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Hospital Preparedness: Effects of Designated Preparedness Coordinators on Hospital Preparedness for Special Hazard Classes

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This is to certify that the doctoral dissertation by

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Abstract

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Abstract

Since 9/11, little statistical rigor has been placed on identifying the correlates of hospital preparedness. This quantitative study explores the research question: Is there a correlation between the employment of a designated hospital preparedness coordinator and the reported level of preparedness for: (a) general preparedness; (b) chemical, biological, radiological, and nuclear (CBRN) events; (c) pandemic disease outbreaks; (d) mass casualty events; and (e) internal infrastructure failure, as assessed by an online survey. Alternative analysis was conducted to assess the relationship between access to resources and the five dependent variables. Using complexity theory as the theoretical framework, point biserial correlation and Pearson's method were used to assess the relations between the dependent and independent variables. Initially, no statistically significant correlative relationship was found using point biserial analysis. However, further analysis found that the correlation between full-time employment of a preparedness coordinator and pandemic preparedness reached significance. Point biserial analysis of the alternative research questions found statistically significant correlations between access to preparedness resources, CBRN, pandemic, and infrastructure failure preparedness. Pearson analysis found a statistically significant correlation between single facility coordinator responsibilities and pandemic preparedness. This identifies at least two significant correlates of hospital preparedness. Positive social change can be achieved by identifying strategies that leverage these assets in a fiscally sustainable constructs that maximize hospitals' ability to effectively serve the community in disasters but that do not so heavily rely on government funding and grants in a world of ever-changing priorities.

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Chapter 1: Introduction to Study

Introduction

Hospital preparedness for catastrophic disasters, including those involving chemical, biological, radiological, and nuclear/weapons of mass destruction (CBRN/WMD), mass casualty events, pandemics and disease outbreaks, and infrastructure failure, have garnered significant attention over the past decade. In the years since September 11, 2001, health and health care preparedness and those disciplines associated with it have become increasingly important to overall preparedness of a community. In addition to the ability of the health care infrastructure to maintain and sustain operations during a disaster with significant health impacts, an integral part of that equation has become those individuals responsible for coordinating and executing those tasks and actions associated with the health preparedness of a community. However, little rigor has been devoted to ascertaining how these individuals influence overall preparedness at the community or at the facility level.

The present study was a quantitative analysis of the impact of these individuals on health care facilities and systems and their ability to provide care and sustain operations during disasters. Providing data and analysis on the potential impact of these individuals in a disaster situation could affect decisions made by hospital and health care systems when deciding how best to plan for and allocate funds and resources for the preparedness, survivability, and resilience of their institutions. These decisions ultimately affect an

entire community's health and well-being, especially as it relates to responses to pandemics and disease outbreaks, CBRN incidents, and natural disasters.

This chapter (a) discusses the background of the issues; (b) describes the nature of the problem; (c) outlines the nature of the study and the theoretical basis; (d) identifies the research questions and research hypotheses; (e) provides an overview of the methods; and (f) describes the limitations and delimitations associated with these methods. Chapter 2 examines the literature on hospital preparedness and preparedness coordinators, and Chapter 3 will discuss the methodology for assessing how preparedness coordinators influence a hospital's preparedness for terrorist incidents, pandemics, and natural disasters.

Background

The events of September 11, 2001, the subsequent *bacillus anthracis* attacks (also known as Amerithrax), and Hurricane Katrina have resulted in a much greater emphasis on response to disasters, preparedness, and related disciplines. The Federal government and state governments have placed major emphasis on a whole community approach to national preparedness (Assistant Secretary for Preparedness and Response (ASPR), 2006). A key component in this strategy is the preparedness of the nation's health care and medical service delivery system. In the more than a 10 years since the 9/11 tragedy, billions of dollars have been spent on increasing the preparedness and resilience of public health, medical, and health care infrastructure (Toner et al., 2009).

Despite this increased attention and spending, gaps remain in the preparedness and capability of the hospital and health care infrastructure to respond to and recover from disasters with significant health components (Valesky et al., 2011; Kaji, Koenig, & Lewis, 2007). Disasters including 9/11, Hurricane Katrina, the pandemic outbreak of H1N1, and, most recently, superstorm Sandy has reinforced the nature and seriousness of the deficiencies and gaps in health care preparedness capacity and capabilities. These gaps include:

1. Surge capacity (Rebmann, Carrico, & English, 2007).
2. Preparedness for chemical, biological, radiological, nuclear, and high-yield explosive (CBRNE) events and terrorist attacks (McInerney & Richter, 2011).
3. Preparedness for mass casualty events (Peleg & Kellerman 2012)
4. Training of clinical and non-clinical staff (Heinrichs, Youngblood, Harter, & Dev, 2008; Scott et al., 2012)
5. Pandemic and infectious disease preparedness (Moen, Kennedy, Cheng & MacDonald, 2014)
6. Hospital incident command and crisis management (Nemeth, Wears, Patel, Rosen, & Cook, 2011; Yarmohammadian, Atighechian, Hagshenas, & Shams, 2013)
7. Coordinated planning (Zusman & Marghella, 2013)

In addition to these gaps, there are significant challenges to hospital and health care preparedness. These include:

1. Risk perception and the concept of health care disasters as low probability-high impact events (Barbera, Yeatts, & Macintyre, 2009; Zusman & Merghella, 2013)
2. Increased focus on hospital cost centers, health care economics, and profit margins (Barbera, Yeatts, & Macintyre, 2009; Zusman & Merghella, 2013)
3. Increased government focus and accreditation requirements (Barbera, Yeatts, & Macintyre, 2009)

The gaps and challenges listed, taken in there totality, present a formidable obstacles to hospital preparedness.

As a product of this increased emphasis and funding, resulting, in part, from the lessons observed from the Amerithrax attacks and Hurricane Katrina, hospitals and health care systems have increasingly begun to employ preparedness, disaster, and emergency management coordinators (Spieler, Singer, & Cummings, 2007a). These individuals are directly responsible for: (a) compliance with state and federal preparedness mandates; (b) training of staff; (c) accreditation issues; and (d) other preparedness and emergency management related duties. These professionals are markedly different than their predecessors. In years past, hospitals categorized emergency preparedness as an ancillary duty held by a practicing physician or nurse, or distributed among disparate offices within the hospital or system.

In 2007, the National Public Health and Hospital Institute (NPHHI) conducted random survey of 60-member hospitals of the National Association of Public Hospitals

and Health Systems (NAPH) to determine the number of hospitals with such professionals (Spieler, Singer, & Cummings, 2007a). The survey found that 15 of the 60-hospitals (25 percent) surveyed had dedicated emergency management/preparedness professionals on staff (Spieler, Singer, & Cummings, 2007b). They concluded that designated emergency preparedness professionals *might* be critical in increasing and maintaining hospital preparedness.

Additional qualitative works have been attempted with the goal of establishing links between designated preparedness coordinators and reported levels of preparedness; of note are studies from University of Pittsburgh Medical Center in 2009 and NAPH in 2007. However, this and the other studies did not use any scientific or statistical rigor in ascertaining a measure of effect of these professionals. Without a greater understanding of the influence and impact of these professionals on a health care facility's overall preparedness and its ability to operate during special crises events, it will be difficult to understand how to address current gaps and shortfalls in health care preparedness.

Epidemiological Perspectives

According to Sosin & Besser (2008), preparedness and response to bioterrorism events became of import to field epidemiologists in the early 1950s, during the early years of the Cold War. The United States Public Health Service established the Epidemic Intelligence Service which focused on training physicians and allied health professionals on the application of epidemiological principles to disease control, whether naturally occurring or as the result of biological warfare (Sosin & Besser, 2008). However, the

2001 Anthrax letters, natural disasters, and the growing threat of terrorists with WMD has increased the demands on and exposed the gaps in public health and healthcare preparedness and response. Besser and Sosin make the case the epidemiologists have a very distinct and important role to play in closing these gaps.

Sosin & Besser state that epidemiologists, and more specifically field epidemiologists, are uniquely suited to the role and responsibilities of supporting and leading preparedness and response activities in the public health and health care delivery settings (Gregg, 2008). They highlight the roles of epidemiologists' in planning, exercising those plans, assessing threats, and evaluating response and corrective actions as vital to preparedness programs and response to disasters with significant health effects, both man-made and natural. They also assert that the epidemiologist's role in preparedness and response are rooted in the application of conventional epidemiology, but that it also encompasses an understanding and familiarity of environmental problems, occupational hazards, operational issues, and other disciplines integral to public health.

Assigning the tasks of health care preparedness to the epidemiologist is not a new concept. The state of North Carolina currently has a program that embeds epidemiologists in hospitals. They execute the standard roles of an epidemiologist but also to provide assistance to the hospital preparedness coordinator or staff elements responsible for preparedness with the tasks associated with preparing staff and facility for emergencies, especially disease outbreaks and bioterrorism. Markiewicz et al. (2012) stated that public health epidemiologists effectively linked public health agencies and

hospitals to enhance syndromic surveillance, communicable disease management, and public health emergency preparedness and response.

Understanding the strengths and weaknesses of the underlying health care infrastructure is essential to planning and mounting an effective response to incidents and accidents with significant health impacts. The current study has the potential to provide epidemiologists another tool to help plan for and respond to such events.

Problem Statement

Despite the prevalence of these professionals and the general respect for their efforts, there are sparse data on the effect these individuals (or staffs of individuals) have as it relates to the all-hazards preparedness of a hospital or hospital system. After a careful review of the literature, there is no evidence that a study of this nature within the hospital and health care setting has been attempted.

As stated previously, the knowledge base on the topic is sparse. However, the studies and data available show a strong qualitative belief that designated hospital preparedness professionals provide a valuable service. The National Association of Public Hospital and Healthcare Systems 2006 annual preparedness appraisal of its member hospitals asserts that these professionals are greatly improving hospital preparedness (Spieler, Singer, & Cummings, 2007b). Additionally, Toner et al (2009) provide additional context in there study sponsored by the University of Pittsburgh Medical Center. They assert that hospital disaster coordinator have improved the quality

of preparedness planning within their respective facilities (Toner et al., 2009). In both instances, this information is purely qualitative in nature.

In contrast, Kano & Bourque (2008) look at the statistical correlates of preparedness for individual schools in the Los Angeles Unified School System. They found that a key indicator for schools with higher levels of preparedness was that they had access to a designated preparedness coordinator (Kano & Bourque, 2008). They also found that even when the school only had part-time access to such a professional the school reported higher levels of preparedness.

