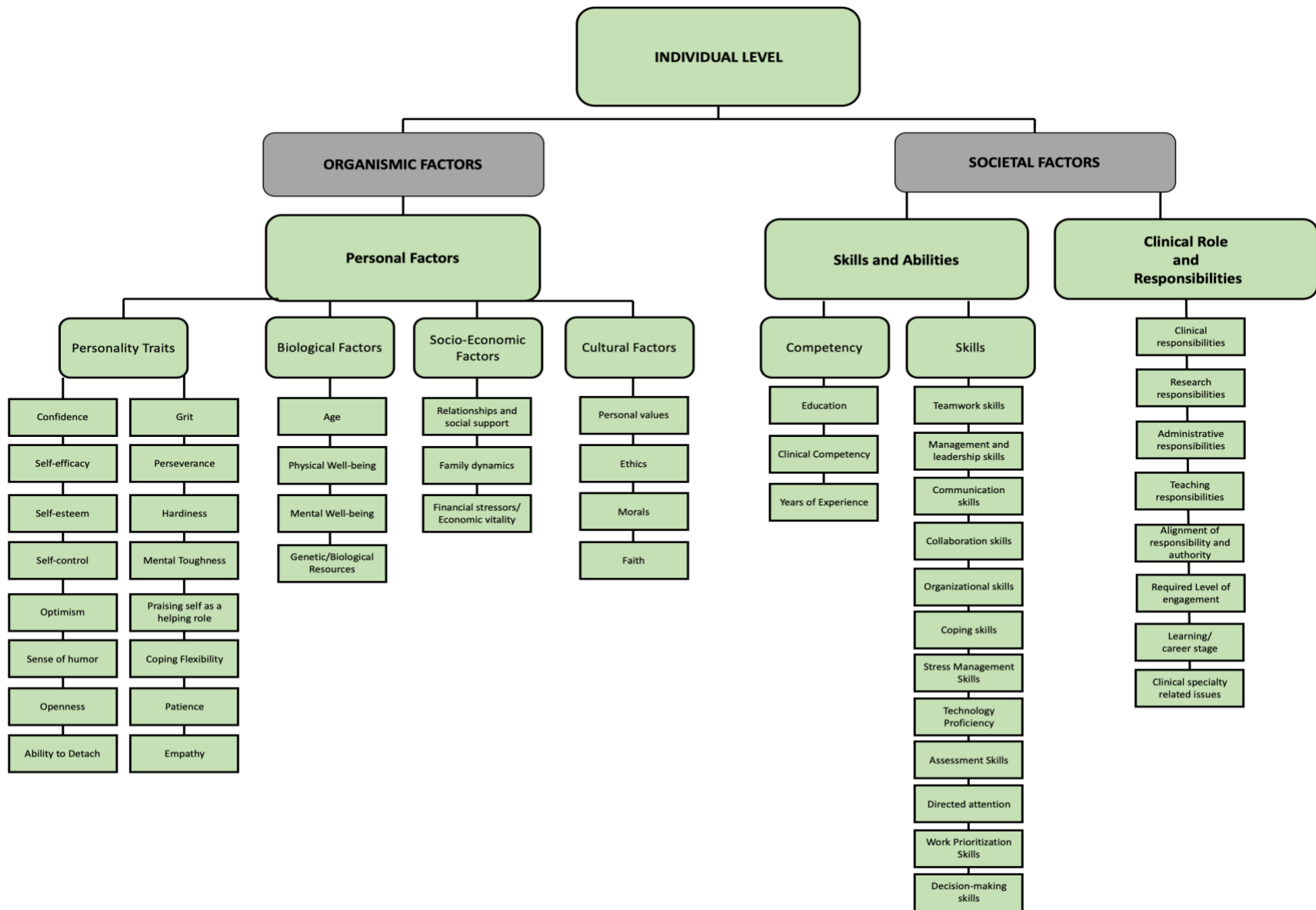
Figure 12. Factors Affecting Resilience: Individual Level

environment, they can significantly affect work performance of an individual and, thus, resilience capability. Poor well-being, lack of social support or negative family dynamics could directly prevent an ED staff member from successfully performing their job duties.

On the other hand, Societal Factors are directly related to the societal system that a person belongs to. In this case, societal factors of an ED staff member would be directly associated with his/her job duties and responsibilities in the Emergency Department. Societal Factors in the diagram are represented by two categories: Skills and Abilities as well as Clinical Role and Responsibilities. Skills are Responsibilities category consists of Competency and Skills – factors that an organization would be particularly interested in, especially when considering an individual for a particular role. Some of the factors in this section with the highest frequency are *Education* (n = 3, 12%)*, Years of Professional Experience* (n = 2, 8%)*, Clinical Competency (*n = 3, 12%)*, Communication and Collaboration Skills* (n = 2, 8%)*, Decision-making skills* (n = 3, 12%) *and Coping Skills* (n = 4, 16%).

The Clinical Role and Responsibilities subsection focuses on the job duties of an ED staff member depending on their position or role. These duties are not only related to *Clinical*, but also various *Administrative*, *Research* and *Teaching Responsibilities*. It is important to mention that that the frequency of all the variables is low (n = 1, 4%), which indicates that most of the authors did not consider that this category could potentially affect resilience. However, the career stage that determine work schedule or number of work hours, as well as the duties that must be also completed on top of clinical responsibilities, can further compound the complex and challenging nature of ED staff member's work, therefore affecting their capability to be resilient.

4.1.4 Resilience Capability

Resilience Capability is one of the main dimensions of resilience. It demonstrates how ED staff, while providing their societal role in the ED system, contributes to resilience capability of an Emergency Department. The structure of the resilience capability dimension follows the formal definition of resilience which defines resilience at three consequent stages: Anticipation, Response and Recovery. As previously discussed in this document, Resilience is often compared to other similar capabilities such as *Redundancy* (n = 2, 8%), *Resourcefulness* (n = 2, 8%), *Agility* (n = 2, 8%), *Flexibility* (n = 3, 12%), *Adaptability* (n = 2, 8%), *Robustness* (n = 2, 8%) and *Rapidity* (n = 2, 8%). that were also identified in the models of Resilience. While there exist certain distinctive elements between these capabilities and Resilience, they generally have common features with resilience and can be utilized to achieve, characterize, and assess Resilience Capability at different stages. The diagram summarizing the Resilience Capability dimension is presented in Figure 14.
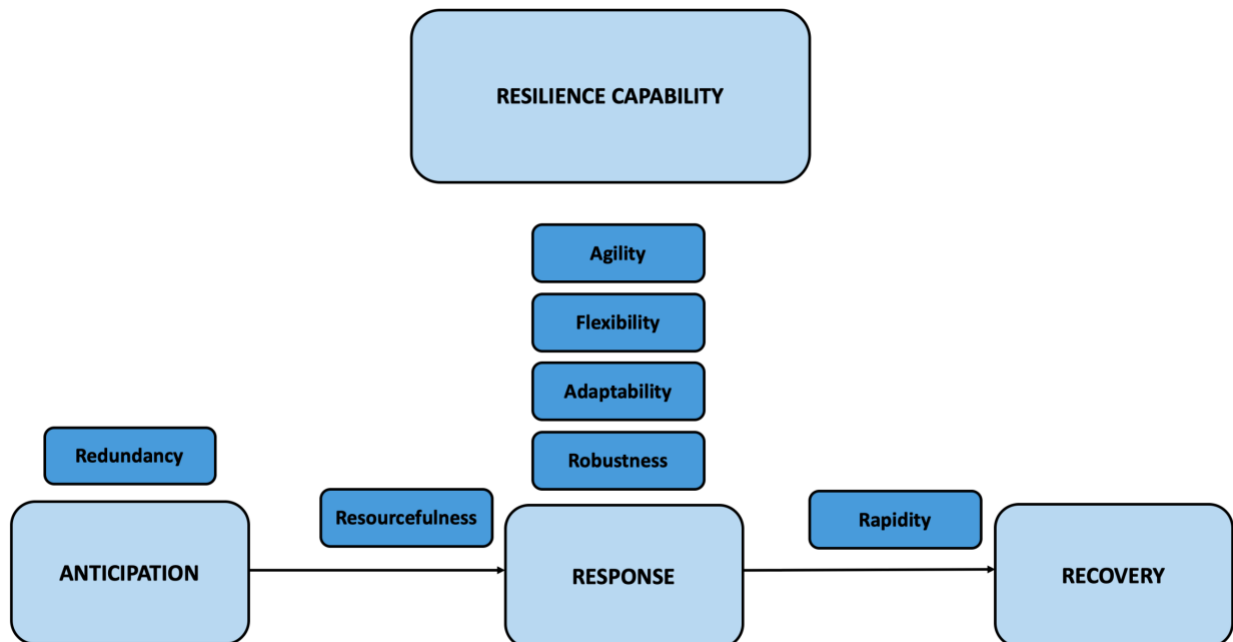
Figure 13. Resilience Capability: Three stages

For example, Resilience Capability of an organization at an Anticipation stage can be assessed through *Redundancy*, which is defined as a strength or extent to which elements, systems, or other units in the organization currently exist that are capable of meeting functional requirements in the event of disruption (Bruneau et al., 2003). *Resourcefulness* determines how well an organization identifies problems, defines priorities, mobilizes, and applies its resources to successfully achieve its missions. Therefore, it can be considered as a proper capability to evaluate the transition from an anticipation stage and preparation to response (Zhong et al., 2014).

Such capabilities as *Agility*, *Flexibility*, *Adaptability* and *Robustness* focus on assessing organization's ability to quickly and effectively cope, adjust and adapt without suffering damage and therefore, can be utilized to characterize the Response stage of Resilience. *Rapidity*, on the other hand, assesses organization's speed to bounce back, restore and recover from an unexpected disruption and, thus, is used to evaluate the Recovery stage of Resilience (Kantur & Iseri-Say, 2012). The next subsections will discuss the characteristics of each stage of Resilience in more detail.

Anticipation

The Anticipation stage of Resilience Capability represents how well an organization is aware of potential risks and prepared to face a mass disruptive event while successfully delivering its mission (Figure 15). First, Anticipation includes preparedness of three main resources of an Emergency Department: Infrastructure/space, staff, and supplies/equipment. The frequency of these characteristics of ED Resilience Capability at Anticipation stage is low: *Infrastructure Preparedness* (n = 1, 4%), *Staff Preparedness* (n = 2, 8%) and *Supply Preparedness* (n = 2, 8%). While most of the articles on resilience in Emergency Departments explicitly discuss these characteristics, they are rarely seen in the models. This could be due to the fact that these concepts

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are exclusively associated with the characteristics of ED operations and therefore, they could only possibly exist across models of Organizational or Staff resilience in Emergency Departments.

Some of the examples of *Infrastructure Preparedness* includes a number of strategies that can be used to evacuate ED patients and staff as well as alternative backup systems and appropriate building codes that help withstand damage in case of natural disasters, for example. Furthermore, as previously mentioned, *Supply Preparedness* is another component of Resilience capability at Anticipation stage that involves availability of essential medical supplies for all types of disasters as well as established plans and strategies for management of these supplies in case of an unexpected disruption of any category.

Staff Preparedness involves an ability of staff to understand disaster management and demonstrate skills of disaster treatment. Furthermore, management strategies for staff should be established, including staff role reassignment plans and strategies for possible recruitment of staff from other departments. *Staff Preparedness* also involves protective and incentive strategies for staff. It is important to mention that while this diagram demonstrates how ED staff contributes to Resilience Capability of an Organization, they also exhibit their own characteristics of resilience that determine whether ED staff members, as individuals, are resilient. These characteristics of individual resilience are discussed in more detail in Characteristics of Staff Resilience section.
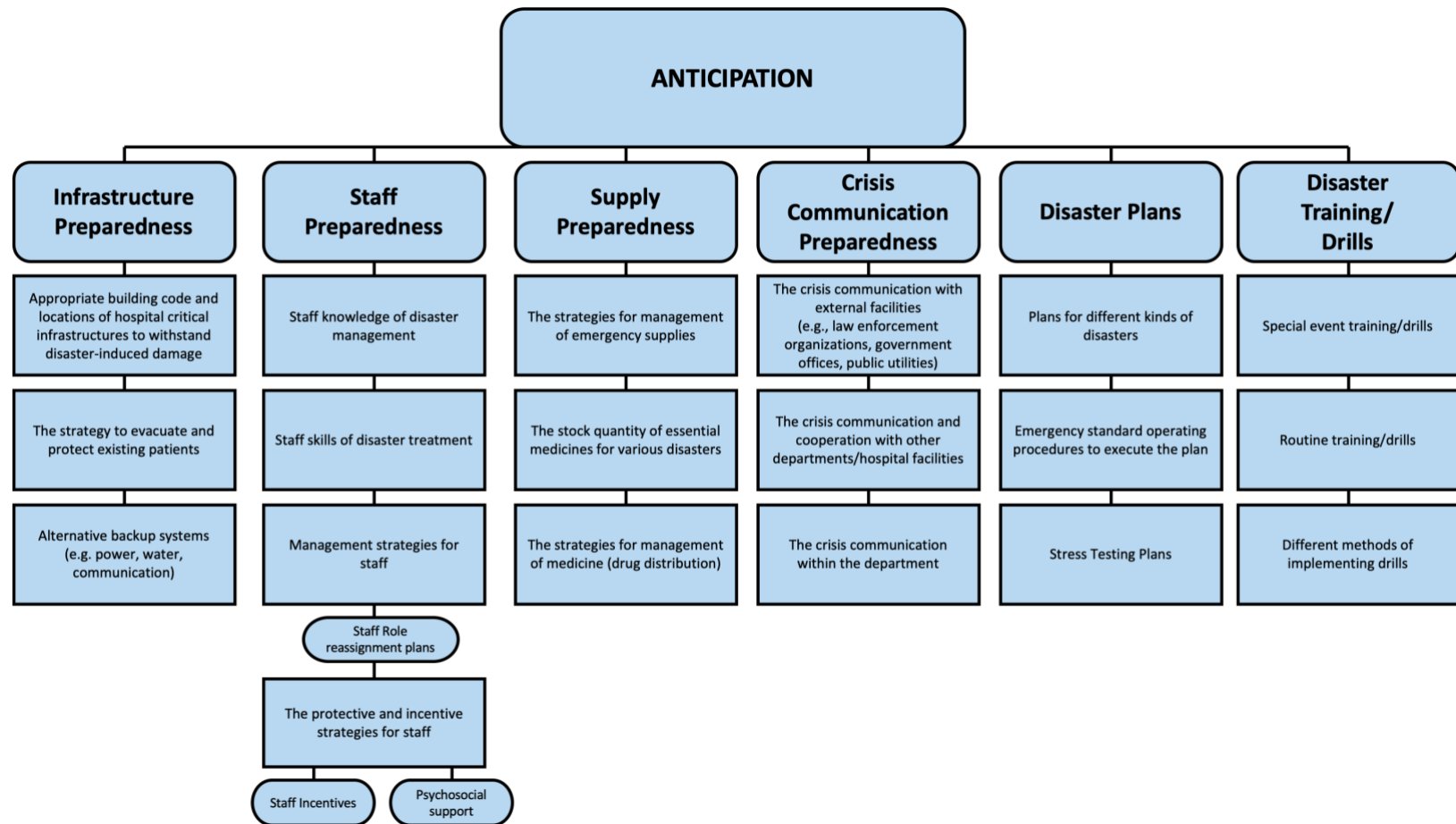
Figure 14. Resilience Capability: Anticipation