Additionally, findings by Avery & Zabriskie-Timmerman (2009) showed that hiring an emergency preparedness coordinator increased preparedness activities of health departments (Avery & Zabriskie-Timmerman, 2009). When they modeled their findings to identify if this were true in broader applications, they also found that all models pointed to greater level of preparedness activities if these individuals were present in the model.

Although, Kano & Bourque (2008) and Avery & Zabriskie-Timmerman (2009) have identified that there seems to be a correlation between access to preparedness coordinators and level of preparedness, they admit that more research and study is required. As it relates to medical and health care preparedness, no such study has been conducted and therefore the literature is devoid of any data correlating these types of professionals with overall preparedness or with these professionals and specific types of events of medical and health care significance.

Purpose of the Study

The purpose of this quantitative survey-based study is to ascertain if a correlation exists between the designated preparedness/disaster coordinator (DPDC) position and a hospital's reported level of overall preparedness for CBRN and mass casualty events, pandemics and disease outbreaks, and infrastructure failure. The theory applied to this research is the complexity theory (Hilhorst, 2003). The population studied consists of the member hospitals of the Northern Virginia Hospital Alliance and District Five of the Maryland Hospital Association.

Theoretical Base

Hospitals are systems within a system. They are part of the larger construct of social, political, economic, and technical systems. This is especially true of safety-net hospitals, which are funded by the county or city for which they serve and are subject to the shifts in political, economic, and social change sentiment. Complexity theory provides a method by which a hospital emergency preparedness coordinator may manage these systems and subsystems; it also provides a roadmap to navigate the internal and external factors associated with the systems approach (Spieler, Singer, & Cummings, 2007b).

Because of its integrated systems-based approach, complexity theory provides an appropriate framework for modeling the cross-cutting factors of a hospital in a disaster context. The following factors are also reasons why complexity theory provides a suitable construct for the study of preparedness coordinators, both in this construct and more

generally: (a) Disaster management is dynamic and requires an adaptive system. This involves cross boundary integration and a diverse mix of personnel, clinical and non-clinical specialties, and internal and external stakeholders. (b) Previous and current literature as well as recent disasters has increased the body of knowledge and understanding of the complexity of disasters and disaster management for health care and public health, yet few studies have examined empirically what the necessary ingredients are for crisis management within the context of a health care facility. This gap in the literature is particularly apparent with respect to personnel charged with the actual crisis and disaster management (O'Sullivan, Kuziemsky, Sullivan, & Corneil, 2012). A more detailed outline of the complexity theory and its relationship to this study is contained in Chapter 2.

The primary dependent variables in this study are overall hospital preparedness, CBRN and mass casualty event preparedness, preparedness for pandemics and disease outbreaks, and preparedness for infrastructure failure. The National Healthcare Preparedness Capabilities defines eight key capabilities needed for hospitals and health care systems to effectively and efficiently prepare, respond, and recover from disasters with health implications or public health and medical emergencies. The National Healthcare Preparedness Capabilities include:.(a) health care system preparedness; (b) health care system recovery; (c) emergency operations coordination; (d) fatality management; (e) information sharing; (f) medical surge; (g) responder health and safety; and (h) volunteer management (ASPR, 2012).

From a practical perspective, testing each of the hospital preparedness program (HPP) core capabilities and associated functions was beyond the scope of this study. However, a review of the literature did identify key capabilities and functions considered to be of increased importance as they relates to overall hospital preparedness. These include:

1. Plans and the degree to which these plans account for an all-hazards approach and response to disasters.
2. Coordination of training and exercises among hospital staff and with support organizations.
3. Staff and facility surge capacity.
4. Memoranda of agreement (MOA), memoranda of understanding (MOU), and planning partnerships with other hospitals, health care facilities, state authorities, local authorities, and other supporting service providers.
5. Overall hospital or system funding and access to funding and preparedness level resources.
6. Socioeconomics and demographics of communities served. (ASPR, 2012; O'Sullivan et al., 2012; Spieler, Singer, & Cummings, 2007a):

Each of the six elements above are systems-based functionalities and require considerable leadership and coordination to efficiently and effectively ensure that hospitals and health care systems are adequately prepared to respond to and recover from disasters. The six elements of the health care preparedness planning model can be viewed

as tasks or task objectives with specific requirements to be met in order for a hospital to acquire and maintain an adequate level of preparedness. Because these items can be viewed as objectives with supporting tasks, task ownership and organization, especially during the potential chaos of an emergent situation, becomes vitally important (Valle, 2000).

Complexity theory is especially suited to serve as the theoretical framework for the present study. The theory focuses on task organization, process ownership, and internal and external interactions and their correlation to preparedness of health care delivery systems for the range of emergency detailed in this work (Plsek & Wilson, 2001).

Research Questions

My overarching research question was: What is the effect of DPDC on the overall preparedness reporting of hospitals? In addition, I examined the following sub questions and hypotheses:

Research Question 1: Is there correlation between overall hospital preparedness and the employment of a DPDC?

$H_0$1: There is no correlation between overall preparedness and the employment of a DPDC.

$H_1$1: There is a correlation between overall preparedness and the employment of a DPDC.

Research Question 2: Is there a correlation between a hospital's reported level of preparedness for CBRN and mass casualty events and the employment of a DPDC?

$H_0$2: There is no correlation between CBRN preparedness and mass casualty event preparedness and the employment of a DPDC.

$H_1$2: There is a correlation between hospital CBRN and mass casualty event preparedness and employment of a DPDC.

Research Question 3: Is there a correlation between a hospital's reported level of preparedness for a pandemic disease outbreak and the employment of a DPDC?

$H_0$3: There is no correlation between pandemic preparedness and the employment of a DPDC.

$H_1$3: There is a correlation between hospital preparedness for pandemic disease outbreaks and the employment of a DPDC.

Research Question 5: Is there correlation between a hospital's reported level of preparedness for a mass casualty event and the employment of a DPDC?

$H_0$4: There is no statistically significant correlation between mass casualty event preparedness and employment of a DPDC.

$H_1$4: There is a statistically significant positive correlation between mass casualty event preparedness and employment of a DPDC.

Research Question 5: Is there a correlation between a hospital's reported level of preparedness for an infrastructure failure and the employment of a DPDC?

$H_0$5: There is no correlation between preparedness for infrastructure failure and employment of a DPDC.

$H_1$5: There is a correlation between hospital preparedness for infrastructure failure or outages and the employment of a DPDC.

Nature of Study

The present study was a quantitative assessment of the overall and specific incident preparedness of selected hospitals in Northern Virginia and Southern Maryland. The target population was member hospitals of the Northern Virginia Hospital Association and District Five of the Maryland Hospital Association, which consist of the counties and municipalities surrounding Washington, D.C. The study involved an individual facility survey that focused on hospital characteristics, make-up and organization of their preparedness programs, and strategic level preparedness information and indicators. The instrument itself was adapted from existing instruments and checklists that were designed and validated to measure hospital preparedness. Point Biserial Correlation Analysis and Effect Size was done using SPSS 22.0 software suite to determine the attributes of hospital preparedness and the relationship between hospital preparedness, those central attributes, and the employ of a DPDC.

This method, the population, and the instruments were selected for several specific reasons. First, Kano & Bourque (2008) used a similar methodology to show a correlation between designated disaster preparedness coordinators and increased levels of preparedness in schools in the Los Angeles Unified School District. The population

sample is a convenience sample which has been selected because of the its proximity to the researcher and the unprecedented access, support, and cooperation being granted by the Northern Virginia Hospital Alliance and District 5 of the Maryland Hospital Association. Finally, the instrumentation being adapted for the present study are open source and have been designed, deployed, and validated in assessing hospital preparedness as well as hospital preparedness for specific events.

Operational Definitions and Key Terms

This section provides operational definitions for terms and phrases germane to the research. The operational definitions consist of those relevant to the dependent and independent variables.

Accreditation. Accreditation is a self-imposed self-assessment and external peer assessment process used by health care organizations to accurately assess their level of performance in relation to established standards and to implement ways to continuously improve. The Joint Commission accreditation is the most widely sought-after because it is a mark of attainment that allows hospital to receive Medicaid and Medicare reimbursement for services (Agency for Health Research and Quality, 2011).

Designated preparedness/disaster coordinator (DPDC). A DPDC is a person or staff of individuals within a hospital who are responsible for pre-, trans-, and post disaster operations designed to ensure that the hospital, in its totality, runs efficiently and effectively (Spieler, Singer, & Cummings, 2007a).

Funding. Funding refers to the amount and also the type of money used to support the preparedness program, which includes grant money, capital funds, and donations (ASPR, 2012).

Interagency planning. Interagency planning refers to a hospital's engagement, planning, and coordination with both public and private sector stakeholders to ensure synergy in efforts and operations during a disaster (ASPR, 2012).

Intra-agency collaboration. Intra-agency collaboration refers to the collaboration and planning of a hospitals internal clinical, allied, and support functions that enhance (ASPR, 2012).

Level of preparedness. Level of preparedness is a product of the measurement of the survey instrument. It is a composite score and snapshot of a facility's overall preparedness. The measures are based on recognized measures of preparedness. For the purposes of this study, no one measure is weighted higher or more important than any other (Kaji et al., 2007).

Preparedness reporting. For the purposes of this study, preparedness reporting is a proxy measure for actual preparedness and ability to respond (Kaji et al., 2007).

Preparedness spending and resource base. Preparedness spending and resource base refers to the sum total of preparedness related equipment and funds a hospital directs towards its preparedness program (Kaji et al., 2007).

Specific events. This term is used within this context of the current study to denote CBRN, pandemic, infrastructure failure, and mass casualty events.

Limitations

Limitations considered in this research study included those of validity, reliability, and other limitations.

Validity

Face validity refers to whether an indicator; or in this case a question in the research survey, and appears is a substantively accurate measure of a variable (Babbie, 2010). The questions presented in this survey for the dependent variable (level of hospital preparedness and designated DPDC) and the independent variables were separated categorically, and I designed the questions specifically to provide a reasonable measure for the variables.

External validity is defined as the degree to which a study's conclusions would hold outside of the study's target population, in a different setting, and at different points in time (Trochim & Donnelly, 2007). This should be a major planning consideration when designing and executing a research study. Based on the universal measures used to assess the dependent variable and the independent measures used to assess the correlational relationship between these measures and DPDC, this study has external validity. However, the sample population of hospitals my present some challenges. These sample hospitals are only those that border Washington, D.C. and are not fully representative of every hospital within the United States.

Construct validity is achieved by ensuring that the program is properly reflected in its construct and the measures are properly reflected in their construct (Trochim &

Donnelly, 2007). In this research, the construct is the independent variable of employment of a DPDC. The effect construct is the dependent variable, the level of overall preparedness and specific event preparedness as previously defined. These constructs were selected based on the review and research hypotheses and questions derived from the same. Except for survey questions pertaining to the hospital preparedness program profile, the remaining questions operationalized these cause and effect constructs and asked the respondents—the individuals who are responsible, at least in-part, for preparedness—to provide specific data points that relate to the construct measures within their facility.

Threats to internal validity can be reasons, conclusions, or inferences of a study that may be incorrect (Trochim & Donnelly, 2007). They may occur in this study in the form of social interaction threats, where the survey respondents may not be completely objective due to fears of retribution from supervisors, managers, and administrators whom the respondents feel may have access to their survey responses (Trochim & Donnelly, 2007). Because of the nature of the study, it was difficult to avoid this. The individuals in the study were ultimately responsible to the leadership of the hospitals and may have felt pressured to embellish survey responses. As the mechanism to counter this, respondents were made aware that the data would be aggregated and no single hospital would be called out specifically. An additional measure employed to counter this particular threat was to garner the support and buy-in of the overarching hospital associations and enlist them as partners to the study. Additionally, study participants were

instructed not to consult one another about participation or compare answers with one another, further limiting threats to validity (Vogt, 2007).

Reliability

Reliability is an indicator of the quality of a measurement and may be defined as the degree to which a measurement is consistent, dependable, or repeatable (Trochim & Donnelly, 2007). The primary types of reliability include test-retest reliability, internal-consistency reliability, inter-rater or inter-observer reliability, and parallel-forms reliability.

As the survey was being administered online under the auspices of a mid-Atlantic state's county emergency management and services departments, it was not practical to utilize the test-retest method for the evaluation of reliability in this study. Due to the nature of the study, it was not practical to use test-retest as a measure of validity. However, it was possible to evaluate internal–consistency reliability due to the design of the survey; it employed multiple survey questions related to each of the independent variables and the dependent variable. Several distinct and interrelated questions addressed each of the independent variable subtypes, as well as questions related to the dependent variable a as a research hypothesis. It is also important to note that this study presented all survey respondents with standardized questions. For this reason, the chances of unreliability of the measurements have been significantly reduced and inter-rater or inter-observer reliability is high. Further steps taken to carefully construct and word

survey questions greatly reduced respondent unreliability significantly and eliminated the need to conduct a time-consuming parallel-forms reliability assessment.

Other Limitations

Other limitations of this study include methodological limitations and limitations of the researcher. Methodological limitations relevant to this study are sample size, a lack of prior research studies on this subject area, and the use of a researcher designed survey that was not pilot-scale tested. Relevant limitations of the researcher include the my limited access to study participants and the inability to account for longitudinal effects in the data due to the limited time frame established for data collection.

Scope and Delimitations

The population surveyed for this study consists of hospitals and the person or persons responsible for each of their preparedness programs and activities within the Washington, D.C. metro area. This included counties in both the State of Maryland and the State of Virginia. The surveyed hospitals were members of hospital associations that act as consortiums for thought, policy, and standard operating procedures, including preparedness. Those individuals or internal offices charged with the coordination of each hospitals preparedness programs are responsible for planning, resource management, training and exercises, internal and external coordination, and a myriad of others tasks. They are also the best qualified to discuss information and issues related to the preparedness of the hospital.

Hospitals outside the National Capital Region (NCR) and their DPDCs were excluded from the study and were not required from the standpoint of statistical significance to prove or disprove the research hypotheses. Noting the limitations of the sample size, this research cannot be generalized to the national population of hospitals but could serve as a template and springboard for further research into the main questions.

Significance

The goal of this research was to explore the relatioinship between designated emergency preparedness professionals, as defined above, and the overall all-hazards preparedness reporting of hospitals (where reporting is a proxy measure of overall preparedness). This study also sought to predict whether or not hospitals with a designated emergency manager reported higher levels of preparedness. This study has the potential to influence hospitals and health systems hiring practices, tactics, techniques, and procedures as they relate to preparedness. This research project is also unique because despite a considerable body of editorial writing and commentary on the topic, no true scientifically rigorous or systistical investigation has been conducted to ascertain the benefits, or lack there of, of this population.

Disaster preparedness and resilience of community have social implication pre-, trans-, and postdisaster (Keim, 2008). The organization and management of health systems and their ability to adapt, maintain, and sustain operations and deliver needed services to a community have a direct impact on a community's ability to rebound from a

disaster (Obama, 2010). Based on the hypotheses of the present study, that DPDCs are the gatekeepers of and catalysts for overall hospital preparedness as well as preparedness for specific events, it is believed that there are significant social change implications.

As stated previously, gaps remain in hospital and health care preparedness. At a time when these gaps are become more apparent, spending on closing these gaps and the number of professionals associated with closing these gaps has decreased (Toner et al., 2009). If communities expected to attain and remain resilient, health care must be a integral piece of this equation (National Health Security Strategy, 2009). Recent events in Boston have provide policy analysts the ability to understand how a so-called textbook hospital response to mass casualty incidents should be executed (Lee & Mckinney, 2013). However, this response also underscores the advantages of hospitals with internal disaster coordination and large resource bases. This response also shows that in a era of shrinking internal preparedness budgets as well as external preparedness funding, that internal management of preparedness is becoming more and more important to the the health of a community (Trust for American Health, 2014).

This study will add to the very scant body of knowledge related to the effect of disaster coordinators on hospital preparedness for the range of disasters detailed in this work. Hospitals and health care organizations provide a vital service to their communities. During a disaster, these hospitals are seen as islands of safety and security where people can get help as well as information. The implication for positive social

change are improved hospital preparedness and an increased community preparedness and resilience in the event of disaster.

Summary

A key part of the emergency preparedness and response infrastructure is public health and health care infrastructure. These components are at the core of a community's resilience and ability to recover from disaster, especially those with significant health impacts. In the wake of 9/11, Amerithrax, Hurricane Katrina, and the pandemic outbreak of H1N1, there has been an increased interest in and focus on the preparedness and resilience of the U.S. public health and health care infrastructure. In the years after 9/11, considerable grant dollars and government program dollars have been spent in an effort to close the apparent capability and capacity gaps. Despite the increased attention on formalized programs and spending, there are still major deficiencies and gaps in hospital and health care preparedness, and as priorities shift these the funding streams continuity to be decrease and reallocated to competing priorities both at the state and federal levels.

In response to and based on the urgency of these gaps and deficiencies in preparedness, many hospitals and health care systems have created position for preparedness/disaster coordinators. Although there has been increased investment by the health care industry and the federal government to fill these positions and considerable credit given to these positions for increasing the preparedness of these institutions, no scientific or statistical studies have been done to establish such a link or correlation between higher level of preparedness and these coordinator positions.

In order to identify the correlates of hospital preparedness, this survey-based, quantitative study will test the hypotheses that the independent variables—the employment of designated preparedness/disaster coordinators, funding, preparedness program organization, environmental factors, accreditation, and program robustness—are positively correlated with a hospital level of preparedness.

The limitations taken into consideration in this study include validity, reliability, and other limitations. Face validity, external validity, construct validity, and external validity were all considered. Test-retest reliability, internal-consistency reliability, inter-rater or inter-observer reliability, and parallel-forms reliability were also addressed in the context of this study. Methodological limitations are sample size, a lack of prior research studies on this subject area, and the use of a researcher-designed survey that was not pilot-scale tested. The main limitation of the researcher was my limited access and interaction with the study participants.

The scope of this study included member-hospitals of hospital associations in the jurisdictions immediately surrounding the NCR, Maryland Hospital Association Region Five and the Northern Virginia Hospital Association. While the individual hospitals are members of these organizations, there is wide variation in their operational and tactical level preparedness programs. Additionally, these hospitals represent a mixture of urban, suburban, and rural facilities.

As a seminal work focusing on the quantitative measure of how a preparedness coordinator actually affects hospital preparedness, the significance of this study will be

its contribution to a body of qualitative data. Health care and hospital preparedness are essential functions of governments and health authorities. They also have a direct bearing on a community's ability to respond to and recover from disasters. Improving health care and hospital preparedness promotes social change by ensuring that the health care infrastructure in a given community can support the response to and recovery from disasters with significant health components and impacts. This study is also significant in that it provides as vehicle by which field epidemiologists can investigate, evaluate, and categorize that health care preparedness in a given jurisdiction, based on the organization and management practices of its hospitals.

Chapter 2 covers topics related to the present study, including: the theoretical base of the study, a brief description of hospital preparedness, an overview of current gaps in hospital preparedness, health care infrastructure, and measures of hospitals preparedness, and dependent and independent variables. The topics constituting the independent variables include a designated hospital preparedness/disaster coordinator, funding, accreditation, community engagement and collaborative planning, and exercises and training. There are definite gaps in the literature corresponding to the relationship of these independent variables to what has been defined in this study as the dependent variable of hospital preparedness. As evidenced in this literature review, much of the focus on hospital preparedness has been directed towards the actual planning and funding issues and not the actual management, organization, and execution of preparedness activities. As seen in the literature, the quantitative value of preparedness coordinators in either

public health or health care has not been determined. For this reason, this study makes an important contribution to public health and health care preparedness.

Chapter 3 presents the research methodology leveraged in this study of hospital preparedness and the effect on designated hospital preparedness/disaster coordinators, including a description of the dependent and independent variables and the my role in data collection. The target population is described, which was drawn from the member-hospitals for both the North Virginia Hospital Association and District Five of the Maryland Hospital Association. These are the jurisdictions that are closest to Washington, D.C. The survey instrument consisted of approximately 50 questions in the categories of respondent hospital profile, accreditation and affiliation, emergency planning, training and exercises, disaster operations, funding, community engagement and collaborative planning, and preparedness program administration and execution. Descriptive statistics were calculated for all study variables. Differences in means were tested using independent sample *t* tests and differences between frequency distributions, or proportions, were tested using Pearson chi-square tests. Bivariate correlations were calculated between all independent variables using Pearson's method.

Multivariate analyses were done to test each research hypotheses. Taken into consideration were threats to face-, external-, construct-, and internal validity. Reliability considerations included internal-consistency-, inter-observer-, and parallel-forms reliability. Data were analyzed using the IBM SPSS Version 20.0 statistical software package. Protection of human participants and ethical considerations included informed

consent, anonymity, and deception. Dissemination of the research findings is anticipated in a peer-reviewed journal.