Crisis Communication Preparedness (n = 2, 8%) focuses on the ability of organization to maintain communication during any time of incident within the Emergency department, with other hospital facilities and departments, as well as other societal systems, such as emergency response teams. Establishment of *Disaster Plans* (n = 4, 16%) and *Disaster Training/Drills* (n = 4, 16%) are important indicators of anticipation stage in organizational resilience, that were included in a number of identified models or explicitly defined and described in the text. It is critical for an organization to establish disaster plans for every event category, taking into account the specific characteristics of that event as well as conducting training and disaster drills to ensure that an organization, including staff, is prepared to respond to any kind of event at any time.

Response

Three main categories of characteristics associated with the resilient *Response* of an Emergency Departments to unexpected disruptions were identified: *Surge Capacity*, *Continuity of Essential Services* and *Adaptation* (Figure 16). The frequency of the characteristics of Resilience at the Response stage is low, since most these features of resilience are specifically associated with the nature of ED environment and its mission, compared to other hospital departments or organizations. First, the Respons*e* stage of Resilience focuses on evaluating the strategies of organization for *Surging Staff, Space* and *Supplies* (n = 1, 4%). These strategies include staff role reassignment, calling in and transferring staff from other non-critical departments, utilizing additional space, or using equipment or supplies from other departments.

Second, since one of the main characteristics of resilience is Emergency Department's ability to *Continue Essential Services* (n = 1, 4%), including admission and treatment of patients not
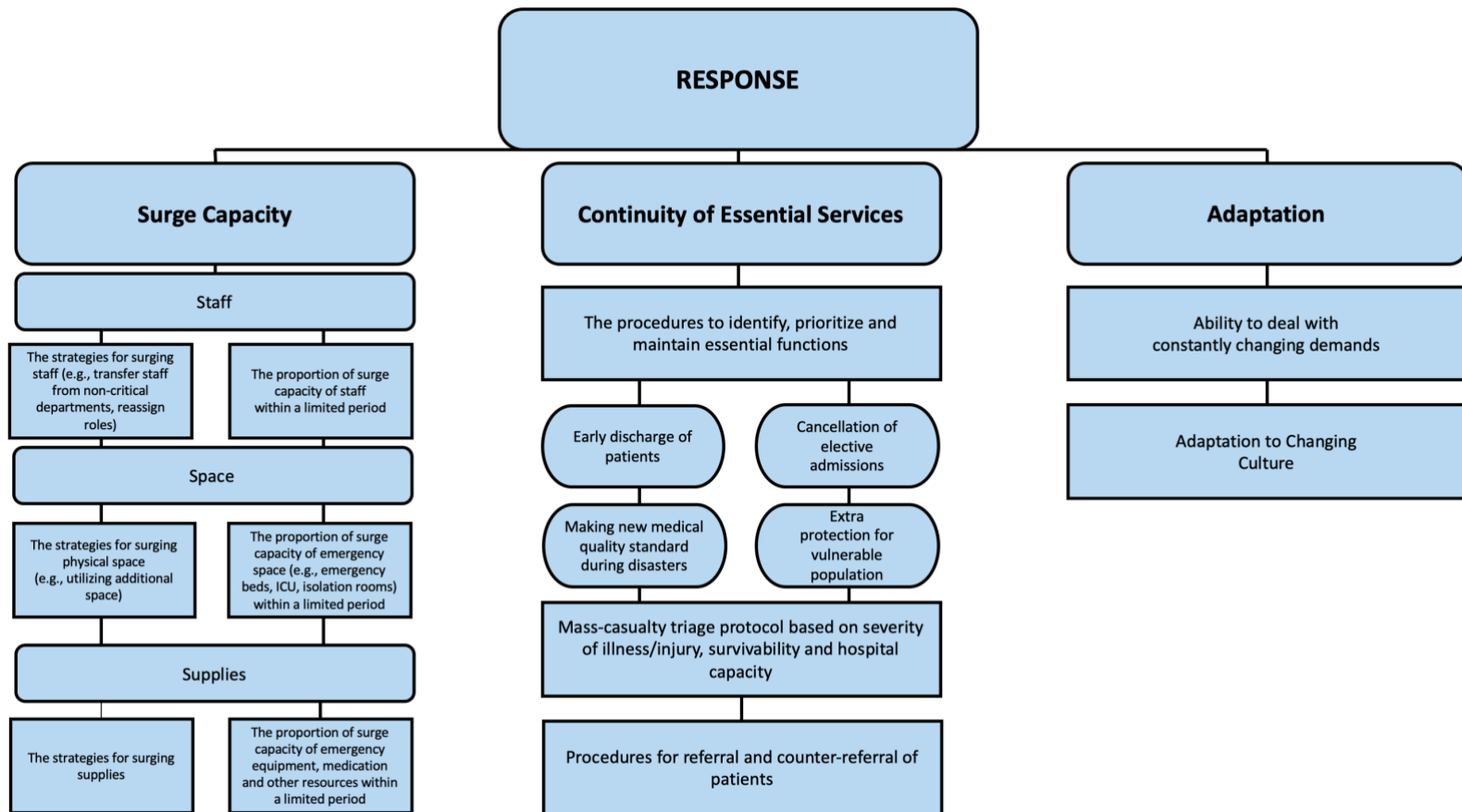
Figure 15. Resilience Capability: Response

associated with ongoing unexpected disruption. In order to successfully manage this situation and provide quality care, some of the strategies that are usually implemented by resilient EDs include early discharge of patients, cancellation of elective admissions, establishment of triage protocols either based on the severity of injury or the type of injury as well as transferring patients to other units. Third, based on the definition of resilience, successful *Adaptation* (n = 4, 16%) is one of the processes that occurs in resilient organization during the Response stage. Adaptation includes an ability of organization and its staff to adapt to constantly changing demands, culture, and dynamics in the Emergency Departments.

Recovery

The *Recovery* stage of Resilience Capability is characterized by organization's ability to return to its normal pre-incident operations as well as learn from the experience and identify the areas that need improvement in order to more successfully cope with an unexpected disruption in the future. The models of resilience generally identified three main categories of Recovery: *The Evaluation Report* (n = 1, 4%), *Identification of Improvement Areas* (n = 2, 8%), *Strategies for Recovery* (n = 4, 16%) (Figure 17).

These categories are also sometimes represented as three stages. After the event, an Evaluation report is created that summarizes the nature if the disruption, describes the response and assesses various areas of the response. Based on the assessment, the areas that require improvement are identified. These areas are mostly associated with resources, capabilities, or strategies of an organization, including staff, infrastructure, supplies, communication, and disaster plans. At the same time, while the Evaluation report is created to assess the response and develop future strategies to better cope with the event in the future, strategies for the recovery of the organization
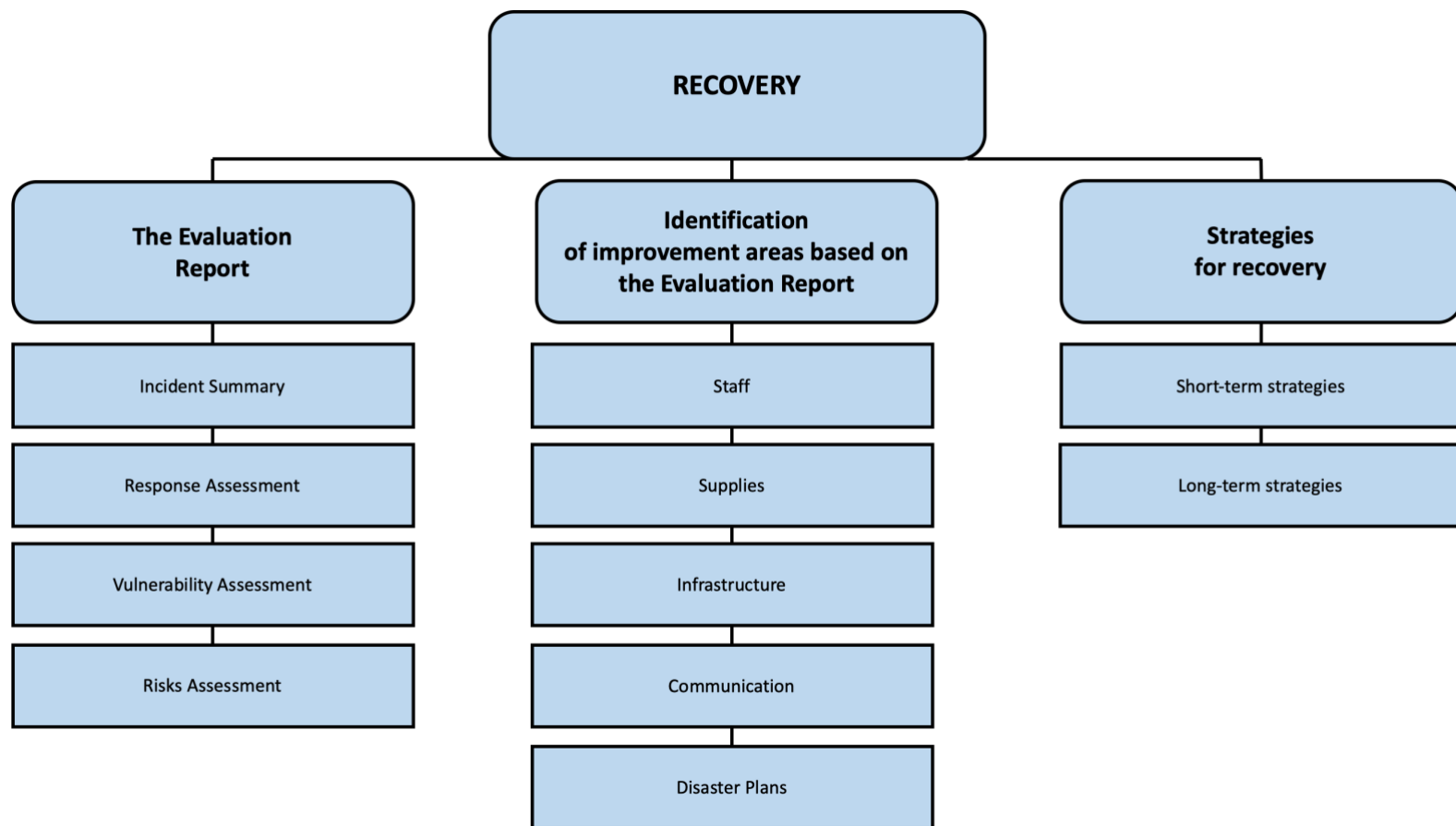
Figure 16. Resilience Capability: Recovery

are established depending on the impact of the incident on the Emergency Department and its staff. They include both short-term and long-term strategies for recovery. While the models and descriptions discuss generalizable recovery process and do not provide enough detail concerning possible recovery strategies and post-event actions in order to better respond to an incident in the future, this stage of resilience will be further analyzed and discussed in section 4.2 (i.e., Preliminary Model Validation).