Chapter 2: Literature Review

Introduction

The purpose of this study is to test the impact of DPDCs on the general overall preparedness of a hospital as well as its preparedness for specific catastrophic events, including: CBRN events, pandemic disease, infrastructure failure, and mass casualty events. Additionally, this study will look at the impact of funding and resource base on a hospital's level of preparedness for the same events. This literature review focuses on the questions, hypotheses, and alternative hypotheses considered by this research study.

At issue is the lack of statistically and scientifically rigorous analysis of the effect of designated preparedness and disaster coordinators on a hospital's overall preparedness. There have been no statistically validated studies to identify the relationship between such individuals or staff teams and the overall preparedness of a given facility or health system. However, there is anecdotal evidence and testimonial evidence that such a link exists. There is also reason to believe there is a correlation between higher levels of preparedness activities in hospitals and the DPDC position. Studies in schools and public health departments have shown that employment or access to the services of these individuals result in higher levels of preparedness-related activities and higher senior level confidence in preparedness posture (Kano &Bourque, 2008).

The first section of this chapter reviews the theoretical considerations grounding the study and considers other literature supporting the approach. The next section on the strategic framework and current state of hospital preparedness provides a brief overview

of the federal and industry guidelines for hospital preparedness as well as a snapshot of the general state of the U.S. hospital system's preparedness for disasters. The subsequent sections of this chapter consider the specific types of incidents mentioned above as well as the role that preparedness coordinators and resource base play in an individual hospital facility's preparedness posture. The literature review then considers relevant general issues. The final section of this chapter integrates the results of the literature review and identifies the specific gaps in the literature that point to the need for the present research study.

A further note on this chapter concerns the role of the DPDC and the information presented in this chapter. This chapter focuses on those key tasks, tactics, techniques, procedures, and indicators of hospital preparedness that could potentially be influenced by the employment of a DPDC, such as planning, coordinating access to medical countermeasures, staff training and education, surge capacity management, decontamination capabilities, and infection control.

The following databases were searched to identify the literature: Academic Search Premier, Business Search Premier, Criminal Justice Periodicals, ProQuest Dissertations and Theses, Political Science: A SAGE Full-Text Collection, and ProQuest Central. The following keywords were used: *chemical terrorism, hospital preparedness, hospital preparedness for CBRN incidents, hospital preparedness for mass casualty events, hospital evacuation planning, hospital surge capacity, hospital disaster planning, hospital disaster coordinator,* and *disaster preparedness coordinators*. Additionally, the

Google Scholar assisted Walden application was used to identify key resources and articles.

Theoretical Considerations

Complexity theory of adaptive systems for health care and hospital management during disasters is described by Hilhorst (2003) and reframed by O'Sullivan et al. (2012). It provides a clear and concise model for describing the internal and external connectedness and qualities required for general hospital preparedness, preparedness for specific catastrophic events, and the specific dimension of control as detailed by Comfort (2007). There is a dearth of literature outlining the gaps in hospital preparedness and also regarding those policies and activities that may correlate with overall hospital preparedness. While the literature identifies both the potential correlates to hospital preparedness and the assessed gaps, many hospitals and health care facilities remain in marginal states of preparedness (Niska & Shimzu, 2011). Hospitals are complex entities, and by extension, so is the preparedness of a hospital or hospital system. One of the gaps that has not been assessed is the management and supervision of such programs and the potential affect it may have on the previously identified gaps. It is through the lens of complexity theory that this paper attempts to analyze this phenomenon.

Complexity theory describes to the organization, interaction, and operation of complex systems. A complex system is characterized by several independent elements that continuously interact, spontaneously organize, and then reorganize themselves into ever more complicated and elaborate constructs (Valle, 2000). As defined by Plsek &

Greenhalgh (2001), a complex system is a collection of individual agents with freedom to act autonomously of one another. However, those individual agents' actions are interconnected and are able to change the context of other agents.

Complexity is characterized by: (a) a large number of similar but independent elements or agents; (b) persistent movement and responses by these elements to other agents; (c) adaptiveness so that the system adjusts to new situations to ensure survival; (d) self-organization, in which order in the system forms spontaneously; (e) local rules that apply to each agent; and (f) progression in complexity so that over time the system becomes larger and more sophisticated. Another way to describe this complexity is through the operation and technical lens of Kolmogorov-Chaitin complexity, which defines the complexity of an entity through the amount of information it takes to describe it (Satell, 2013). An example of this is describing the number googol in exponential terms (i.e. 1^{100}) rather that writing it out in long notion with 100 zeros.

Systems characterized by constant change, especially those that have cross-cutting inter- and intra-organizational boundaries, cannot be analyzed without considering the dynamics influencing operations (Ansell, Boin, & Keller, 2010; Cilliers, 1998). Framing the disaster operation of a health care organization in terms of complexity recognizes the discreet interactions between components and between a given system and its environment (Coiera, 2011), and is now recognized as an essential lens through which to view disaster management.

Hospitals and health care systems are complex, adaptive systems. The level of complexity is increased during disasters. During disasters and in steady state operations, hospitals are largely dependent on productive interactions (Plsik & Wilson, 2001). However, the organization and management of the delivery of services during a disaster does not always reflect this. In a disaster or emergent situation with significant health impacts, the complexity and priority of the interaction within a hospital or health system increase, for example, the steady state interactions between the emergency department and surgical department change. This could take the form of elective surgeries being canceled to accommodate incoming patients or the emergency department allowing surgeons to participate in triage and treatment to ensure the most urgent and efficacious selection of patients for surgery.

According to Satell (2013), individuals with the ability to identify and manage these complexities are the most effective for their organizations. However, as it relates to disaster managers in hospitals, no measures have been taken to assess this. There is evidence that disaster managers in other settings are well suited to manage complex systems, including those in schools and school systems and public health departments. Kano and Bourque (2008) and Avery & Zabriskie-Timmerman (2006) found that with complex systems, a DPDC significantly increased preparedness activities, including: training, exercises, allocation of funding, and general feeling of preparedness by staff members and leadership. For this reason, complexity theory and its associated elements

make an excellent framework on which to build an assessment of preparedness and the effect of DPDC in hospitals (O'Sullivan et al., 2012).

Structure and Influencers of Hospital Preparedness

Much of how hospital preparedness is currently viewed has been shaped by the events of September 11, 2001, which was a catalyst for a resurgent look at and the restructuring of American public health and health care preparedness. There are four main influences that shape hospital prepared and shape the conversation about this topic: The Joint Commission, the Executive Branch and the President, Congress, and the Department of Health and Human Service's Office of the Assistant Secretary for Preparedness and Response.

The Joint Commission

The Joint Commission on the Accreditation of Healthcare Organizations (JCAHO) or Joint Commission (TJC) sets standards for health care organizations and issues accreditation to those organizations that meet those standards. TJC is an independent, not-for-profit organization established in 1951 to provide voluntary accreditation to hospitals (Sauer, McCarthy, Knebel, & Brewster, 2009). TJC accreditation is voluntary but extremely important because it provides a mechanism to show the facility complies with all conditions of participation for Medicare. Which means it is able to receive reimbursement for services rendered to Medicare and Medicaid recipients (American Society of Healthcare Engineering, 2013).

TJC has organized emergency preparedness within a set of all-hazards standards that provide for a so-called safe "environment of care" (Sauer et al., 2009). The standards are built for hospitals and are incident specific with provides a beneficial resource for hospital preparedness planners. They are based on the comprehensive emergency management model, and have undergone three rounds of revision since 2001. The guidance is focused on: managing consequences to, providing safe and effective patient care during an emergency, clearly defining staff roles, training those roles and responsibilities; and sustaining staff competencies over time. There are six focus areas for hospitals to demonstrate they have proper plans and response mechanisms prepare for, mitigate the effect of, respond to and recovery from a disaster.

The Executive Branch of the Federal Government

In the aftermath of 9/11, President George W. Bush issued HSPD-5 (Homeland Security Presidential Directive) which established the Department of Homeland Security as the Cabinet-level secretariat as well as call for the development of comprehensive National Response Plan (NPR) and a National Incident Management System (NIMS) (Sauer et al., 2009). These two documents provide a national-level all-hazard response framework to respond to and management disasters. Also contained in HSPD-5 is the mandate that hospitals comply with NIMS and develop disaster preparedness programs and plans than comply with the NRP. President Bush also issues HSPD-7 which identified critical infrastructure priorities and named public health and health care a critical and protected resource. HSPD-7 named the Department of Health and Human

Services as the lead Federal agency for mitigating risk and protecting public health and health care infrastructure.

In 2003, HSPD-8 was issued designating hospital and emergency departments as emergency response providers (Sauer et al., 2009). Following the issuance of HSPD-8, HSPD-10 charged hospitals increase its focus on traditional disasters and terrorist threats as well as to prepare for the threat of threats from terrorist use of Weapons of Mass Destruction, especially biological agents. In 2007, HSPD-21 the *National Strategy for Public Health and Medical Preparedness* was issued. It called for a multi-sector, cross-functional approach to the health care preparedness. It also established the concept of resilient communities and defined health care preparedness as it the context of community resilience.

Congress

After 9/11, Congress passed to successive pieces of legislation, the Public Health Security and Bioterrorism Preparedness Act (Bioterrorism Act) which was replaced by the Pandemic and All-Hazards Preparedness (PAHPH) (Sauer et al, 2009). The Bioterrorism Act and PAHPA established what is now designated as the Office of the Assistant Secretary of Preparedness and Response (ASPR) within DHHS. The Bioterrorism Act called for state and local governments to increase resource expenditure and allocation to become better prepared for bioterrorism and other public health emergencies. PAHPA consolidated several programs under ASPR. It also mandated that

state and local governments and other entities (grant eligible) to develop and implement emergency management plans and standards develop by DHHS/ASPR.

DHHS and the Hospital Preparedness Program

As previously mentioned, DHHS and ASPR are designated the lead Federal agencies for public health and health care preparedness and response. ASPR administers the Hospital Preparedness program, which has had substantial influence over hospital preparedness in two ways: 1) All funding for HPP be administered by state health departments so that community response entities work together to develop community capabilities; and 2) HPP uses a capabilities-based model which requires recipients to develop and demonstrate specific capabilities in order to receive funding (Sauer et al., 2009). These shifts from early granting structures and preparedness has resulted in a more objective way to measure capabilities across the sector, and provide a greater mechanism for community-wide and regional cooperation and collaboration of hospitals.

The goal of the Hospital HPP is to enhance the ability of hospitals and health care systems to prepare for and respond to bio-terror attacks on civilians and other public health emergencies, including pandemic influenza and natural disasters. All 50 states, as well as the District of Columbia, the nation's three largest municipalities (Chicago, Los Angeles, and New York City), the Commonwealths of Puerto Rico and the Northern Mariana Islands, three territories (American Samoa, Guam, and the U.S. Virgin Islands), Micronesia, the Marshall Islands, and Palau, have received over $4 billion in HPP

funding through grants, partnerships, and cooperative agreements since 2002 (Trust for America's Health, 2014; ASPR, 2013).