Characteristics of Staff Resilience

While the Resilience Capability dimension of the Initial Model demonstrated how resilience of ED staff, as one of the main resources of EDs, contributes to organizational resilience capability at three main stages of resilience (i.e., societal sole of staff resilience), staff members, as individuals, also exhibit certain characteristics that indicate their personal resilience (i.e., organismic role of staff resilience). The diagram that shows Characteristics of Staff Resilience is presented in Figure 18.
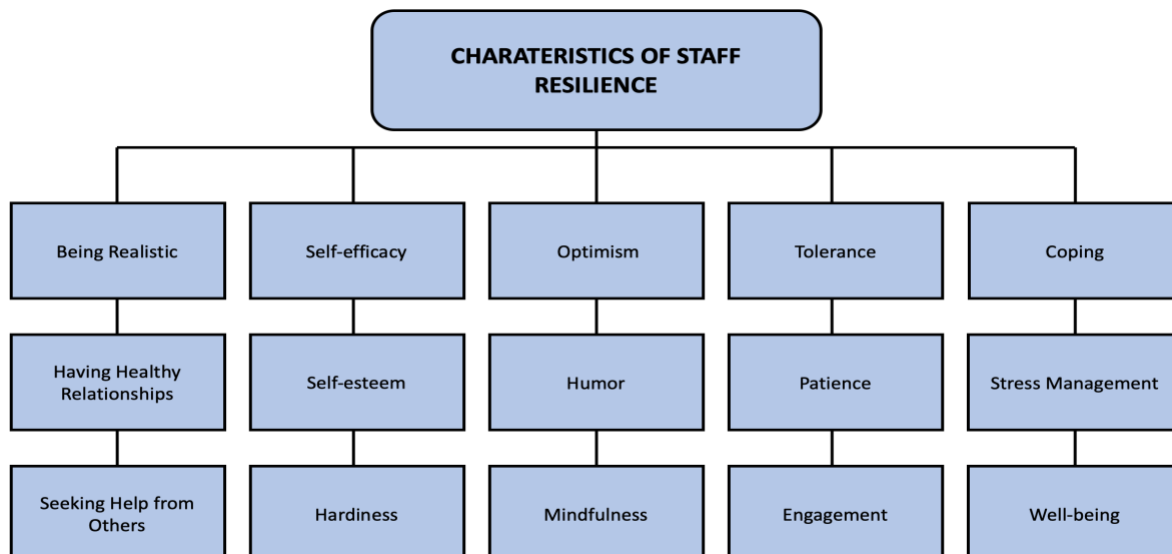
Figure 17. Characteristics of Staff Resilience

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Some of the characteristics of staff resilience with the highest frequency are *Coping* (n = 5, 20%),

Self-efficacy (n = 4, 16%) and *Mindfulness* (n = 3, 12%). As mentioned in section 4.1.3 (i.e.,

Factors affecting Resilience, Individual Level*)*, as a result of the Thematic Analysis, certain

variables were identified by some authors as Personal factors while others defined these variables

as Characteristics. In fact, 8 out of 15 (53.33%) variables represented in the diagram of this

dimension are also described as Factors Affecting Resilience by some authors. These variables

are: Humor, Coping, self-efficacy, self-esteem, optimism, patience, hardiness, and well-being. As

mentioned before, these overlapping variables can be found in both of the categories (i.e., factors

affecting resilience and characteristics of staff resilience) in the Appendix A.

4.1.5 Characteristics of Emergency Department Complexity

The Characteristics of ED complexity, as one of the dimensions of resilience, describe the unique,

highly dynamic, and mission-focused nature of Emergency Department organizations as well as

challenging work environment compared to other organizations (e.g., manufacturing

organizations). This dimension consists of two main categories: characteristics of the overall

department complexity and characteristics of staff's complex work environment (Figure 19).

The variables highlight the dynamics that already daily exist in the department and that persist

when mass casualty incidents occur. The components characterize day-to-day issues and

challenges that were also earlier discussed in this study, including the delivery of medical care,

and required fast decision-making, while dealing with a disparity between a number of patients

and inadequate resources.
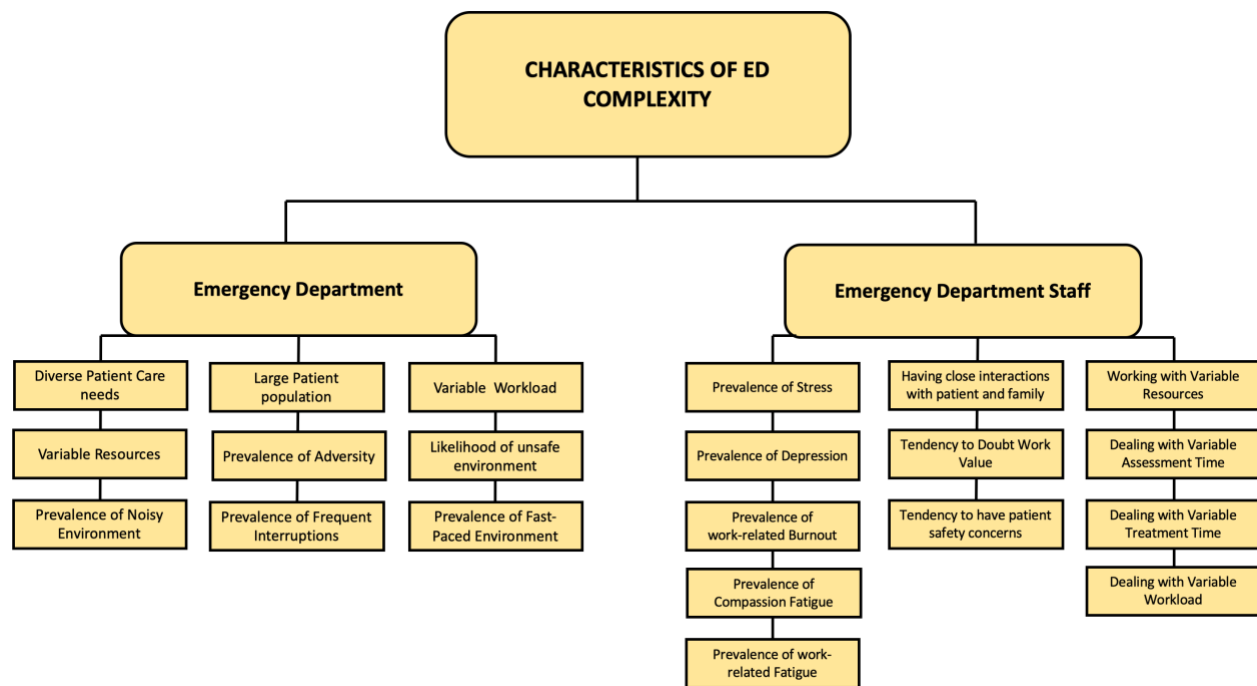
Figure 18. Characteristics of Emergency Department Complexity

The adverse events further compound the challenges that exist in the ED work environment. The frequency of these variables across selected models of resilience ranges between n = 1 (4%) and n = 3 (12%). A relatively low frequency stems from the fact that these variables are exclusively used to describe EDs and therefore, only models of ED staff or organizational resilience could potentially include these characteristics. Yet, the variables the highest frequency (n = 3, 12%) that are associated with ED environment are *Variable Resources*, *Prevalence of Adversity* and *Variable Workload*, and those that are related to the complexity of work environment is *Dealing with Variable Workload*. A higher frequency across these variables, compared to other characteristics, emphasizes a previously discussed issue of disparity between a number of patients and inadequate resources that is particularly typical for Emergency Departments and which is something that ED staff members have to manage during routine operations.

4.1.6 Outcomes of Resilience

Outcomes of Resilience dimension represents variables that describe what EDs and ED staff gain as a result of being resilient during mass casualty incidents. Therefore, the diagram that shows the Outcomes dimension of the Initial Model consists of two main categories: outcomes for an ED organization and for ED staff (Figure 20).
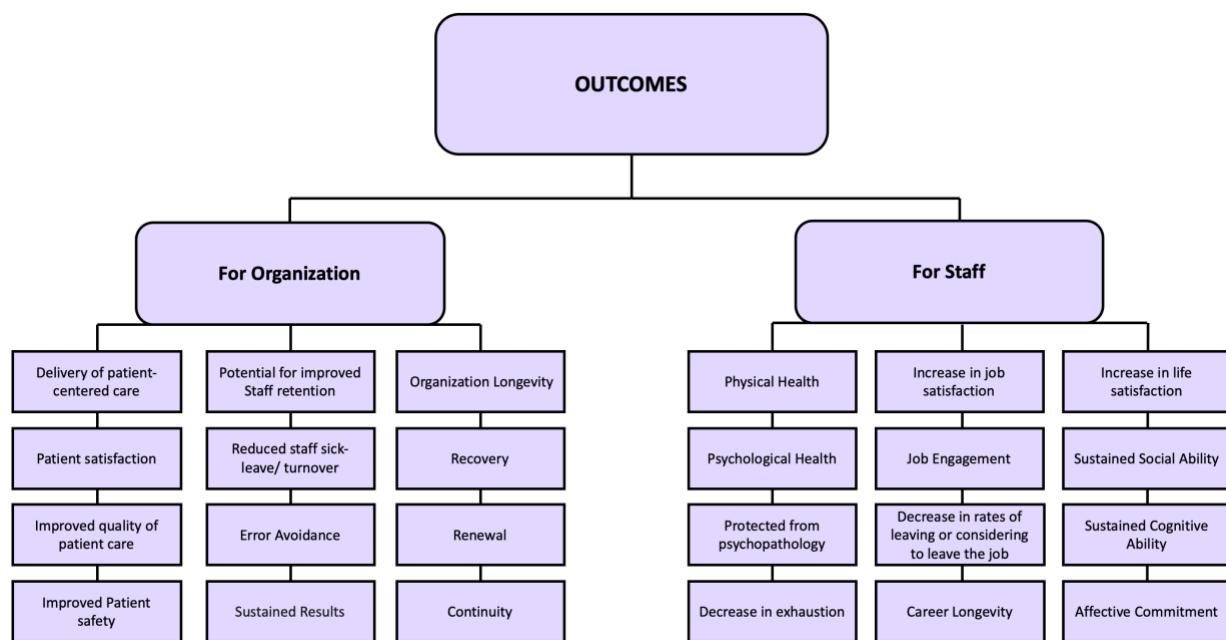
Figure 19. Outcomes of Resilience

The outcomes of resilience for Emergency Departments were found to be mainly associated with improvements in patient care, staff satisfaction as well as an ability of organization to successfully and safely deliver its mission. The outcomes that were most frequently mentioned in the models (n = 3, 12%) are *Improved Quality of Patient Care* and *Reduced Staff Sick Leave/Turnover.* Therefore, demonstrating that one of the main outcomes of resilience for an organization is the

ability of an ED to successfully deliver its mission (i.e., good quality of patient care) and retain staff members who are satisfied with their job.

The outcomes of resilience for Staff members, on the other hand, primarily focus on personal outcomes for staff members as individuals, such as improved health, job satisfaction and general life satisfaction. In fact, the majority of the selected models that incorporated outcomes of resilience for staff included such variables as *Increase in Job Satisfaction* (n = 5, 20%), *Decrease in exhaustion* (n = 3, 12%) and *Job engagement* (n = 3, 12%). Thus, an ability of staff members to resiliently respond to unexpected disruptions results in their overall physical and mental wellbeing, job fulfillment as well as motivation and enthusiasm associated with what they professionally do.

4.2 Preliminary Model Validation

As a result of the second literature review, a total of 19 case studies were selected to test the Initial Model. The case studies focused on the response of Emergency Departments to mass casualty events in the US. The majority of studies describe the response to well-known adverse events such as terrorist attacks, hurricanes and pandemics/epidemics. Particularly, the majority of case studies (n = 5, 26.3%) focused on the response of EDs of four different Boston hospitals to Boston Marathon Bombings, while three case studies discussed how EDs handled ongoing Covid-19 pandemic. A more detailed summary of identified case studies is presented in Table 1.

Incident	Trigger Category	Number of Case Studies	Publications
Boston Marathon Bombings	Terrorist Attack	5	(D'Andrea, et al., 2013; Landman et al., 2015; Nadworny et al., 2014; Hojman et al., 2019; Hemingway & Ferguson, 2014)
Covid-19 Pandemic	Pandemic	3	(Uppal et al., 2020; Leiker & Wise, 2020; Hartford et al., 2020)
Hurricane Sandy	Hurricane	2	(Tran et al., 2014; Greenstein et al., 2016)
Hurricane Katrina	Hurricane	2	(Brevard et al., 2008; Mortensen & Dreyfuss, 2008)
Hurricane Harvey	Hurricane	1	(Chambers et al., 2020)
San Bernardino Terror Attack	Terrorist Attack	1	(Lee et al., 2016)
Dartmouth Hitchcock Medical Center shooting	Terrorist Attack	1	(Merrens, 2018)
September 11 Attacks	Terrorist Attack	1	(Kirschenbaum et al., 2005)
Fort Hood Shooting	Terrorist Attack	1	(Shepherd et al., 2011)
Oklahoma City Terrorist Bombing	Terrorist Attack	1	(Hogan et al., 1999)
Hepatitis Epidemic	Epidemic	1	(James et al., 2009)

Table 3. Identified Case Studies

The Case Studies illustrated both successful handling of incidents and examples of failures in responses to adverse events. For instance, the response of all Boston Emergency Departments and their staff to Boston Marathon Bombings is considered to be extremely successful and significant to the study of emergency response, which also explains the high number of identified and selected case studies associated with this particular incident. On the other hand, poor response of Charity Hospital ED in New Orleans, Louisiana to Hurricane Katrina resulted in the permanent closure of the hospital and its ED, which was an example of an unsuccessful response.

After the Case Studies were analyzed, the gaps and inconsistencies that exist in the model were evaluated. Furthermore, the gaps that exist in the Case studies were also defined and recommendations concerning case study work regarding ED response are proposed. Then, the

Initial Resilience Model was refined based on the findings from the case studies. The results of these stages as well as are discussed in more detail in the following sub-sections.

4.2.1 Gaps in the Model

The Case Study Analysis demonstrated that the Initial Model that was developed as a result of Phase 1 generally reflects the response of Emergency Departments to mass casualty events quite well. The case studies primarily focus on the real-time actions of EDs from the moment they are notifies about an incident that occurred until post-event debriefings and evaluations of the response. Therefore, the cases primarily covered the following parts of the Initial Model: *Triggers*, *Factors Affecting Resilience: Aggregate Level*, *Resilience Capability* and *Characteristics of ED Complexity*. While the Case studies mainly emphasized the importance of variables that are present in the Initial Model across *Factors Affecting Resilience: Aggregate Level* and *Characteristics of ED Complexity* sections, they also identified gaps that exist in the *Triggers* and *Resilience Capability* dimensions.