Past priorities include improving bed and personnel surge capacity, decontamination capabilities, isolation capacity, pharmaceutical supplies, training, education, drills, and exercises (Macintyre &Barbera, 2009). Current HPP priorities include strengthening hospital capabilities in the areas of interoperable communication systems, bed tracking, personnel management, fatality management planning, and hospital evacuation planning. In order to provide focus for grantee acquisition and use of funds, HPP defines eight key capabilities needed for hospitals and health care systems to effectively and efficiently prepare, respond, and recover from disasters with health implications or public health and medical emergencies. The focus areas provide grantees areas that can be assessed and resources allocated in order to increase preparedness related activities, increase community engagement, enhance or develop capabilities, purchase equipment and materiel, and to hire and train personnel.

Capabilities	1. Health care system preparedness 2. Health care system recovery 3. Emergency operations coordination 4. Fatality management 5. Information sharing 6. Medical surge 7. Responder health and safety 8. Volunteer management

Figure 1: Hospital preparedness key capabilities: ASPR 2012. This figure highlights the key functions association with crisis management and disaster response for hospitals and health systems.

The Status of U.S. Hospital Preparedness

Hospital disaster preparedness and resilience is a comprehensive concept derived from existing disaster resilience frameworks. It has four key domains: hospital safety; disaster preparedness and resources; continuity of essential medical services; recovery and adaptation. These domains were categorized according to four criteria, namely, robustness, redundancy, resourcefulness and rapidity (Zhong, Clark, Hou, Lang & Fitzgerald, 2013). The purpose of this paper is examine the correlation between overall hospital preparedness as well as preparedness for special disasters, including pandemic disease, CBRN/WMD/HAZMAT events, mass casualty events, and infrastructure failure. This section provides a snapshot of the current state of hospital preparedness for the above classes of disasters as well as overall preparedness. However, it is worth noting that because of manner in which the HHS, NAPH, the Joint Commission, and other aggregators of hospitals preparedness, there is a significant lag in reporting. Much of the actual data on hospital preparedness used for this study is circa 2007 and 2008; however, it was reported between 2011 and 2013.

There are general measures of general hospital disaster preparedness. These measures are and prescribed standards are dictates from the HPP and accreditation organizations such as the Joint Commission (Kaji, Langford, & Lewis, 2008). While these standards are given standards, there have been very few scientifically rigorous methods developed to actually assess the overall preparedness of a given health care facility in general terms or for the special incident preparedness being discussed in this

study. However, it understood that at present, there are major gaps in preparedness both on a very basic and general level as well as for those special incidents (Niska & Shimzu, 2011).

Assessed Gaps

The most recent and current assessment of hospital preparedness was conducted in 2008 by Niska & Shimzu. For their analysis Niska & Shimzu used the data collected from the National Ambulatory Medical Care Survey (NHAMCS) which included an Emergency Preparedness Supplements (Niska & Shimzu, 2011). According to the U.S. Centers for Disease Control and Prevention, the NHAMCS is designed to collect data on the utilization and provision of ambulatory care services in hospital emergency and outpatient departments. Findings are based on a national sample of visits to the emergency departments and outpatient departments of non-institutional general and short-stay hospitals (CDC, 2013).

In survey-year 2008, the U.S. Department of Health and Humans Services (HHS) included a Pandemic and Emergency Response supplement to the survey designed to provide an assessment of the preparedness of both hospital and allied health facilities' preparedness for pandemics, technological, and natural disasters (CDC, 2008). The NHAMCS was administered on-site at each participating hospital by field assessor employed by the U.S. Census Bureau. The supplement in question consisted of an eight-page self-administered questionnaire with a total of 112 data points (Niska & Shimzu, 2011). It was completed for each sample hospital by the person responsible for the

hospital's emergency response plan. The global sample of hospital consisted of 5,212 in-scope ambulatory medical facilities. The study had as sample population 395 and was selected using a multistage probability sampling design involving samples of geographic primary sampling units and hospitals with emergency departments (ED) or outpatient departments within those units.

The keying findings of the study were separated into key areas which included: mutual aid agreements, cooperative training, funding, and access to preparedness related resources, planning, and training (Niska & Shimzu, 2011). The following findings are the most germane to the topics being assessed in the current study:

- Nearly all hospitals had emergency response plans that specifically addressed at least one or some of the following hazards: CBRN/HAZMAT, natural disasters/loss of critical infrastructure, mass casualty events, and pandemic disease (Niska & Shimzu 2011). However, only about 80 percent had plans for Radiological events, and even fewer had mass casualty plans that included plans and procedures for explosive or incendiary events. Further, less that 70 percent had plans that spanned the entire range of hazards.
- Nearly all hospitals in the sample participated cooperative planning with one of the following entities: state and local emergency management; other hospitals; emergency medical services; state and local public health; state and local law enforcement HAZMAT teams; and the Federal Bureau of Investigation (FBI). Of While greatest number of hospitals had conducted

planning and engagement with the first six entities listed, just over 60 percent had coordination with local HAZMAT teams and less than 20 percent with the FBI. Further, approximately 16 percent had done planning or engagement with all eight (Niska & Shimzu 2011).

- Approximately 85 percent of hospitals in the sample population had done the preliminary laydown for Mutual Aid Agreements and Memoranda of Understanding with other hospitals that included items such as transfers of patients and sharing of supplies and staff (Niska & Shimzu 2008). However, less than half had such agreements with burn centers for victims of explosive or incendiary incidents. Additionally, less that 20 percent of these agreements had been signed or put into effect.
- In 2008, just over 80 percent of hospitals had conducted internal disaster drills, however, only half had conducted such drills with external partners, e.g. EMS, other hospitals, fire departments, etc. (Niska & Shimzu 2008). Hospital drill scenarios overwhelmingly focused on general situations. Less than 70 percent of hospitals had done disasters drill the focused on mass decontamination of patients, however, only about 40 percent hand focused decontamination of aerosolized biological agents. Sixty percent of hospitals had executed drills for pandemic or epidemic disease incidents; however, less than 40 percent had included management of delayed onset disease and even fewer, had included scenario elements focusing on mass vaccination or

distribution of mass prophylaxis to hospital staff, patients, or the community and just over half had done specific chemical events. Approximately 30 percent of all hospital had conducted drill focusing on incendiary or explosive incident, and roughly 20 percent had conducted drills relating to nuclear or radiological incidents.

- Between 2002 and 2007, roughly 25 percent of hospitals received greater than $150,000 in federal preparedness funding, roughly 20 percent received greater than $75,000 but less than $150,000, and roughly a quarter had received more than zero but less than $75,000. About 5.2 percent received no funding, and over 25 percent of hospitals were unaware if they had received any federal preparedness funding (Niska & Shimzu 2011).

Role of the Designated Hospital Preparedness Coordinator

The role of DPDC within the hospital has become a much scrutinized and debated topic in the light of disasters such as 9/11, Hurricanes Katrina and Sandy, and the Boston Marathon Bombing (Russell & William, 2008). However, little scientific rigor has been applied to understand the effect they have on overall hospital preparedness activities or the overall operation of the hospital during a disaster or large-scale emergency. Some studies show anecdotal evidences that DPDCs provide a boost to pre-disaster preparedness activities. There have also been stories of important role play by the DPDC gleaned from Boston Marathon Bombing and Hurricane Sandy. However, there are no

real-life case studies which show the link between this position, preparedness, and emergency operations.

The overall hypothesis of this paper is that the DPDC has a positive effect on hospital preparedness. However, it is limited to a specific set of tasks and activities, including: training and exercising, internal planning, cooperative planning, medical material management, surge capacity and volunteer management, and specific incident response procedures (e.g. CBRN event, pandemics and disease outbreaks, and infrastructure failure.

Roles and Responsibilities

At the most basic level, the responsibility of the DPDC is to ensure the hospital emergency management program is properly staffed, resourced, and funded to meet and comply with regulatory and legal requirements, as well as to ensure the safe of hospital staff as they provide services to the community during disasters or crisis situation (Russell & Williams, 2008). Hicks, Christian, & Sprung (2011) highlight this position in the light of its operation components, detailing that this individual should be delegated the overarching authority to implement processes and procedures that ensure continuity, crisis management, surge capacity, and interface with internal and external response partner (Hicks, Christian, & Sprung, 2011). They further elaborate that the hospital or health system's clinical staff should act in their roles to provide the DPDC with the need information and assistance to facilitate his/her role to manage the response and recovery.

Based on the above position description, the following activities are those for which that DPDC has oversight and a high level of influence or control (Russell & Williams, 2008; Hick, Christian, & Sprung, 2011):

Roles and Responsibilities

• Serves as the POC for:
  o Hospital-wide and department specific emergency action planning
  o developing, scheduling, evaluating, and executing drills and exercises
  o training, capacity, capability and competency building and maintenance
  o purchase and logistical management of disaster response supplies and medical materiel
• Develop comprehensive plans for internal crises and utility and infrastructure failure
• Act as Incident Coordinator during crisis events; execute the overarching goals and objective of the hospital/health system executives
• Serve as liaison with local, state, and federal agencies relating to disaster preparedness and response.
• Coordinates and manages volunteer, surge capacity, and disaster space management programs

Figure 1. Roles and responsibilities of a hospital preparedness emergency manager or hospital preparedness coordinator.

Financial Landscape and Emphasis

The HPP provide grant funding for hospitals to enhance capabilities. As previously stated, HPP has eight core capabilities that hospitals and health systems are advised to address in order to have the basic level of preparedness for disasters. Among these is Emergency Operation Coordination. In the annual survey of HPP grant recipients, grant awardees reported the Emergency Operation Coordination was among the top for capabilities that hospital need to enhance (ASPR, 2012). Additionally, Emergency Operations Coordination assistance was third on the list of technical assistance requests. A great deal of the funding was spent on acquiring personnel with the

required skill sets to increase hospital preparedness. In 2012, 13 percent of all HPP awarded grant-dollars were spent on personnel (ASPR, 2012). However, only 1 percent was allocated for Emergency Operation Coordination.

Current Thinking

As stated previously, there is not a large body of evidence in favor of or against the employment of DPDCs. Few studies have been done to identify the effect on disaster coordinator on their given entities. However, those that have been done to statistically validate this relationship show a positive correlative relationship, they include one in the context of the emergency department, one study in a school setting, and one in the context of public health departments. In 2007, the National Public Health and Hospital Institute (NPHHI) found that of 60-NAPH hospitals survey, 25 percent had fulltime DPCCs, and concluded that they *may* be critical in increasing and maintaining hospital preparedness (Spieler, Singer, & Cummings, 2007). In 2003, Gaushe-Hill, Schmitz, & Lewis all studied the emergency departments in the U.S. and their level of preparedness to deal with pediatric emergencies. They found that hospitals that had a designated physician and nurses as pediatric emergency coordinators had higher preparedness scores, which included disaster-related plans and equipment (Gaushe-Hill, Schmitz, & Lewis, 2003). Kano & Bourque (2008) found that schools in Los Angeles County who had access to a DPDC, on at least as part-time basis, reported higher levels of preparedness activities and staff confidence in overall preparedness. Additional qualitative work has been done to establish links between designated

preparedness/disaster coordinators, of note is the study from University of Pittsburgh Medical Center in 2009. Additionally, in 2009, Avery & Zabriskie-Timmerman found that health departments with a full-time DPDC were strongly correlated with higher levels of preparedness activities.

Hospital Preparedness for CBRN and Mass Casualty Events

This section provides a look at hospital preparedness for chemical, biological, radiological, and nuclear and mass casualty events. This section focuses on those key tasks or indicators of hospital preparedness for CBRN and mass casualty events that are influenced by the employment of a DPDC, such as: accessing medical countermeasures, staff training and education, and decontamination.

CBRN and mass casualty event can be either intentional or accidental. In the context of intentional release, CBRN terrorism is the intentional use or release of chemical, biological, radiological, or nuclear agent as a weapon by terrorist organization or individual for political, economic, or social gain (Department of Labor, n.d.). Accidental release of CBRN agents are those that occur as a result of unintentional action, disasters, or negligence. CBRN agents include items such as chlorine, sarin, mustard agent, anthrax, ricin, cobalt-63, cesium-137, nuclear power plant accident, or an improvised nuclear device. Mass casualty events span the range of convention and non-conventional incidents and natural and man-made disasters including explosive or incendiary events, building collapses, or natural disasters that have large numbers of casualties.

Preparedness for these types of events consists of many other elements this includes: staff training, specialized expertise, and coordination with entities outside the hospital, surge capacity, specialized equipment, and the ability to identify and treat exposures to such agents (Bennett, 2006; Wetter, Daniell & Tresser, 2001). While a majority of early research, publication, and efforts focused a great deal on training, equipment, and surge capacity, a great deal of current research focuses on weather clinicians are perceive themselves and their facility as prepared for a chemical or biological attacks and how well current procedures work in rendering care and medical management of victims.

Planning, Exercises, and Training

As seen in Niska & Shimzu (2011), most hospitals have plans that address both chemical and biological terrorist events. However, only about 80% percent had plans for radiological and nuclear incidents, and only about 79% had plans for explosive or incendiary events. However, as it relates training, when surveyed, only 69 percent of hospitals reported participated in a drill focusing on decontamination of patients from a chemical incident, and only 55 percent had done exercises focusing on industrial chemical accidents (Niska & Shimzu, 2011). Additionally, only 42 percent of hospitals had participated in drills that exercised decontamination of aerosolized biological agents. Further, only 39 percent of hospitals had done drill that focused on delayed disease onset and even fewer (32 percent) had practiced the mass distribution of vaccine and medical counter measure in conjunction with a biological attack. Only, 30 percent had

participated in drills with training driven by explosive or incendiary scenarios, and 18 percent had participated drills featuring radiological or nuclear incident response.

As it related to staff training, Greenberg (2011) report that roughly 70 percent of emergency department directors reported having at least one hour of classroom training relating cholinesterase antagonist and chemical nerve agents within the year previous to the study, and 22 percent reported having had such training in the previous two years prior to the survey. However, disaster drills focusing on these agents were far less frequently reported. Roughly 7 percent reported such a drill within the previous year, and only 30 percent reported executing such a drill in the previous three years. Additionally, 28 percent reported not having ever taken part in such a drill. Of those who had taken part in drills, only less than 5 percent were *very confident* that their drill experiences had prepared them for a real MCI, and more than half were either *not confident* or only *slightly confident* in the effectiveness of their drills. These findings are similar to those of Hood, Fernandez-Flack & Larranaga (2010) where it was found that the teams subjected to the mock decontamination simulation had on participated in one drill in the past three years leading up to the survey (Hood, Fernandez-Flack & Larranaga, 2010)

Decontamination

A key capability and a point concern during all CBRN and HAZMAT events is the ability of a hospital staff to control contamination and efficiently and effectively decontaminate patients – meaning they reduce the level of skin surface contamination with spreading the contamination to others or other parts of the body. Several studies

have shown that hospitals have much of the needed equipment and facilities to conduct decontamination. This is in part due to the large sums of money that have been provided through HPP granting as well as independent expenditures of health systems and individual hospitals (Bennett, 2006). Bennett (2006) found that of the population he surveyed, greater than 75 percent of the respondents reported having what they considered to adequate decontamination facilities for victims exposed to chemical or biological contaminants. Paralleling these results, a 2011 study of the 15-largest metropolitan areas in the country shows an even greater level of preparedness relating to facilities and equipment related to decontamination of patients. The survey of metro emergency department directors form the 94 percent had robust facilities to conduct emergency decontamination of victims of chemical or biological events (Greenberg, 2012).

However adequately equipped hospitals maybe, it has been found that hospital-based decontamination teams (HBDT) are capable of executing the tasks assigned. In a 2010 study of HBDTs found that teams using running water decontamination systems had not properly followed standard decontamination guidance from the Operational Safety and Health Administration (OSHA), which included: lack of use of a decontaminating agent (e.g. soap or a .05 percent per chlorate solution) and insufficient showering and decontamination times (Hood, Fernandez-Flack & Larranaga, 2010). When looked at under black light and compared pre- and post-drill, the mock victims showed increased skin surface area decontamination – meaning that the chemical

stimulant had not been washed away or hydrolyzed but spread over a greater area of the body.

Medical Materiel Management

An additional concern hospital is the medical management of patient post chem-bio event. Of key concern is access to drugs and equipment needed for treatment. This involves the identification, procurement, and administration of chemical agent antidotes, antiviral drugs, antitoxins, and antibiotics as well as other assets and resources. This is complicated by the for profit models of hospitals. Hospitals usually operate on a just-it-time model, which ensures that they have on-hand supplies of need medications and supplies (Phalen, 2013). They do not, as a matter of course, stockpile supplies and medication unless there is an imminent threat. In an effort to deal with such issues, the U.S. Department of Health and Human Services through the Centers for Disease Control and Prevention established the Strategic National Stockpile (SNS), and within the SNS is the program called CHEMPACK (HHS, 2013).

The SNS and the CHEMPACK program are funded by the federal government (HHS, 2013). SNS stockpiles vaccines, antiviral drugs, antitoxins and other resources, including perishable medical supplies and mechanical. The program can deploy an array of medical countermeasure or equipment to anywhere in the country in twelve hours. Additionally, the CHEMPACK program pre-stage chemical anti-dotes at many large metropolitan hospitals because of the need to administer in a timely fashion incident to the exposure. The CDC has made an aggressive push to inform hospitals, clinics,

pharmacies, and other health care facilities about these programs and the capabilities offered. However, when emergency department directors were asked, more than a quarter reported having never even hearing of the Strategic National Stockpile and another 25 percent reported having heard the name but were unfamiliar with the function of the program (Greenberg, 2011).

In application, as it concerns hospital planning for stockpiling, accessing, and administering MCM, the literature has been pretty consistent. Bennett (2006) found that greater than 55 percent of hospital in Mississippi had plans and supplies to administer chemical agent antidote, antivirals, and antibiotics to both patients and staff. Kaji & Lewis (2006) had similar finding when they surveyed the hospital in Los Angeles County. They found that 51 per of hospitals surveyed had stockpiles of MCM and plans to administer them in response chemical and biological events (Kaji & Lewis, 2006). While Bennett did not assess the accessibility of mechanical vents, his study did suggest that these a key pieces of equipment (Bennett, 2006). Conversely, Kaji & Lewis found that fewer than one-third of hospital had access to 6 or more mechanical ventilators and were unaware of how to surge these numbers if the need arose. Finally, as it relates to planning and administration of MCM, Bennett found that fewer than half of the hospital surveyed had plans to provide MCM to the families of staff members.

Perception of and Willingness to Respond

CBRN Events Staff training has been shown to be very important indicator of preparedness and willingness of hospital clinical and non-clinical staff members to

respond to incidences of chemical and biological terrorist incidents (Schur, Beck, & Meuller, 2004; Grimes & Mendias, 2011). In an informal panel discussion of emergency department personnel individual expressed that they would be more apt to report to work or stay at work to respond biological attacks or chemical terrorist events if they had extensive and on-going training with these types of scenarios and personal protective equipment. However, based on the finding of Niska & Shimzu (2011) and Greenberg (2011) less than 70 percent of hospitals had done disasters drill the focused on mass decontamination of patients, however, only about 40 percent hand focused decontamination of aerosolized biological agents. Sixty percent of hospitals had executed drills for pandemic or epidemic disease incidents; however, less than 40 percent had included management of delayed onset disease and even fewer, had included scenario elements focusing on mass vaccination or distribution of mass prophylaxis to hospital staff, patients, or the community and just over half had done specific chemical events.

While training has shown a correlation with perception of readiness and willingness of staff members report, as seen earlier in the chapter, there remains a question about how effective or the perceived effective of training and exercises and the perceived ability and willingness to respond hospitals ability respond and the effectiveness of efforts during a chemical and biological terrorist event. Greenberg (2011) found of those they survey, who had taken part in drills, and less than 5 percent were *very confident* that their drill experiences had prepared them for a real MCI, and more

than half were either *not confident* or only *slightly confident* in the effectiveness of their drills.

An additional topic that found in the literature dealing with willingness to report to work and respond focused on family obligations and family readiness, especially as it relates to dependent children. Barnett, Balicer, Bolgett et al (2005) point out that the safety and well-being of family members is a central concern for health professionals. Anxiety over their safety and welfare can significantly impact a worker's sense of personal control, and has been identified as a significant contributor to one's risk perceptions (Barnett, Balicer, Bolgett et al., 2005). However, as pointed out by Bennett, only roughly a quarter of hospitals had written plans to provide services families' or workers.