While the *Triggers* dimension seems quite objective as it contains widely known categories of potential incidents and unexpected disruptions, some other components of this dimension were identified in the case studies that were not present in the Initial Model. First, one of the studies (James et al., 2009) focused on evaluating the response of an Emergency Department to Hepatitis Epidemic. While the Initial Model contains only *Pandemics* as a part of biological disasters category, *Epidemics* should be also added, as these types of diseases differ based on the degree of spread. Second, several case studies, including case studies on the response of EDs to Boston Marathon Bombings as well as the shooting in Dartmouth-Hitchcock Medical Center, a new category of triggers dimension was identified. While already existing categories mainly focus on

external incidents that occur outside of the ED territory but affect their operations, certain similar adverse events can happen on the premises of EDs or hospitals. These incidents can include *Terrorist attacks*, *Active shooter*, *Infant Abduction* and *Prisoner Elopement*, and can be categorized as *Hazards on the Premises*. This observation does not only result in a new category of Triggers, but it also affects Resilience Capability dimension of the Initial Model, since internal hazards would create even more challenging circumstances for EDs and their staff, that could include the evacuation of patients, for example.

Since the case studies primarily discuss the actual response of EDs, they significantly focus on the *Resilience Capability* dimension, where the majority of gaps was identified. The *Anticipation* portions of the dimension reflect the anticipation stage described in the studies quite well. Just as in the Initial Model, case studies describe preparedness of staff, supplies, infrastructure, and communication as well as already established disaster plans. It was observed, however, that the Initial Model contains certain gaps at the *Response* stage of the *Resilience Capability* dimension. While this dimension in the Initial Model describes Surge Capacity of staff, space and supplies, continuity of essential services as well as the adaptation process, it does not reflect some of the important actions and dynamics that help EDs to successfully respond to mass casualty events. First, the Initial Model contains a *Mass* Casualty *Triage Protocol* in the *Continuity of Essential Services Subcategory.* As a result of case study analysis, *Mass Casualty Triage* that is usually developed based on either the severity of injuries or types of injuries was identified as a separate characteristic of Response stage of resilience. On the other hand, *Continuity of Essential Services* is associated with strategies and actions directed to manage other patients, whose injuries are not related to a mass casualty event. Similar to the Initial Model, some of the strategies identified in

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the case studies that are associated with the continuity of essential services are expedited discharge of patients, cancellation of elective admission as well as transfer of patients to other units.

Furthermore, the results identified another characteristic of the *Response* stage of Resilience that included a real-time communication and cooperation with other teams, including emergency response teams and other hospital departments. This part of the Response stage was particularly emphasized in the studies that discussed response of Boston hospitals to Boston Marathon Bombings that are considered to be the most successful. It is suggested that specifically an effective real-time communication with EMS teams and cooperation with physicians and nurses from other departments, especially OR teams, led to a very successful response and positive outcomes.

The Case Studies mainly discussed the same characteristics of *Recovery* stage of Resilience Capability dimension as they are depicted in the model. However, the studies described this stage in more detail and the results show certain gaps that exist in the Initial Model. First, the *Evaluation Report* is only an example of the *Debriefings* process. Numerous case studies indicate that right after the adverse event, several phases of debriefings occur, including "hot washes", which is the first phase of debriefings in which all staff members who participated in the response provide feedback on the incident and discuss strengths and weaknesses. Furthermore, another gap that existed in the Initial Model is the lack of characteristic that describes *Improvement Strategies* that can potentially lead to *Implementation of Changes*. While this dimension in the Initial Model included *Identification of Improvement Areas* as one of the characteristics, it did not include the purpose of it. After the areas that require improvement have been identified, feasible strategies that would target and potentially improve those areas should be developed.

While the majority of the case studies did not include any additional variables that exist across *Factors Affecting Resilience: Aggregate Level* and *Characteristics of ED complexity* dimensions of the Initial Model, they emphasized the importance of these concepts when defining a successful response of an ED organization. First, the case studies substantially discussed how Emergency Departments mobilize its resources and capabilities as well as utilize its strategies to successfully respond to a mass casualty event while delivering quality care to all patients. These Resource, Strategies and Capability are subgroups of Operational Setting factors in the Aggregate Level diagram. The case studies highlight the importance of defining these factors and their potential effect (either negative or positive depending on the presence/absence of the factor) on the response of EDs.

Furthermore, the identified case studies discussed how effective communication and collaboration between individual staff members, teams, units, and departments resulted in a successful response even when there were issues with disparity between available resources and the number of patients. These factors are already present in the Initial Model of Resilience as part of Workplace Collaboration subcategory in *Factors Affecting Resilience: Aggregate Level* diagram. The case studies also emphasized the characteristics of day-to-day complexity of Emergency Departments and ED staff work environment that make successful response to mass casualty events even more challenging, compared to other Healthcare organizations.

4.2.2 Gaps in the Case Studies

While case studies generally described what is reflected in the Initial Model quite well, they did not discuss certain parts of the model. Fist, as previously mentioned, the case studies mainly focused on the *Resilience Capability* dimension of the model, discussing how EDs anticipated,

responded to, and recovered from unexpected disruptions. They also demonstrated and emphasized the critical role of ED staff in the response. Even when the department was dealing with inadequate resources, limited space availability or extremely large number of severely injured patients, effective actions of ED staff members allowed to successfully cope with the situation and overcome challenges.

While the case studies describe how significantly staff contribute to resilience capability of Emergency Departments, they do not focus on characteristics of ED staff members that could describe their resilience or indicate successful coping with the event. It is recommended that the authors of case studies on ED response to mass casualty events consider evaluating and discussing the characteristics that ED staff members as individuals exhibit that could potentially indicate their resilience or successful coping with the situation. Furthermore, while case studies focus on discussing *Aggregate Level* of the *Factors Affecting Resilience* dimension, they do not describe any *Individual Level* factors. The case studies mainly focus on the response at societal systems level (i.e., ED level), however, as previously discussed in this report, individual-level factors significantly contribute to aggregate-level factors.

It was also observed that not all the case studies comprehensively describe the response of EDs to mass casualty events. While case studies that focus on a certain event, such as Boston Marathon Bombings or Covid-19 Pandemic, rigorously and comprehensively discuss the response of EDs from the moment they were notified about the event, including a very detailed timeline, up until the post-event actions focused on learned lessons and potential improvement, the majority of case studies on other mass casualty events lack certain details or describe only certain parts of ED response.

Furthermore, the number of case studies that described response of EDs to Boston Marathon Bombings as well as the number of studies on Covid-19 Pandemic Response was relatively large compared to case studies that focus on ED response to other significant mass-casualty events was. This could be associated with the fact that response actions of discussed Emergency Departments to Boston Marathon Bombings are considered to be extremely successful and can be used as examples of a resilient response. Since Covid-19 pandemic is the most recent mass disruption, a number of case studies on actions of different EDs were published, that involved examples of both successful and poor responses. In addition, a lot of the case studies focus on general emergency response and they either vaguely describe the actions of EDs or not mention ED stage of response at all.

Another observation was that while the majority of case studies discussed post-event actions, including debriefings, evaluation reports, identification of improvement areas and implementation of new strategies and plans, they did not discuss the outcomes of a successful response for an Emergency Department organization and its staff, which is reflected in the *Outcomes* dimension of the Initial Model. The case studies primarily focused on what was done right or wrong during the response, but they did not quite analyze what an organization and/or its staff gained or lost as a result of their specific response.

4.2.3 Revised Model

Based on the results of Case Study analysis, specific changes to Initial Model were made. These changes primarily included incorporation of additional variables into the diagrams of *Triggers* as well as *Resilience Capability: Response* and *Resilience Capability: Recovery* dimensions. The changes made to these dimensions were not significant, as the Initial Model very well reflected

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patterns and characteristics of successful responses of Emergency Departments in the US to mass casualty events.

First, the changes were made to *Triggers* dimension of the Initial Model. As previously mentioned, certain case studies described response to other types of mass casualty events such as *Epidemics* that fall under *Biological Hazards* category as well as new category of events – *Hazards on the Premises*. A revised version of the *Triggers* dimension is represented in Figure 21.
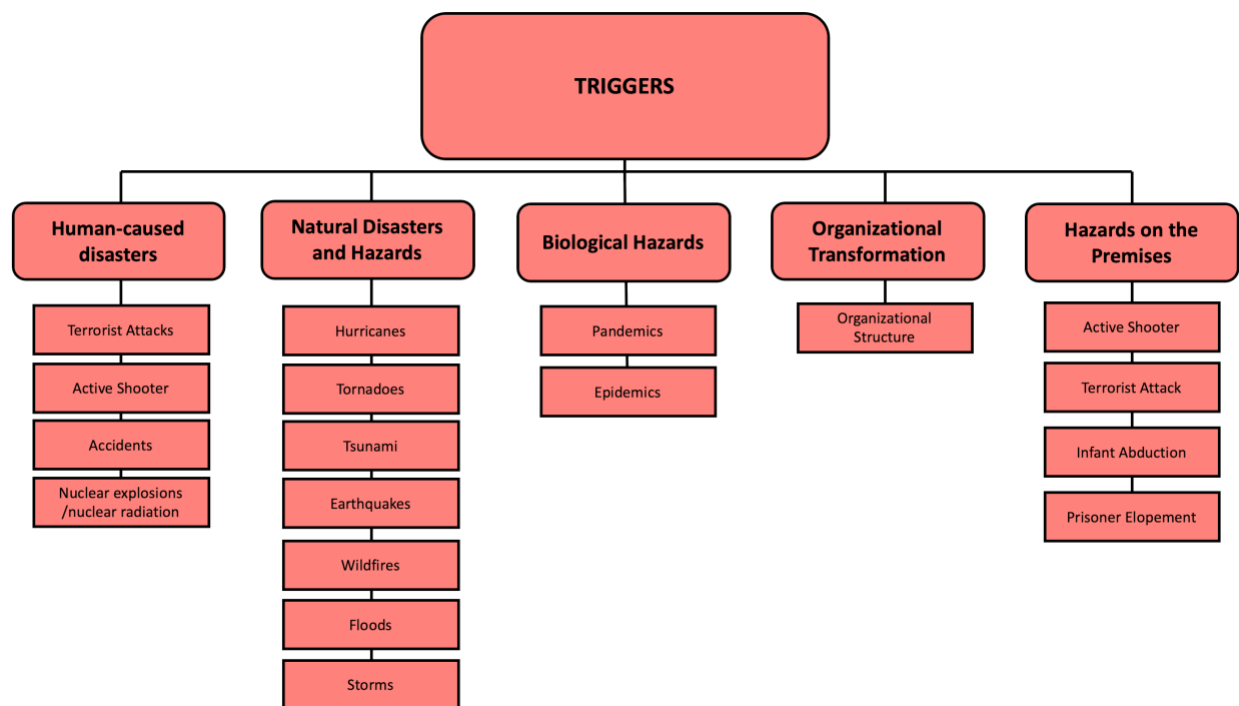
Figure 20. Triggers of Resilience, Revised

While the rest of the categories focus on the incidents that occur outside of Emergency Departments but the impact of which affects ED operation, Hazards on the Premises is a type of incident that occurs inside the Emergency Department facility, which makes a successful response even more challenging. This type of trigger also affects the Response stage of resilience capability,

as it will require additional action, such as evacuation of patients, or alternatively, lockdown of the department.

Furthermore, certain changes were made to the *Resilience Capability* dimension at the *Response* stage (Figure 22). While Case Studies emphasized Surge Capacity, Continuity of Essential Services and Adaptation as characteristics of resilient response of EDs to mass casualty events, two new categories were implemented in the diagram of *Resilience Capability* dimension at the *Response* stage: *Communication and Cooperation with other teams* as well as *Mass Casualty Triage*. While in the Initial Model, *Mass Casualty Triage* was a part of Continuity of Essential Services characteristic, this was inconsistent with the results of case study analysis. *Continuity of Essential Services* characteristic primarily focused on actions surrounding patients whose injuries or illness are not associated with mass casualty events. *Mass Triage Protocol*, on the other hand, is directly related to casualties of mass disruptive events. Another new characteristic that was added to the diagram is *Communication and Cooperation with other teams*, as it was discussed across numerous case studies as a critical characteristic of a successful response.
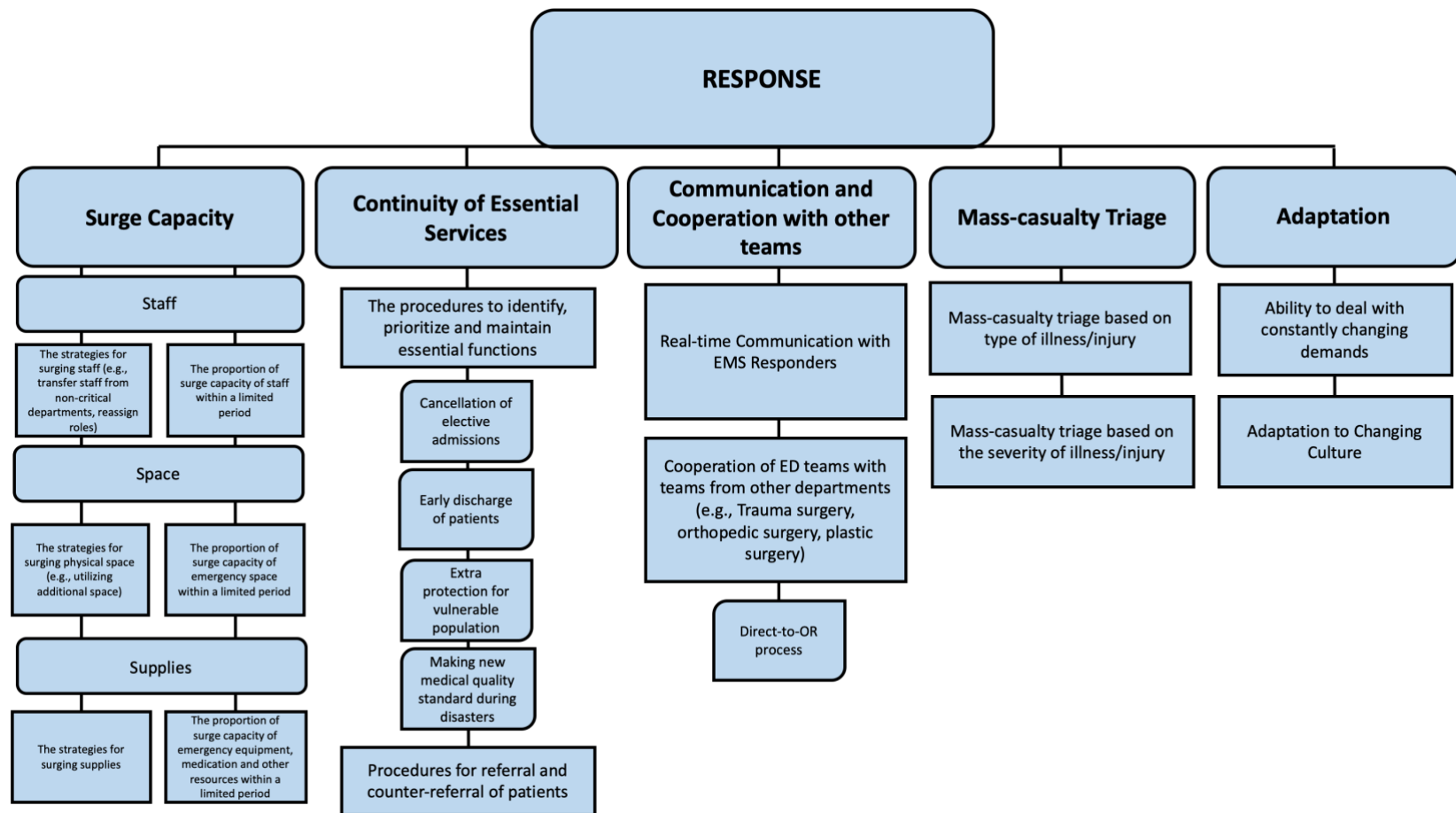
Figure 21. Resilience Capability: Response, Revised