Hospital Preparedness for Pandemics and Disease Outbreaks

In light of the 2009 outbreak of Pandemic Avian Influenza (H1N1), much of literature regarding hospital preparedness for pandemic disease focuses on this topic. An additionally driver of pandemic preparedness was the outbreak of Sudden Acute Respiratory Distress Syndrome (SARS). However limited the scope of the scenario, the activities and intended outcomes are the same: the ability to provide effective service in the event of a mass outbreak of disease. In this way, pandemic preparedness is not all that different from bioterrorism preparedness.

In pandemics, hospitals are the on the frontlines of caring for the population during pandemics. After the 2009 HINI Pandemic Influenza A, two major studies looked

at hospital response. The studies found: a lack adequate health care worker training programs, and lack stockpiled personal protective equipment and other necessary medical equipment, such as ventilators (Redman, 2010). Other identified deficiencies include a lack of around-the-clock infection prevention coverage, little-to-no capacity for a surge in the need for negative-pressure facilities and/or for health care workers, failure to participate in hospital preparedness drills that involve an infectious disease scenario, and no prioritization plan for allocation of limited doses of antiviral medications. At the individual hospital level, DPDC can affect several activities that contribute to greater levels of preparedness, either directly or indirectly. Those activities include: planning training and exercising, surge capacity management, and staff readiness and incentives.

Plans, Training, and Exercises

As seen in Niska & Shimzu's study of the U.S. hospital, most hospitals had done planning for disease outbreaks (Niska & Shimzu, 2011). However, only 40 percent had conducted exercises or drills simulating conditions of pandemic or mass disease outbreaks. These numbers are similar to those found after the 2009 H1N1 Pandemic. In a study of Atlanta metro hospitals, of the 26 hospital emergency departments in the survey over 24 had plans for pandemics and major disease outbreaks. However, more than half reported having not conducted either a tabletop exercise or operational exercise for the plan.

Surge Capacity Management

Surge capacity is defined as the ability to obtain adequate staff, supplies and equipment, structures and systems to provide sufficient care to meet immediate needs of an influx of patients following a large-scale incident or disaster (Adams, 2009). Surge capacity spans a continuum of care across conventional (usual spaces, staff and resources), contingency (functionally equivalent care using non-traditional patient care space, staff and resources) and crisis (sufficiency of care in a scarce resource setting) (Sprung et al, 2010; Hicks, Christian, & Sprung, 2010). Surge capability includes continuity of operations (COOP) and crisis planning, staff management, resource acquisition and allocation, space management, and medical materiel management (Niska & Shimzu, 2011).

Hospital COOP refers to the ability of the hospital to ensure that the infrastructure that supports normal steady-state operations is available to support crisis operations, even if a key component of that infrastructure is missing or degraded. As previously noted, Niska & Shimzu (2011) found that the vast majority of hospitals had undertaken some level of disaster or crisis management planning, greater than 99 percent. However, as it relates to COOP planning, Niska & Shimzu about 85 percent of hospital had plans for the sustainment of operation in crisis and potentially austere situations (Niska & Shimzu, 2011). These finding are echoed in smaller scale studies in Los Angeles conducted by Kaji & Lewis (2006) and in Atlanta conducted by Sugerman et al. (2009).

The second focus of surge capacity deals with effective managing and allocating the skill sets of the available workforce. A great deal of research has focused on the ability of hospital to effective manage its staff during pandemics and disease outbreaks. Much of the researched has focused availability of trained personnel and the ability to share those personnel across facilities and across hospital coalitions. However, one of the planning assumptions that should be made in the full spectrum of events discussed in this paper is that all hospital facilities will be constrained by resource and personnel. Niska and Shimzu (2008) found that roughly only about 60 percent of hospital had plans in place to share health professionals with other agencies with the community. A further finding by Niska and Shimzu, which was supported by Rambhia et al., just over half were equipped for the advanced registration of volunteer health professionals (Niska & Shimzu, 2011; Rambhia et al., 2012). Additionally, they found that roughly 60 percent of hospitals had made planning assumptions for employee absenteeism during outbreaks or providing incentives, such as child care, for those who show-up for work during the event (Niska & Shimzu, 2011). Taking a deeper look at staff members, willingness to report (WTR) is of central concern and how hospital can increase the willingness of their staffs to report for duty during widespread disease outbreaks. As seen previously in this paper, only 60 percent of hospital workers were willing to report to work in response to a CBRN event (Balicer et al., 2011). As it relates to pandemic disease and widespread disease outbreaks, Balicer and colleagues found that roughly 72 percent of hospital workers were willing to report to work in asked and only 82 percent were willing to report if required

(Balicer et al., 2010). These results were modified by the incentives offered by the hospital, including: childcare, medical countermeasures, and providing personal protective equipment (Balicer et al., 2010; Balicer et al., 2011).

Another area of surge capacity focus is equipment, space management, and resource allocation. Niska & Shimzu (2011) and Rambhia et al. (2011) found that approximately 90 percent of all hospitals had plans and agreements with other facilities to share beds. However, only around 80 percent had agreements to share equipment and supplies across systems or in regional coalitions (Niska & Shimzu, 2011; Rhanbia et al., 2011). Niska & Shimzu found that 90 percent of hospital had plans to implement isolation procedures in negative pressure rooms. However, only 70 percent of hospital had plans to establish beds with staffing and equipment in non-clinical spaces, and even fewer had plans to open up decommissioned areas of the hospital to accommodate increased demand for care, 49 percent; while only half of all hospitals had plans to use inpatient units to augment intensive care units (Niska & Shimzu, 2011). In allocating and prioritizing these resources, Niska & Shimzu found that 86 percent of hospital had plans for cancelling elective procedures and admissions, 70 percent had developed triage procedures for ICU, while only 64 percent had coordinated regionally to implement crisis standards of care for pandemics and disease outbreaks, and only 43 percent of hospitals had plans for implementing augmented standards for the initiation and removal of mechanical ventilation.

Medical Materiel Management

The other area where DPDC can affect levels of preparedness and activities associated with medical materiel management, this includes managing internal stockpiles of pharmaceutical and equipment and access to outside sources of equipment including access to state and federal stockpiles. As previously reported, 80 percent of hospital had plans for sharing equipment and supplies with other hospitals (Niska & Shimzu, 2011; Rambhia et al., 2011). However, in a resource constrained environment, the planning assumption should be that such mutual aid pacts may not work because everyone will need the same things (Adida, Delaurentis, & Lawley, 2011). An additional factor complicating the idea of sharing and stockpiling of medical materiel is cost. Most hospitals operate on a just-it-time model, purchasing and ordering items as the reach a minimum threshold amount (Phalen, 2013). Stockpiling of pharmaceutical is often limited to that which the hospital needs for normal operations, and equipment and supplies, such as PPE, is stocked for acute situations but not for long drawn out events such as a pandemic (Hashikura &Junko, 2009). This also extends to major pieces of equipment, such as ventilators. In a small-scale study, Kaji & Lewis found that less than a third the hospital in LA County had access to six or more ventilators (Kaji & Lewis, 2006).

Hospital Preparedness for Loss of Function and Infrastructure Failure

Hospitals are systems within a system that are built and rely upon the operation of other systems (Achour, Miyajima, Pascale, & Price, 2014). These supporting systems

include transportation, water, power, gas, and climate control. When these systems are disrupted, hospitals have limited options to respond to and mitigate the effects, especially if the disruptions are prolonged. Because of hospitals reliance on external systems to function, they can rely of system redundancies, fully or partially evacuate the facility, or shut-down all together. Managing and coordinating the planning and execution of these options can be greatly affected by DPDCs, especially external coordination and evacuation (Russell & William, 2008)

Concrete data could not be found related to hospital redundancy for loss of function or infrastructure failure, including: back-up generation of power, access to fuel, back-up water, etc. However, Niska & Shimzu (2011) found that 95 percent of hospital had emergency evacuation plans and roughly 80 percent had plans for large patient movements within the hospital and between hospitals. Nearly 90 percent of all hospitals had MOUs with one or more hospitals to accept adult patient, however, only half had plans with one or more hospitals for the transfer of children. As stated, the ability to coordinate evacuations and diversion activities is a key to efficient disaster response. Niska & Shimzu found that 85 percent of hospital participated in regional communication systems that tracked ED bed capacity; and 80, 70, and 65 percent participated in systems that tracked adult, child, and neonatal ICU beds respectively.

Conclusion

As stated previously in this paper, the purpose of this study is to identify if there is a correlation between the employment of DPDC in hospitals and the level of overall

preparedness reported. However, there is no literature that provides a statistical or scientifically verified data in this context. The literature review relied on drawing parallels to studies done on disaster coordinator in schools, emergency departments, and public health departments which find that such individuals increase preparedness related activities, which serve a proxy for measure levels of preparedness (Gaushe-Hill, Schmitz, & Lewis, 200; Kano & Bourque, 2008; Avery & Zibreski-Timmermen, 2009;).

The theoretical framework for the current study is Complexity Theory. The literature illustrates the hospitals are complex systems that rely function of both internal and external systems, especially during disaster and crises. Complexity theory describes to the organization, interaction, and operation of complex systems. Hospitals and health care systems are complex adaptive systems. The level of complexity is increased during disasters. The literate also shows that entities that employ individuals with the ability to identify and manage these complexities are the most effective for their organizations. This is central to the design of this study.

While limited, the literature also shows that there is a significant belief that the position of DPDC has a significant impact on hospital preparedness. However, no statistical data exists to provide a definitive correlative link between hospital preparedness activities and the employment of such personnel. However, a limited body of evidence provides a statistical link between disaster coordinators and preparedness activities in other settings, including schools, hospital emergency departments, and public

health departments. These quantitative studies show that disaster coordinator have some effect of the preparedness of the entities in which they work.

The literature also shows that within the areas of focus hospitals and hospital staffs engagement in preparedness activities at a strategic-level. However, at the operational-level, many hospitals are not engaging in those activities that specifically address key capabilities. These activities including: scenario/incident-specific planning and training, exercises and drills; volunteer and surge capacity management; internal and external collaboration; and medical materiel and equipment management.

The body of literature highlighted in chapter two of this paper, identifies the function, roles and responsibilities of emergency and disaster coordinators, and showed that there is a statistical correlation between these individuals and preparedness in other fields, which might have overlap in the context of hospitals. This chapter also identified and strengthened the rationale for the selection of Complexity theory as the theoretical framework for this study. It also provides context for identifying testable variables, which are those points of intersection between hospital preparedness for CBRN and mass casualty incident, pandemics and diseases outbreaks, and infrastructure failure and loss of function. These variables and testable measures were identified through identifying current assessed gaps in hospital preparedness.