The *Recovery* diagram of Resilience Capability dimension was also slightly expanded based on the findings from case studies (Figure 23). The *Evaluation Reports* characteristic was substituted by *Debriefings,* which includes *Evaluation Reports* as well as "*Hot Washes".*
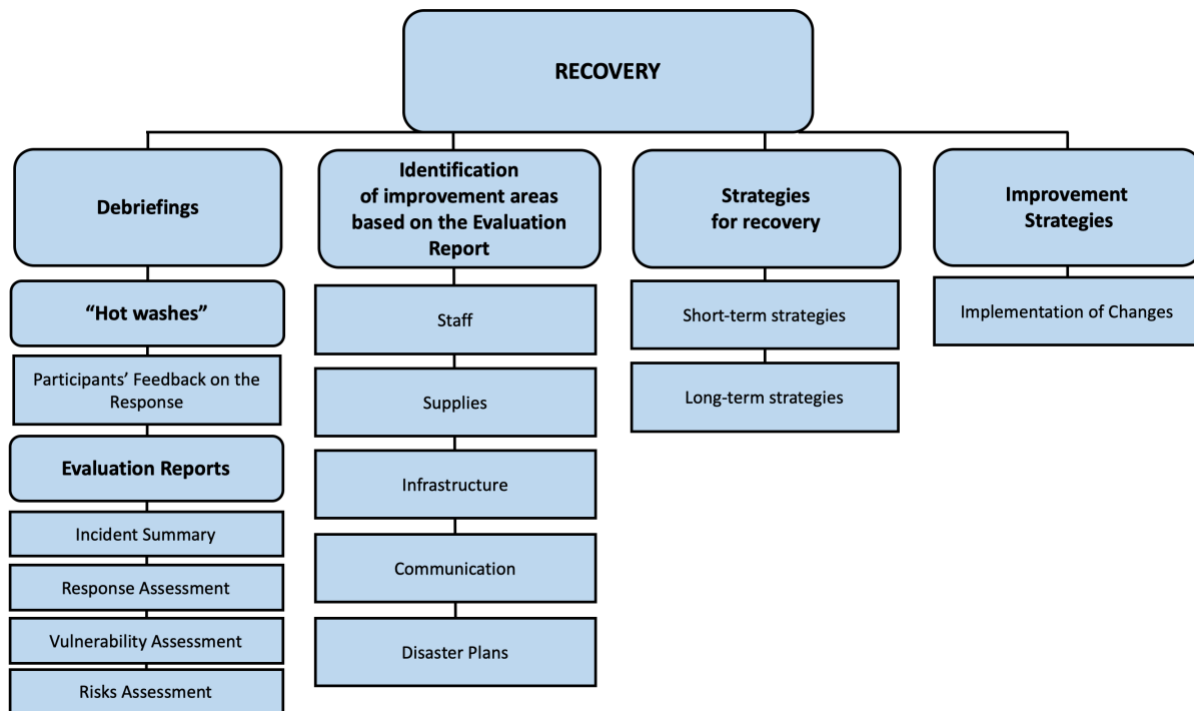
Figure 22. Resilience Capability: Recovery, Revised

Furthermore, the *Improvement Strategies* characteristic was added to the diagram that focuses on that would target and potentially improve those areas should be developed. Therefore, empirical evidence from the identified Case Studies supported the expansion of *Response* and *Recovery* stages of the Resilience Capability Dimension, demonstrating the unique and complex nature of resilient response of Emergency Departments.

CHAPTER FIVE: DISCUSSION

The results of the Initial Model Development using Thematic Analysis demonstrated the complex nature of Resilience Capability. Five main dimensions of Resilience were identified: Triggers, Factors Affecting Resilience, Resilience Capability, Characteristics of ED Complexity and Outcomes of Resilience. Furthermore, the relationships between these dimensions were also established by leveraging mediation and moderation concepts. While the research questions for this study included Motivating Factors as one of the primary areas of interest, it was not explicitly defined as one of the dimensions in the Initial model of Resilience as a result of Thematic Analysis. Instead, these factors that define the reasons why ED and its staff need to be resilient can be found at certain already-existing dimensions such as characteristics of ED complexity or Outcomes, for example. Emergency Departments are generally highly complex organizations with challenging work environment for ED staff. These characteristics are likely to prompt Emergency Departments and ED staff to become resilient in order to successfully handle mass casualty events on top of already existing daily complexities.

Motivating factors can also arise from outcomes of response to an unexpected disruption. If the response were successful, ED organizations would be motivated to maintain their resilience capability. On the other hand, if an ED poorly responded to an unexpected disruption, the outcomes would likely prompt EDs to improve their resilience. Similarly, motivating factors can emerge as a result of other organization's successful or poor response. It could motivate a particular ED to learn from that organization's response and either utilize similar resilience strategies in case of a successful response or avoid the mistakes that were made by that organization if they poorly handled the disruption.

During the first phase of the study, it was observed that the majority of models lacked comprehensiveness, which is demonstrated by the frequency values of the variables. While the total number of identified variables is 218, the frequency of each of these variables is relatively low. This indicates that the models of resilience in the literature are not comprehensive and mainly focus on a certain dimension of resilience. Furthermore, variables that belong to certain dimensions of resilience (e.g., Factors Affecting Resilience, Characteristics of Staff Resilience, Outcomes of Resilience) have a significantly higher frequency compared to variables from other dimensions (e.g., Triggers, Resilience Capability, Characteristics of ED Complexity), which indicates low maturity of certain dimensions of resilience. Certain gaps and inconsistencies across models of resilience in the literature have been also identified. This includes inconsistencies in identifying variables that belong to certain dimensions of resilience. For example, a set of variables that was previously discussed in sections 4.1.3 and 4.1.4. These variables were identified as factors affecting resilience by some authors, while other authors described them as characteristics. While both of these approaches could be correct, it is recommended that this inconsistency is further analyzed.

The results of Case Study Analysis were quite consistent with what was reflected in the Initial Model. In fact, the Initial Model demonstrated different dimensions of resilience and inter-relationships between them, while case studies primarily focused on the actual response of EDs, therefore mainly describing the Resilience Capability dimension of the model. The results of this phase also emphasized the importance of aggregate-level factors, including organizational resources, capabilities, and strategies as well as the workplace collaboration factors for successful response of EDs during mass casualty events. The studies also mentioned characteristics of the

complex nature of Emergency Departments, another dimension of the Initial Model, that make it very challenging for these organizations to effectively respond to unexpected disruptions.

As a result of Case Study Analysis, the changes were made to two main parts of the Initial Model: Triggers and Resilience Capability. While the results were consistent with the categories and variables that already existed in the diagrams of these dimensions, they also identified new types of Triggers as well as characteristics of Resilience Capability. The results of Case Study Analysis generally supported the structure and content of the Initial Model. Additional research involving model validation is recommended in order to further refine the model. The suggestions concerning future work are discussed in more detail in section 6.2.

5.1 Contribution

From a theoretical, academic, and educational standpoint, this study contributes to the literature in several important ways. First, this study contributes to the general knowledge base of resilience as a critical organizational capability in the Emergency Departments when dealing with unexpected disruptions. It also underlines the importance of having resilient ED staff members to improve organizational resilience capability.

Second, the majority of the identified models of organizational and staff resilience are relatively simple. These models do not focus on the relationships between dimensions, lack rigor and comprehensiveness, particularly at the Emergency Department level compared to Healthcare level or the level of all organizations. This study proposes a Pre-Validated Model of staff resilience that consists of a diagram representing main dimensions of resilience and inter-relationships between them as well as a series of diagrams that summarize each Dimension of Staff Resilience Model.

The diagram of Dimension of Resilience illustrates the relationships that exist between the main dimensions. The diagrams of each dimension represent how variables at individual level are connected and contribute to organizational level. Therefore, demonstrating how critical the staff resilience is to resilience capability of the entire organization.

Another research contribution of this study was leveraging the systems approach and fractal nature of societal systems, that allowed to collapse the complexity of the model making it more feasible to validate in real world settings. Furthermore, utilizing the systems approach in this research provided a framework for the introduction of the aggregate level into the model to represent the collection of individuals, teams, units, or departments that make up an organization. This demonstrated how important the contribution of those subcomponents is as well. This study also emphasized the critical difference between an organismic and societal roles of staff resilience, which was particularly observed across the 25 identified models of resilience. While engineering management and industrial engineering literature focus on evaluating how staff resilience contributes to resilience capability of an organization (i.e., societal systems role of staff resilience), articles on organizational and industrial psychology investigate resilience of ED staff members as individuals (i.e., organismic role of staff resilience).

The results of this study are also expected to also make potential practical contributions. Since this research investigates different dimensions of staff resilience and its contribution to the resilience capability of the entire organization, it could support Emergency Department staff in the US to become more resilient. It could guide them in the process of anticipating disruptions, coping, and adapting in changing environment, as well as recovering from significant unexpected disruptions. It could also help them reduce emotional distress, lower the impact of adverse events on their

decision-making and procedures as well as allow them to provide timely, safe, and quality care to all the patients.

Furthermore, this study investigates the real-life response of EDs to mass casualty events through Case Study Analysis and assesses how well the model represents actual behaviors and actions taken in the EDs during unexpected disruptions. The findings from the Case Study Analysis could help Emergency Departments avoid mistakes that were made by other EDs and learn from the examples of successful responses.

CHAPTER SIX: CONCLUSION

The Initial Model of Emergency Department staff resilience was developed based on the existing in the literature models of organizational and staff resilience across three levels (i.e., Emergency Department, Healthcare and General). It was observed that models of organizational or staff resilience at Emergency Department level were less comprehensive and rigorous compared to models at Healthcare and General level, which indicates a significant gap in the study of resilience in the EDs. The Initial Model consisted of five main dimensions: Triggers, Factors Affecting Resilience, Resilience Capability, Characteristics of ED Complexity and Outcomes. The sixth identified dimension was Motivating factors that are located across certain dimensions of resilience such as Characteristics of ED Complexity and Outcomes. The Initial Model consisted of a Model of Resilience that included five main dimensions and demonstrated the inter-relationships that exist between them as well as a series of diagrams of each dimension of resilience. The diagrams primarily focus on demonstrating how factors and capabilities of staff contribute to resilience of an Emergency Department organization.

The results of the Case Study Analysis indicated that the Initial Model was a good reflection of a real-life Emergency Department response to a mass casualty event. The Case Studies, however, mainly focused on the Resilience Capability dimension of the Initial Model, that allowed to expand and refine that dimension. As a result of this phase, additional types of Triggers were identified that were used to expand the model. While Case Studies discussed the actual response of an Emergency Departments to a mass casualty event, including anticipation, response, and recovery stages, they also emphasized the importance of organizational resources, capabilities and strategies that can significantly contribute to organization's ability to successfully handle adverse events.

Furthermore, the significance of workplace collaboration was also greatly discussed. Effective communication and collaboration between societal subsystems (i.e., individuals, teams, units, and departments) allowed EDs to successfully respond to mass casualty events even when major issues, such as imbalance between available resources and number of patients, existed.

6.1 Study Limitations

One of the limitations of this study is defining the type of events that Emergency Departments need to be resilient against. Some literature defines resilience as an organizational attribute that is used in the Emergency Departments to address both chronic and acute disruptions, while other scholarly sources argue that resilience is a capability necessary for dealing only with acute adverse events. This study defined resilience as an organizational, team or individual (depending on the systems level investigated) capability that organizations, teams or individuals in the organization have to demonstrate during acute, or unexpected disruptions, such as mass casualty events. To address this, the formal definition of resilience was revisited that stated that resilience is triggered by an unexpected disruption. Therefore, resilience capability is necessary during acute events, while chronic, or day-to-day, issues such as overcrowding, process and technological changes, need to be controlled by Emergency Departments every day.

A limitation associated with the development of the Initial Model includes identification and selection of existing in the literature models of organizational and staff resilience. Only a certain portion of the existing and available resilience could have been identified. To address this, a rigorous search strategy was utilized. Precise inclusion criteria were established, multiple sets of search terms were created that were then further revised and expanded if needed as well as reliable academic search databases (i.e., Google Scholar, Web of Science, ProQuest) were used. A similar

limitation of this study is related to extraction of Case Studies from the literature since not all the possible existing in the literature Case Studies on the ED response to mass events could have been identified. To mitigate this, a robust search approach was utilized that included setting inclusion criteria (both primary and secondary), developing search sets and associated search terms as well as using three different academic databases to include a wide range of studies on the topic.

Limitations of this study also include lack of model validation. The model that has been designed so far is proposed and was developed based on the existing models of resilience and informed by Empirical Case Studies. To further identify any possible gaps and inconsistencies that might exist in the model as well as to ensure its functionality and reliability, Expert Study as well as Delphi Study should be conducted in order to validate the model. To address this, as a part of future work, a two-phase Expert Study will be conducted that will be followed by a multi-round Delphi Study.

6.2 Future Work

Future work for this research will include performing model validation consisting of two main stages: Expert Study and Delphi Study. An Expert Study will consist of two phases and will be conducted using online qualitative survey questionaries. Experts for both Phase 1 and Phase 2 studies will consist of professionals who have academic or industry expertise related to Organizational Resilience as well as professionals who have experience in Emergency Department operations. In Phase 1, experts will be presented with a survey that includes a series of open-ended questions and consists of three main sections: general questions about participants' background and experience, open-ended questions about specific dimensions of resilience, and open-ended questions about the relationships between the dimensions of resilience (Appendix B). The survey with open-ended questions would allow participants to provide unbiased responses and report their

experiences. Based on the responses of the experts, a Phase 1 Expert Study model will be created that will be compared against Pre-Validated Model that was developed as a result of TA and Case Study Analysis. Any identified gaps or inconsistences in the Pre-Validated Model will be recorded and the model will be refined. In Phase 2, experts will be presented with the Model that was developed based on Thematic Analysis, Case Study Analysis and first phase of Expert study, and asked to review it as well as provide feedback on the relationships between the main dimensions, structure, and content. The results of the survey will be used to refine and explore relative importance to guide reduction of the model.

After a two-phase Expert Study is conducted, a multi-round Delphi Study will be conducted. There will be two groups of participants: academic researchers and industrial professionals. Academic experts will be researchers who study ED resilience in the United States, including the authors of literature on resilience in Emergency Departments. The experts will be identified from the papers they published, the journals related to Healthcare operations, and participation in professional society activities such as conferences. Industry professionals consist of experts who currently work in Emergency Departments and have experience in dealing with unexpected significant events within the past five years. These experts must have experience in dealing with significant disruptive events in the past five years in the ED in Central Florida. In order to recruit practitioner experts, public representatives of Emergency Departments in Central Florida will be considered. During the Round 1, the experts, in the form of online survey questionnaire, will be shown the Pre-Validated model that was developed based on TA, Case Study Analysis and Expert Study results. The participants will be asked to rate elements of the model and to report whether they agree with their representation. They will be then asked about any potential gaps or missing elements in the

model. The model will be revised based on the results of the Round 1 survey and reported back to the experts along with the revised model for the Round 2 survey. The results of the second iteration will be reviewed, the model will be refined accordingly, and the state of consensus will be evaluated. If the state of consensus is reached, the model will be finalized, documented, and shared with Delphi Study participants. If the state of consensus is not reached, further rounds of Delphi Study will be conducted until the participants come to consensus.

There also exist broader opportunities for future research. The implementation of systems references (i.e., organismic, societal, high-order societal and ecological factors at different levels) into a model of staff resilience in this study is a starting point for discussion and further research of systems approach in a study of Emergency Department staff resilience. This could be explored through additional systems theories or systems archetypes that might aid in the development of a more efficient model. So far, the created model is somewhat large and complex that leads to difficulties in executing empirical studies. By leveraging other systems theories, the model might be further collapsed that would result in a more efficient model.

Further work could also include Case Study Analysis that would compare cases of ED response to mass casualty events from other countries and the response of US Emergency Departments. To investigate this, the countries should be grouped into categories based on certain criteria, including the specifics of the Healthcare system. Exploring how the differences in Healthcare ecosystems affect resilience of Emergency Departments and staff could be beneficial for further refinement of ED resilience model and, in general, the study of ED resilience in the United States.

APPENDIX A: INITIAL MODEL CODEBOOK

Dimension	Variable	Frequency	Description	Sources
Triggers	Human-caused disasters	2	Terrorist attacks, active shooter, accidents, nuclear radiation and explosions	(Decerbo, 2018; Mugdh & Pill, 2011)
	Natural disasters	2	Hurricanes, Tornadoes, Tsunami, Earthquakes, Wildfires, Floods, Storms	(Decerbo, 2018; Mugdh & Pill, 2011)
	Pandemics	1	A type of biological disaster, an epidemic of an infectious disease that affects a significant portion of the population.	(Decerbo, 2018)
	Organizational Structure	1	A type of organizational transformation when organization moves from one state of affairs to another.	(Decerbo, 2018)
Characteristics of ED Complexity	Diverse Patient Care needs	1	Diverse and variable patient care needs, including level of patient's clinical urgency	(Innes, 2019)
	Variable Resources	3	Variable availability of essential resources including properly working equipment.	(Cusack et al., 2016; Innes, 2019; Lin et al., 2019)
	Prevalence of Noisy Environment	1	Noisy and chaotic nature of ED environment that prevent proper communication and interaction.	(Innes, 2019)

	Large Patient population	1	Patient population and associated needs to not correspond to availability of staff, space, and resources.	(Brigham et al., 2018)
	Prevalence of Adversity	3	A negative work-related phenomenon or event which leads to difficulties in performing job duties among staff.	(Cusack et al., 2016; Malik & Garg, 2017; Britt et al., 2016)
	Prevalence of Frequent Interruptions	1	Interruptions during care provision.	(Innes, 2019)
	Variable Workload	3	Imbalance between organization's operating boundary and healthcare demands.	(Cusack et al., 2016; Brigham et al., 2018; Innes, 2019)
	Likelihood of unsafe environment	2	Presence of violence aggression and risk of assault especially in the waiting rooms particularly when aggressive or violent patients or visitors were present.	(Innes, 2019; Brigham et al., 2018)
	Prevalence of Fast-Paced Environment	1	Work environment where activities and decisions happen quickly and these activities are continuously occurring throughout the day.	(Cusack et al., 2016)
	Prevalence of Stress	2	Tendency of staff to experience stress caused by work-related issues	(Ang et al., 2018; Rees et al., 2015)
	Prevalence of Depression	1	Tendency of staff to experience depression caused by work-related issues	(Rees et al., 2015)
	Prevalence of Work-related Burnout	2	A state of physical or emotional exhaustion due to work-related overload that also involves a sense of reduced accomplishment and loss of personal identity.	(Ang et al., 2018; Rees et al., 2015)

	Prevalence of Compassion Fatigue	2	A type of occupational burnout which is thought to occur as a result of providing ongoing empathy and compassion to others but neglect of one's own self-care	(Ang et al., 2018; Rees et al., 2015)
	Prevalence of Work-related Fatigue	1	A type of occupational burnout which is thought to occur as a result of long work hours, long hours of physical or mental activity, excessive stress and insufficient break time.	(Rees et al., 2015)
	Having close interactions with patient and family	2	Consideration of needs of the patient's family, providing family with information and involving them in decision-making, managing family responses.	(Innes, 2019; Lin et al., 2019)
	Tendency to Doubt Work Value	1	Gradually diminishing professional passion.	(Lin et al., 2019)
	Tendency to have patient safety concerns	2	Tendency to have concerns about patient safety when ED care did not satisfy the needs of the patients and their families in ability to offer quality care	(Lin et al., 2019; Innes, 2019)
	Working with Variable Resources	1	Staff members have to deal with and manage variable availability of essential resources including properly working equipment.	(Cusack et al., 2016)
	Dealing with Variable Assessment Time	1	Performing safe medical patient assessment within a limited period of time.	(Innes, 2019)
	Dealing with Variable Treatment Time	1	Providing medical treatment within a limited period of time.	(Lin et al., 2019)
	Dealing with Variable Workload	3	Managing high workload as a result of imbalance between supply and demand.	(Cusack et al., 2016; Brigham et al., 2018; Innes, 2019)

Factors affecting Resilience	Alignment of societal expectations and clinician's role	1	The level of society's, including patients', expectations about modern medicine, treatment, understanding of medical conditions and the benefit of interventions.	(Brigham et al., 2018)
	Culture of safety and transparency	1	National public reporting systems for medical errors, voluntary and confidential reporting systems, provision of incentives for safe practices through insurers and regulators.	(Brigham et al., 2018)
	Discrimination and overt and unconscious bias	1	The level of gender and racial equality.	(Brigham et al., 2018)
	Media Portrayal	1	The effect of media portrayal of medical staff on patients' perceptions about physicians, nurses, PAs.	(Brigham et al., 2018)
	Patient behaviors and expectations	1	The level of trust and relationship between a patient and a staff member	(Brigham et al., 2018)
	Political and economic climates	1	The effect of political and economic climates that exist in the area, region, state, country, region on the organization and its staff.	(Brigham et al., 2018)
	Social determinants of health	1	Social, economic, physical state that influence individual and group differences in health status	(Brigham et al., 2018)
	Stigmatization of mental illness	1	Level of support of medical staff mental health and possibility of punitive actions against staff with mental health issues.	(Brigham et al., 2018)
	Accreditation, high-stakes assessments and publicized quality rating	1	The process of assessing the level of performance of hospital in relation to established standards by State medical boards and accrediting institutions.	(Brigham et al., 2018)

Documentation and reporting requirements	2	Documentation requirements for reimbursement and requirements of reporting of quality measures.	(Brigham et al., 2018; Lee et al., 2013)
HR policies and compensation issues	2	HR strategies and hospital policies that drive salaries, wages, or benefits paid to employees.	(Bowers et al., 2017; Brigham et al., 2018)
Initial licensure and certification	1	Initial licensure and certification issued by regulatory agencies and private entities that ensures that Hospital ED staff has the required training knowledge and experience to practice their occupation.	(Brigham et al., 2018)
Insurance company policies	1	Agreements between insurers and health policyholder that determine that claims that insurance company is required to pay.	(Brigham et al., 2018)
Litigation Risk	1	The Risks of malpractice suits and the allegation of medical malpractice.	(Brigham et al., 2018)
Maintenance of licensure and certification	1	Hospital ED staff maintains their permission issued by regulatory agencies and private entities to practice their occupation.	(Brigham et al., 2018)
National and state policies and practices	1	Characteristics of US national healthcare sector, including laws, policies, practices, and specifics at a state level.	(Brigham et al., 2018)
Reimbursement structure	1	Healthcare reimbursement process in which private health insurers or government agencies pay for the medical services of healthcare providers.	(Brigham et al., 2018)
Shifting systems of care and administrative requirements	1	The requirements defined for best practice of medical care or administration in these systems is not stable but it changes over time.	(Brigham et al., 2018)

	Community Resources	2	Assets in a community that serve as a help in meeting certain needs of those around them.	(Brigham et al., 2018; Britt et al., 2016)
	Supporting policies	2	Policies underpinning practice that vary broadly with both standing orders and clinical pathways	(Brigham et al., 2018; Innes, 2019)
	Organizational Learning	5	The process of creating, retaining, and transferring knowledge and skills within an organization	(Malik & Garg, 2017; Hodliffe, 2014; Brigham et al., 2018; Ma et al., 2018; Decerbo, 2018)
	Learning Culture	4	An organization's effort to create learning opportunities for all of its members	(Malik & Garg, 2017; Hodliffe, 2014; Brigham et al., 2018; Ma et al., 2018)
	Knowledge sharing culture	6	A workplace culture that allows employees to acquire and share information and provide opportunities for mutual learning between individuals at the workplace	(Bowers et al., 2017; Lee et al., 2013; Malik & Garg, 2017; Brigham et al., 2018; Brown et al., 2017; Decerbo, 2018)
	Physical Learning and Practice Setting	1	physical space and intangible culture where medical students have an opportunity to learn and practice their medical skills	(Brigham et al., 2018)
	Curriculum	1	A planned sequence of instruction for medical students, interns, and residents.	(Brigham et al., 2018)
	Student affairs policies	1	Regulations and procedures associated with academic affairs, including academic standards, curriculum, administrative policies, and procedures, particularly in teaching hospital emergency departments	(Brigham et al., 2018)
	Student-centered focus	1	A welcoming environment that allows medical students, interns, and residents to be involved in the process to the extent of their ability while ensuring the patient continues to receive appropriate quality care.	(Brigham et al., 2018)

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Mentorship	2	A dynamic relationship between two individuals in which a mentor, an experienced individual in an organization imparts skills and guidance to the mentee.	(Brigham et al., 2018; Decerbo, 2018)
Professional development opportunities	2	The workplace policies and structures that provide opportunities for nurses to engage in reflection, career development, and lifelong learning.	(Brigham et al., 2018; Cusack et al., 2016
Implicit Communication	5	The transmission of ideas, knowledge, and thoughts between two or more team members via a nonverbal channel.	(Bowers et al., 2017; Hodliffe, 2014; Teo et al., 2017; Decerbo, 2018; Gibson & Tarrant, 2010)
Explicit Communication	5	The transmission of ideas, knowledge, and thoughts to the receiving party between two or more team members via a verbal channel.	(Bowers et al., 2017; Hodliffe, 2014; Teo et al., 2017; Decerbo, 2018; Gibson & Tarrant, 2010)
Inquiry and dialogue	1	An organization's efforts in creating a culture that supports questioning and offers feedback to its employees.	(Malik & Garg, 2017)
Professional relationships	3	Respectful and receptive working relationships with colleagues that encourages questioning and innovation.	(Brigham et al., 2018; Decerbo, 2018; Gibson & Tarrant, 2010)
Collaboration	3	The skill of individuals to work in a team toward a common goal by sharing knowledge, information, skills, and ideas.	(Brigham et al., 2018; Decerbo, 2018; Gibson & Tarrant, 2010)
Leadership	7	The process of a superior influencing subordinates to accomplish team goals, provide good management and decision-making during times of crisis, and continuous evaluation of strategies against organizational goals.	(Bowers et al., 2017; Brown et al., 2017; Lee et al., 2013; Hodliffe, 2014; Brigham et al., 2018; Zhong et al., 2014; Gibson & Tarrant, 2010)
Level of Autonomy	1	Level of independence that an individual has in making decisions that directly affect their work and/or work environment.	(Brigham et al., 2018)

	Staff Participation and Involvement	3	The engagement and involvement of staff who understand the link between their own work, the organization's resilience, and its long-term success. Staff are empowered and use their skills to solve problems.	(Kantur & Iseri-Say, 2012; Lee et al., 2013; Hodliffe, 2014)
	Deference to expertise	1	The ability to migrate decisions to the person(s) with the greatest expertise for the issue at hand.	(Bowers et al., 2017)
	Norms	1	A standard or pattern or behavior that has been established amongst team members.	(Bowers et al., 2017)
	Team structure and functionality	1	Composition of teams (members, roles, hierarchy), team development stages, level of support and resources available for teams.	(Brigham et al., 2018)
	Transactive memory	1	A combination of knowledge held by individual team members and the collective awareness of individual team member knowledge.	(Bowers et al., 2017)
	Unified Commitment	2	The demonstration of effort to collectively learn from errors that have occurred.	(Bowers et al., 2017; Kantur & Iseri-Say, 2012)
	Cohesion	2	An engagement in and commitment to a group.	(Bowers et al., 2017; Kantur & Iseri-Say, 2012)
	Delegation	1	The process of distributing and entrusting work to another person.	(Brigham et al., 2018)
	Level of competitiveness	1	The level of competition between individuals in an organization and/or team, which aims to inspire motivation and increase productivity within the workforce by comparing employee performance	(Brigham et al., 2018)

	Presence of Organizational Silos	2	People are encouraged to move between different departments or try different roles within our organization to gain experience.	(Brown et al., 2017; Lee et al., 2013)
	Stability of membership	1	The extent to which team members wish to remain as part of the team.	(Bowers et al., 2017)
	Compliance	1	The process of following rules, regulations, and laws that exist within an organization and/or team.	(Gibson & Tarrant, 2010)
	Trust	2	The belief, confidence, or expectation that a fellow team member will be responsive and act in an ethically justifiable manner.	(Gibson & Tarrant, 2010; Bowers et al., 2017)
	Level of Psychological safety	2	A perception that one can speak up without repercussion.	(Bowers et al., 2017; Ma et al., 2018)
	Level of support for all healthcare team members	2	Health and safety workplace practices that enable staff to feel connected, safe and keep well.	(Brigham et al., 2018; Cusack et al., 2016)
	Diversity and Inclusion	2	An organization's mission, strategies, and practices to support a diverse workplace.	(Brigham et al., 2018; Cusack et al., 2016)
	Infrastructure	1	Infrastructure and design of the department that provides the conditions for an efficient, timely and safe response	(Gibson & Tarrant, 2010)
	Workplace safety	3	Process, plans and strategies of protecting employees from work related illness and injury	(Brigham et al., 2018; Zhong et al., 2014; Innes, 2019)

Resource availability	5	The management and mobilization of the organization'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	(Kantur & Iseri-Say, 2012; Brown et al., 2017; Lee et al., 2013; Decerbo, 2018; Gibson & Tarrant, 2010)
Scope of practice	1	A set of laws and regulations that define procedures, actions, and processes that a healthcare staff member is permitted to follow in order to comply with the terms of their professional license.	(Brigham et al., 2018)
Technological Resources	3	Presence of resources such as diagnostic equipment, electronic medical records, telemedicine, artificial intelligence.	(Brigham et al., 2018; Gibson & Tarrant, 2010; Decerbo, 2018)
Broad resource networks	2	Ability to form relationships with others who may share fundamental resources.	(Bowers et al., 2017; Teo et al., 2017)
Systems interoperability and usability	3	The electronic sharing of health-related data within an organization and with other organizations and an ability of healthcare information technology to exchange, interpret and use data cohesively.	(Brigham et al., 2018; Decerbo, 2018, Teo et al., 2017)
Management of keystone vulnerabilities	3	Management of organizational aspects are likely to mitigate negative impacts of a crisis	(Bowers et al., 2017; Decerbo, 2018; Gibson & Tarrant, 2010)
Crisis Management	1	The technique by which an organization deals with a disruptive and unexpected event that puts at risk the organization and/or its stakeholders.	(Gibson & Tarrant, 2010)
Compensation and value attributed to work elements	2	Adequate staff compensation, including any financial benefits as well as demonstration of and staff recognition	(Bowers et al., 2017; Brigham et al., 2018)
Simulation training/ programs	2	Practice of the handling of unlikely events.	(Bowers et al., 2017; Decerbo, 2018)

Workflow optimization	2	Implementation of techniques to optimize workflow in the department.	(Brigham et al., 2018; Innes, 2019)
Situation monitoring and reporting	3	The ability to discern what is or is likely to become a threat in the near future.	(Bowers et al., 2017; Brown et al., 2017; Lee et al., 2013)
Financial Management	4	Retainment of financial resources available during a crisis.	(Bowers et al., 2017; Innes, 2019; Decerbo, 2018; Gibson & Tarrant, 2010)
Logistics	2	Establishment of efficient logistics to ensure that emergency response organizations can maintain operational effectiveness and logistical continuity during and immediately after an impact.	(Decerbo, 2018; Zhong et al., 2014)
Data collection	1	Data collection and documentation requirements for staff (physicians, nurses, PAs)	(Brigham et al., 2018)
Innovation and Creativity	4	Staff are encouraged and rewarded for using their knowledge in novel ways to solve new and existing problems and for utilizing innovative and creative approaches to developing solutions	(Brown et al., 2017; Lee et al., 2013: Gibson & Tarrant, 2010; Kantur & Iseri-Say, 2012)
Congruent Organizational mission and values	2	Establishing commitment, trust and strong internal alignment and creating a common purpose.	(Brigham et al., 2018; Gibson & Tarrant, 2010)
Patient-centered focus	1	A patient's specific health needs and desired health outcomes are the driving force behind treatment plans, all decisions and quality measurements.	(Brigham et al., 2018)
Focused Strategy	1	A plan that provides direction and serve as an anchor in times of uncertainty and chaos.	(Kantur & Iseri-Say, 2012)

	Recovery Priorities	1	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.	(Lee et al., 2013)
	Planning Strategies	3	Formulation of a preconceived way to deal with hazards, crises, or potentially unexpected adverse event.	(Brown et al., 2017; Lee et al., 2013; Bowers et al., 2017)
	Re-allocation Strategies	1	Strategies of resource reallocation.	(Innes, 2019)
	Confidence	1	A feeling of self-assurance arising from one's appreciation of one's own abilities or qualities.	(Innes, 2019)
	Self-efficacy	2	Self-efficacy is an individual's belief in his/her own ability to perform a specific task.	(Gillespie, et al., 2007; Ang, et al., 2018)
	Self-esteem	1	A positive or negative attitude toward oneself.	(Bowers, et al., 2017)
	Self-control	1	The capability to modulate and control impulses.	(Bowers et al., 2017)
	Optimism	2	The tendency to anticipate a positive outcome, even in the face of adversity.	(Bowers, et al., 2017; Lin, et al., 2019)

	Sense of humor	1	The ability to find humor about life situations and about oneself.	(Bowers, et al., 2017)
	Openness	1	Receptivity to new ideas and new experiences.	(Gillespie et al., 2007)
	Ability to Detach	1	The ability to emotionally detach and calmly react in highly stressful and adverse situations.	(Ang et al., 2018)
	Grit	1	The passionate pursuit of long-term goals.	(Bowers et al., 2017)
	Perseverance	1	Perceived ability to overcome adverse circumstances.	(Bowers et al., 2017)
	Hardiness	1	An openness to viewing change as a challenge.	(Bowers et al., 2017)
	Mental Toughness	1	The ability to persevere through difficult circumstances and emerge without losing confidence.	(Bowers et al., 2017)
	Praising self as a helping role	1	A staff member understands the importance of the positive and critical role he/she plays in the department.	(Lin et al., 2019)
	Coping Flexibility	1	The ability to flexibly adjust coping strategies to face distinct stressors.	(Bowers et al., 2017)

Patience	1	The capacity to accept or tolerate delay, trouble, or suffering.	(Bowers et al., 2017)
Empathy	1	The capacity to understand or feel what another person is experiencing from within their frame of reference.	(Brigham et al., 2018)
Age	2	Chronological age of an individual.	(Cusack et al., 2016; Gillespie et al., 2007)
Physical Well-being	3	The ability to perform physical activities and carry out social roles that are not hindered by physical health issues.	(Cusack et al., 2016; Brigham et al., 2018; Cooper et al., 2020)
Mental Well-being	3	A state of well-being in which an individual realizes their own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community.	(Cusack et al., 2016; Brigham et al., 2018; Cooper et al., 2020)
Genetic/Biological Resources	1	Genetics of an individual.	(Britt et al., 2016)
Relationships and social support	4	The perception that an individual is cared for, has assistance available from other people, and is part of a supportive social network.	(Cusack et al., 2016; Bowers et al., 2017; Britt et al., 2016; Cooper et al., 2020)
Family dynamics	3	Individual's relationship with his/her family.	(Britt et al., 2016; Brigham et al., 2018; Decerbo, 2018)
Financial stressors/ Economic vitality	1	The financial situation of an individual.	(Brigham et al., 2018)

Personal values	1	Broad desirable goals that motivate people's actions and serve as guiding principles in their lives	(Brigham et al., 2018)
Ethics	1	Moral principles that govern a person's behavior or the conducting of an activity.	(Brigham et al., 2018)
Morals	1	A person's standards of behavior or beliefs concerning what is and is not acceptable for them to do.	(Brigham et al., 2018)
Faith	1	A belief in the doctrines of a religion.	(Bowers et al., 2017)
Education	3	Level of academic education of staff members	(Decerbo, 2018; Grafton et al., 2010; Gillespie et al., 2007)
Clinical Competency	3	Level of clinical skills, the ability to provide safe care, to accurately assess and critically think through the best options for care using evidence-based practice	(Cusack et al., 2016; Gillespie et al., 2007; Lin et al., 2019)
Years of Experience	2	Number of years of working in a certain professional area	(Cusack et al., 2016; Gillespie et al., 2007)
Teamwork skills	1	Interrelated abilities that let an individual work effectively in an organized group	(Brigham et al., 2018)
Management and leadership skills	1	The ability to lead, communicate, manage, and work with a team which is critical for administrative success	(Brigham et al., 2018)

Communication skills	2	The ability to successfully communicate information and ideas, including skills such as active listening and questioning	(Brigham et al., 2018; Innes, 2019)
Collaboration skills	2	The ability of an individual to work with others towards a common goal.	(Gillespie et al., 2007; Lin et al., 2019)
Organizational skills	1	The ability to use available resources and time efficiently and effectively.	(Brigham et al., 2018)
Coping skills	4	A dynamic situation-specific reaction to stress.	(Bowers et al., 2017; Brigham et al., 2018; Ang et al., 2018; Gillespie et al., 2007)
Stress Management Skills	2	A technique aimed at controlling an individual's stress level; particularly chronic stress levels.	(Bowers et al., 2017; Gillespie et al., 2007)
Technology Proficiency	1	The required level of proficiency in computer skills among staff to successfully perform their administrative (i.e., data collection), clinical, teaching and research skills.	(Brigham et al., 2018)
Assessment Skills	1	Skills of performing a structured physical examination that allows to obtain a complete assessment of the patient.	(Innes, 2019)
Directed attention	1	The ability to direct interpretations to a more flexible disposition.	(Bowers et al., 2017)
Work Prioritization Skills	1	An ability to correctly prioritize tasks, increase efficiency, create structure and order.	(Lin et al., 2019)

	Decision-making skills	3	A skill of choosing between two or more courses of action.	(Brown et al., 2017; Lee et al., 2013; Innes, 2019)
	Clinical Responsibilities	1	Any task or duty involving the professional component of medical practice, which requires clinical judgement and skills.	(Brigham et al., 2018)
	Administrative Responsibilities	1	Duties that include leading committees, clinical and faculty teams; budget management, completing essential paperwork; establishing chain of command maps, designing, and implementing disciplinary processes.	(Brigham et al., 2018)
	Research Responsibilities	1	Involvement of staff members, specifically physicians in biomedical research	(Brigham et al., 2018)
	Teaching Responsibilities	1	Responsibilities to design and implement disciplinary processes, provide comprehensive staff-in-training education	(Brigham et al., 2018)
	Alignment of responsibility and authority	1	The level of authority or leading role in a team corresponds to the assigned responsibilities	(Brigham et al., 2018)
	Required Level of engagement	1	The level to which a person feels invested in and has influence over the processes and outcomes that occur in their workplace	(Brigham et al., 2018)
	Learning/ career stage	1	A career stage of a staff member that potentially impacts the number of work hours, work schedule and responsibilities.	(Brigham et al., 2018)
	Clinical specialty related issues	1	Specifics or issues related to a particular specialty.	(Brigham et al., 2018)

Outcomes	Delivery of patient-centered care	1	An individual's specific health needs and desired health outcomes are the driving force behind all health care decisions and quality measurements.	(Innes, 2019)
	Patient satisfaction	1	A measure of the extent to which a patient is content with the health care which they received from a healthcare organization	(Grafton et al., 2010)
	Improved quality of patient care	3	A level of value provided by any health care resource	(Cusack et al., 2016; Innes, 2019; Cooper et al., 2020)
	Improved Patient safety	2	The absence of preventable harm to a patient during the process of health care and reduction of risk of unnecessary harm associated with health care to an acceptable minimum.	(Cusack et al., 2016; Innes, 2019)
	Potential for improved Staff retention	2	Improvement in ability of organization to retain its employees	(Grafton et al., 2010; Cooper et al., 2020)
	Reduced staff sick leave/ turnover	3	Decrease in the number (or percentage) of staff members who leave an organization are replaced by new staff members	(Cusack et al., 2016; Bowers et al., 2017; Hodliffe, 2014)
	Error Avoidance	1	The prevention and/or minimization of errors.	(Bowers et al., 2017)
	Sustained Results	1	The ability to duplicate results each time a strategy is implemented.	(Bowers et al., 2017)
	Organization Longevity	1	Timespan indicative of the organization's success in its business environment in the past.	(Bowers et al., 2017)

	Recovery	1	A return of organization to a state of pre-event condition	(Kantur & Iseri-Say, 2012)
	Renewal	1	Improved post-event organization with a higher level of understanding of a wider set of relationships and an increased sensitivity toward perceiving the whole organizational system.	(Kantur & Iseri-Say, 2012)
	Continuity	1	An ability of organization to continue to function through an operational interruption	(Kantur & Iseri-Say, 2012)
	Physical Health	1	Decreased prevalence of physical disease following stress; increased pain tolerance; improved recovery from illness.	(Bowers et al., 2017)
	Psychological Health	1	Decreased prevalence of stress-related diseases such as Post-Traumatic Stress Disorder and Complicated Grief.	(Bowers et al., 2017)
	Protected from psychopathology	2	Protection from behaviors and experiences which may be indicative of mental illness or psychological impairment following trauma	(Cooper et al., 2020; Çam, & Büyükbayram, 2017)
	Decrease in exhaustion	3	Decrease in a state of extreme physical or mental fatigue.	(Çam, & Büyükbayram, 2017; Rees et al., 2015; Ang et al., 2018)
	Increase in job satisfaction	5	The global positive feeling an employee has about their job.	(Cusack et al., 2016; Hodliffe, 2014; Cooper et al., 2020; Çam, & Büyükbayram, 2017; Grafton et al., 2010)
	Job Engagement	3	A fulfilling and positive dedication, enthusiasm, and immersion in one's work.	(Cusack et al., 2016; Bowers et al., 2017; Hodliffe, 2014)

	Decrease in rates of leaving or considering leaving the job	2	Decrease in the extent to which an individual wishes to remain a member of the organization.	(Bowers et al., 2017; Hodliffe, 2014)
	Career Longevity	2	The length of time an individual remains in job.	(Bowers et al., 2017; Grafton et al., 2010)
	Increase in life satisfaction	1	Increase in the degree to which a person positively evaluates the overall quality of his/her life as a whole	(Çam, & Büyükbayram, 2017)
	Sustained Social Ability	1	The ability to maintain effective relationships and demonstrate appropriate social skills in the face of stress.	(Bowers et al., 2017)
	Sustained Cognitive Ability	1	The ability to collect, process, and act on information during or following periods of extreme stress.	(Bowers et al., 2017)
	Affective Commitment	1	Employee's positive emotional attachment to the organization.	(Malik & Garg, 2017)
Characteristics of Staff Resilience	Being Realistic	1	An ability of an individual to realistically evaluate the situation, understand what can or cannot be done as well as establish a practical plan and achievable goal	(Cooper et al., 2020)
	Having Healthy Relationships	2	The maintenance of positive social relationships within the organization.	(Britt et al., 2016; Bowers et al., 2017)
	Seeking Help from Others	1	A staff member feels comfortable asking co-workers for help and obtaining their assistance in decision-making	(Britt et al., 2016)

	Self-efficacy	4	Self-efficacy is an individual's belief in his/her own ability to perform a specific task	(Rees et al., 2015; Cooper, et al., 2020; Grafton, et al., 2010; Cusack et al., 2016)
	Self-esteem	1	A positive or negative attitude toward oneself.	(Grafton et al., 2010)
	Hardiness	1	An openness to viewing change as a challenge.	(Grafton et al., 2010)
	Optimism	2	The tendency to anticipate a positive outcome, even in the face of adversity.	(Cooper, et al., 2020; Grafton, et al., 2010)
	Humor	2	Ability to find humor about life situations and about oneself.	(Cooper, et al., 2020; Grafton, et al., 2010)
	Mindfulness	3	A mental state in which an individual focuses attention on the present moment, while acknowledging one's feelings and thoughts without judgement.	(Cusack et al., 2016; Bowers et al., 2017; Rees et al., 2015)
	Tolerance	2	Sympathy or indulgence for beliefs or practices differing from or conflicting with one's own	(Gibson & Tarrant, 2010; Grafton et al., 2010)
	Patience	1	The capacity to accept or tolerate delay, trouble, or suffering.	(Grafton et al., 2010)
	Engagement	1	The level to which a staff member feels invested in and has influence on the work-related processes and outcomes	(Brown et al., 2017)

	Coping	5	A process of adjustment following an adverse event. Coping maybe emotion- or problem-focused.	(Cusack et al., 2016; Britt et al., 2016; Rees et al., 2015; Gibson & Tarrant, 2010; Grafton et al., 2010; Cooper et al., 2020)
	Stress Management	1	A technique aimed at controlling an individual's stress level; particularly chronic stress levels.	(Bowers et al., 2017)
	Well-being	1	Physical, mental, and social fulfillment.	(Britt et al., 2016)
Resilience Capability	Agility	2	The ability to quickly and effectively cope with unexpected changes in the environment, recognize opportunities and develop competitive direction changes to pursue these opportunities	(Bowers et al., 2017; Gibson & Tarrant, 2010)
	Flexibility	3	The ability, on a relatively low cost, to quickly adjust to foreseen as well as unforeseen changes in the organizational environment	(Kantur & Iseri-Say, 2012; Britt et al., 2016; Brigham et al., 2018)
	Adaptability	2	The ability of an organization to adapt to a changing environment and to come out of crisis stronger than before	(Bowers et al., 2017; Grafton et al., 2010)
	Robustness	2	The ability of element, systems, and other units of analysis to withstand stresses and demands without suffering damage, degradation, or loss of functions.	(Kantur & Iseri-Say, 2012; Zhong et al., 2014)
	Resourcefulness	2	The capacity to identify problems, establish priorities, and mobilize resources to avoid or cope with damage or disruption and the ability to apply human and material resources to meet priorities and achieve goals	(Kantur & Iseri-Say, 2012; Zhong et al., 2014)
	Redundancy	2	The extent to which elements, systems, or other units of analysis exist that meet functional requirements in the event of disruption, degradation, or loss of functionality of primary systems	(Kantur & Iseri-Say, 2012; Zhong et al., 2014)

Rapidity	2	The speed of hospital responsiveness through fixing things up, bouncing back, functional recovery and adaptation	(Kantur & Iseri-Say, 2012; Zhong et al., 2014)
Infrastructure Preparedness	1	Appropriate building code and locations of hospital critical infrastructures to withstand disaster-induced damage, the strategy to evacuate and protect existing patients, Alternative backup systems (e.g., power, communication)	(Zhong et al., 2014)
Staff Preparedness	2	The protective strategies for key staff (e.g., staff role reassignment, staff incentives), the key staff knowledge of disaster management and the key staff skills of disaster treatment.	(Decerbo, 2018; Zhong et al., 2014)
Supply Preparedness	2	The strategies for management of emergency supplies, the stock quantity of essential medicines for various disasters, the strategies for management of medicine (drug distribution).	(Decerbo, 2018; Zhong et al., 2014)
Crisis Communication Preparedness	2	The crisis communication with external facilities, the crisis communication and cooperation with other departments/hospital facilities, the crisis communication within the department.	(Decerbo, 2018; Zhong et al., 2014)
Disaster Plans	4	Plans for different kinds of disasters, emergency standard operating procedures to execute the plan, stress Testing Plans	(Decerbo, 2018; Zhong et al., 2014; Brown et al., 2017; Lee et al., 2013)
Disaster Training/Drills	4	Special event training/drills, routine training/drills, different methods of implementing drills	(Decerbo, 2018; Zhong et al., 2014; Brown et al., 2017; Lee et al., 2013)
Surge Capacity	1	The strategies for surging staff, physical space, supplies.	(Zhong et al., 2014)

	Continuity of Essential Services	1	The procedures to identify, prioritize and maintain essential functions, Mass-casualty triage protocol based on severity of illness/injury, survivability and hospital capacity, Procedures for referral and counter-referral of patients	(Kantur & Iseri-Say, 2012)
	Adaptation	4	Ability to deal with constantly changing demands, Adaptation to Changing Culture	(Kantur & Iseri-Say, 2012; Lee et al., 2013; Britt et al., 2016; Decerbo, 2018)
	The Evaluation Report	1	Incident Summary, Response Assessment, Vulnerability Assessment, Risks Assessment	(Zhong et al., 2014)
	Identification of Improvement Areas based on Evaluation Report	2	Defining which area needs improvement in the Emergency Department - staff, supplies, infrastructure, communication, disaster	(Decerbo, 2018; Zhong et al., 2014)
	Strategies for recovery	4	Short-term and long-term recovery strategies	(Kantur & Iseri-Say, 2012; Zhong et al., 2014; Lee et al., 2013; Davis et al., 2020)

APPENDIX B: EXPERT STUDY SURVEY

EXPERT STUDY SURVEY

Instructions:

This study is interested in experiences and perspectives of experts in the areas of Organizational Resilience and ED Operations. This survey consists of three sections:

1. General questions about your background and experience.
2. Open-ended questions about specific dimensions of resilience; and
3. Open-ended questions about the relationships between those dimensions

To begin, please read the following definitions, which are relevant for the survey questions:

<u>Organizational Resilience</u> is the ability of an organization to anticipate mass disruptive events, effectively absorb and adapt in a changing environment to deliver its objectives as well as successfully recover and emerge from a challenging event stronger than before the disruption.

<u>Emergency Departments</u> are open, dynamic, high-risk systems that operate within hospitals and serve a critical role of providing immediate medical care.

<u>Emergency Department staff</u> includes registered nurses and nurse practitioners, ED technicians, emergency medicine residents, attending physicians, interns, and physician assistants. Note that physicians are sometimes independent contractors and not employees of the hospitals, however, they are considered to be staff members due to their role in the ED operational environment.

Please note that we are interested in learning more about your professional opinion and experiences and there are no right or wrong answers to any of the questions. You may also skip any question that you are not comfortable answering.

The results of the survey will be used to further develop a model of ED staff resilience to support EDs in developing their resilience capabilities.

Section I: Pre-survey Questions: Background and Experience

Question 1:
How many years of experience do you have in the area of organizational resilience?
1. Over 20 years
2. 10 - 20 years
3. 5 – 10 years
4. Less than 5 years
5. I have no experience in organizational resilience

Question 2:
When was your last experience with organizational resilience?
1. In the past 5 years
2. 5-10 years ago
3. 10-20 years ago
4. Over 20 years ago
5. I have no experience in organizational resilience

Question 3:
What kind of experience in the area of organizational resilience did you have?
1. Research
2. Practice/Industry
3. Both Research and Practice/Industry
4. Neither Research nor Practice/Industry
5. I have no experience in organizational resilience

If you had experience in the area of organizational resilience, please briefly describe it below:
_____

Question 4:
How many years of experience do you have in the area of Emergency Department operations?
1. Over 20 years
2. 10 - 20 years
3. 5 – 10 years
4. Less than 5 years
5. I have no experience in Emergency Department operations

Question 5:
When was your last experience with Emergency Department operations?
1. In the past 5 years
2. 5-10 years ago
3. 10-20 years ago
4. Over 20 years ago
5. I have no experience in organizational resilience

Question 6:
What kind of experience in the area of Emergency Department operations did you have?
  1. Research
  2. Practice/Industry
  3. Both Research and Practice/Industry
  4. Neither Research nor Practice/Industry
  5. I have no experience in Emergency Department Operations

If you had experience in the area of Emergency Department operations, please briefly describe it below:
_____

Section II: Specific Dimensions of Resilience

Question 1:
How would you describe a resilient Emergency Department?
_____

Question 2:
How would you describe a resilient Emergency Department staff member?
_____

Question 3:
What is the difference between resilience capability at Emergency Department Level and resilience capability at individual Emergency Department staff member level?
_____

Question 4:
What are some of the key barriers for resilience in Emergency Departments?
_____

Question 5:
What are some of the factors that facilitate resilience in Emergency Departments?
_____

Question 6:
What are the reasons why an Emergency Department as an organization might want or need to become resilient?
_____

Question 7:
What are the reasons why an Emergency Department staff might need to become more resilient?

_____

Question 8:
What does an Emergency Department gain from building resilience?

_____

Question 9:
What are the outcomes of being resilient for staff members as individuals?

_____

Question 10:
What are the most common unexpected disruptive events that Emergency Department staff members need to be resilient against?

_____

Section III: Relationships between Dimensions of Resilience

Question 1:
How does the healthcare sector affect Resilience Capability of Emergency Departments?

_____

Question 2:
How do hospitals affect Resilience Capability of Emergency Departments?

_____

Question 3:
How do Resilient staff members as individuals contribute to Resilience Capability of Emergency Departments as organizations?

_____

Question 4:
How do resilient staff members as individuals contribute to Resilience Capability of Emergency Departments as organizations?

_____

Question 5:
What is the difference between Resilience Capability and characteristics of Resilient staff?

_____

Question 6:
How would you describe the relationship between factors affecting Resilience and the Resilience Capability?

_____

Question 7:
How does the presence of Resilience Capability in Emergency Departments affect the relationship between unexpected disruptive events and the outcomes of these events?

_____

Question 8:
How does the complexity of Emergency Department environment affect its ability and ability of its staff to be resilient?

_____

Additional Comments & Feedback:
This concludes the survey. If you have any additional comments, feedback, questions, or concerns, please feel free to address them below.

_____

Thank you for your time and contribution to this study. Please click "Submit Survey" to submit your response.

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