Chapter 3: Research Methodology

Introduction

This chapter presents the research methodology leveraged in this study to determine the relationship between hospitals with DPDC and disaster preparedness as well as to identify the overall correlates to preparedness for the population. The research design section describes the research questions, corresponding hypotheses, and the dependent and independent variables associated with those research questions. The setting and sample section outlines the target populations. The section on instrumentation and materials discusses the survey instrument and implementation protocols. The data collection and analysis section describes the research hypotheses, level of measurement, statistical correlation methods, and considerations of validity and reliability. The final section in this chapter details ethical considerations and strategies for dissemination of the research findings.

Research Design and Rationale

Based on the research questions presented in Chapter 1, this study was designed to compare the preparedness of two groups: 1. NCR hospitals with DPDC; and 2. NCR hospitals without DPDC. Additionally, based on the overarching hypothesis, the study is designed to test the within group relationship between dependent variables and the independent variables of overall preparedness score, hospital profile and preparedness structure, preparedness spending and resource base, inter-agency and intra-facility planning score, and exercises and training score. Complexity Theory provides the

theoretical framework for the study. Complexity theory and the adaptability of complex systems refers to complex macroscopic collection of relatively similar and partially connected micro-structures – formed in order to adapt to the changing environment, and increase its survivability as a macro-structure. Complexity Theory provides a method in which a Hospital Emergency Preparedness Coordinator by which to manage these systems and subsystems, as well as provides a roadmap to navigate the internal and external factors associated with the systems approach (Spieler, Singer, & Cummings, 2007b).

In developing the construct for this study, and in order to develop a construct built on sound foundations, extensive research of the National Healthcare Preparedness Program, administered by the U.S. Department of Health and Human Service's Office of the Assistant Secretary for Preparedness and Response (ASPR), was conducted to provide a basic foundation for required hospital preparedness capabilities. The National Healthcare Preparedness program defines eight key capabilities needed for hospitals and health care systems to effectively and efficiently prepare, respond, and recover from disasters with health implications or public health and medical emergencies. These capabilities include: (a) health care system preparedness; (b) health care system recovery; (c) emergency operations coordination; (d) fatality management; (e) information sharing; (f) medical surge; (g) responder health and safety; and (h) Volunteer management (ASPR, 2012). These eight capabilities served as the model for developing the dependent variables and the indices to study the research questions.

At its essence, complexity theory is concerned with stability and change in complex systems that consist of a great many independent agents that interact with each other in many ways (Waldrop, 1993, p. 11). The primary dependent variables in this study are the overall Preparedness Score, Training and Exercise Index, Preparedness Program Structure, Inter-agency and Intra-facility planning and coordination, and funding and resource base. Complexity theory was instrumental in scoping the key capabilities as well as in forming the overarch hypothesis that DPDC are correlated with higher reporting in these areas of hospital preparedness.

From a practical perspective, testing each of the Hospital Preparedness Program (HPP) core capabilities and associated functions is beyond the scope of this study. However, a review of the literature did identify key capabilities and functions considered to be of increased importance as it relates to overall hospital preparedness, these include:

1. Plans and the degree to which these plans account for an all hazards approach and response to disasters.
2. Coordination of training and exercises among hospital staff and with support organizations.
3. Staff and facility surge capacity.
4. Memoranda of Agreement (MOA), Memoranda of Understanding (MOU), and planning partnerships with other hospitals, health care facilities, state authorities, local authorities, and other supporting service providers.

5. Overall hospital or system funding and access to funding and preparedness level resources.

Each the six above elements are Systems-based functionalities and require considerable leadership and coordination to efficiently and effectively ensure that hospitals and health care systems are adequately prepared to respond to and recover from disasters.

The research questions posed in Chapter 1 led to the identification of independent variables to be used in the study. The overarching research question was: What is the effect of DPDC on the overall preparedness reporting of hospitals? In addition, I examined the following sub questions and hypotheses:

RQ1: Is there correlation between overall hospital preparedness and the employment of a DPDC?

RQ2: Is there correlation between a hospital's reported level of preparedness for CBRN event and the employment of a DPDC?

RQ3: Is there correlation between a hospital's reported level of preparedness for a pandemic disease outbreak and the employment of a DPDC?

RQ4: Is there correlation between a hospital's reported level of preparedness for a mass casualty event and the employment of a DPDC?

RQ5: Is there correlation between a hospital's reported level of preparedness for an infrastructure failure and the employment of a DPDC?

Based on the five research questions above, the primary predictor or independent variable for the study is the employment of a DPDC. As it relates to the alternative line of inquiry,

the dependent variables are the same; however, the predictor or independent variable is the resource base and access to resources.

Kana and Bourque (2007), the study that serves as the model for the current study, the researched assessed the relationship between school preparedness and access to related resources, which in their model included a disaster preparedness coordinator. As part of the current study, a similar research question was considered and served as the basis for an alternative hypothesis and line of analysis.

> AltR1: Is there a correlation between access to resources and overall resource base positively correlated with overall, CBRN, pandemic, mass casualty, and infrastructure failure/outage preparedness.

I used data collected via a web-based survey, –the internet based tool Survey Monkey, – from member-hospitals of both the Northern Virginia Hospital Alliance and District 5 of the Maryland Hospital Association. These two groups represent urban and suburban areas bordering Washington, D.C. Both organizations have agreed to be part of the study and have extreme interest in its findings as well as in publishing the results.

This design method was selected because it allowed the most flexibility and presented the least resource intensive method. This method was also selected because it represented the best alternative to ascertain the answers to the research questions. Kano and Bourque (2008) used a similar quantitative method to identify key determinants of individual school preparedness. They found that schools in the L.A. County Unified

School District that had access to a DPDC, even if only part-time, were more prepared (Kano & Bourque, 2008). The present study draws on this work as a framework for applying a similar methodology to health care infrastructure and its ability to provide care during disasters and during specific hazardous events.

Setting, Sample, and Sampling Procedures

The intended population for this study is all hospitals in the United States. While it is the goal of most research endeavors to be able to universally generalize findings, it is often not possible to do so (Trochim, 2006). It is more advantageous to attempt to be able to apply findings to a specific section of a larger population. In the present study, it is not feasible to have this as a goal for a multitude for reasons. Chief among them is time and resource constraints as well as a lack of access to this population. The population in the present study was selected because of its accessibility and its members' willingness to participate in the study. The sampling frame for present study, the list of hospitals in the accessible population, is all of the hospitals in the NCR. The actual sample consists of hospitals from two distinct hospital trade groups within the accessible population.

For the present study, the researcher approached the three major hospital alliances in the area known as the NCR that consists of Northern Virginia, Southern Maryland, and the District of Columbia. These areas include urban, suburban, rural, academic, and military hospitals. After several conference calls and negotiations, the Northern Virginia Hospital Alliance and District 5 of the Maryland Hospital Association self-selected to be

included in the sample population, and District of Columbia hospitals were excluded due to a lack of interest in participating in the project.

The population surveyed for this study consisted of hospitals and the person or persons responsible for their preparedness programs and activities within the Washington, D.C. metro area, approximately 36-hospitals and acute care medical facilities (n = 36; Northern Virginia Hospital Alliance = 22 and District 5/Capitol Region of Maryland = 14). The surveyed hospitals are members of hospital associations that act as consortiums for thought, policy, and standard operating procedures, which include preparedness. Those individuals or internal offices charged with the coordination of each hospital's preparedness programs are responsible for planning, resource management, training and exercises, internal and external coordination, and a myriad of other tasks. They are also the best qualified to discuss information and issues related to the preparedness of the hospital because of they are the keepers of the internal knowledge relating to these programs. Additionally, it is the overarching hypothesis of this study that the individuals who serve in this capacity full-time will report higher overall index scores for each of the dependent variables.

Sample size was calculated using G*Power 3.1.7. For a two-tailed point biserial correlation, using a medium effect size, an alpha of .05, and a power of .80, the recommended sample size was calculated to be 84 participants. To achieve empirical validity, 84 participants should take part in the study. However, because of resource and time constraints the present study’s sample population is a convenience sample of 36

Northern Virginia and Southern Maryland Hospitals (*N*=36). The Kano and Bourque (2008) study, the archetype for the present study, had a response rate of 33% from a total accessible population of 470. The sample size for the study was 157-schools (Kano & Bourque, 2008). In the present study we know that the total accessible population equals 36 (*N*=36). Based on the expected response rate as noted in Kano & Bourque, we can expect a sample size of 12-hospitals (*n*=12; Creech, 2011).

Based on α and the expected sample size, our statistical power is .311 or a 31% probability of observing an actual effect. However, it must be noted that the participation rate is expected to be higher. It cannot be assumed that it will be 100% of the *N*. However, because of the populations' interest in, collaboration, and intended post study partnership, it is expected to have at least a 60% or greater participation rate, which increases our statistical power to .608.

Instrumentation and Materials

The survey instrument employed for data collection consisted of an amalgam of specific sections of already validated and peer-reviewed instruments. These include but are not limited to: (a) the 2008 National Hospital Preparedness Supplement from the 2007-2008 National Hospital Ambulatory Medical Care Survey; and (b) the Agency for Health Research and Quality's Preparedness for Chemical, Biological, Radiological, Nuclear, and Explosive Events questionnaire. The data found in Chapter 2 suggest the variables selected are key factors in assessing and determining the overall preparedness of a hospital or health system, which also supports the use of the HPP program

capabilities to help frame the development of the instrumentation. Each of the survey instruments and checklists used to develop the instrument for the present study were developed for and used within federal programs as methods to gather preparedness data from health care providers in an effort to develop and refine preparedness and response criteria and grant funding vehicles. Additionally, each is open source and requires no formal permission for use. Validation of these instruments was done through internal processes that have not been shared in conjunction with the open source publication of these tools.

The primary dependent variable for this study is Overall Hospital Preparedness which can be derived from looking at the pieces of the program and the individual hospitals in more general terms. The primary independent variable being studied is the employment of a DPDC. The survey instrument has been designed in such a way that it extracts pertinent preparedness related data from each of the hospitals, which makes up the preparedness score. The survey questions are provided in Appendix A. They were designed to determine the respondents' assessment of their hospital facility's level of overall preparedness, training and staff preparedness, preparedness program structure, internal and external planning, and resource base as they relate to both the primary and secondary dependent variables. The survey questionnaire consists of approximately 60 questions and 100-elements, divided into the following sections, which correspond to the independent variables that make up the scoring of the dependent variables (for operational definitions and context refer to Chapter 1):

1. Hospital Demographic and Preparedness Program Structure
2. General Preparedness
3. CBRN and Mass Casualty Preparedness
4. Pandemic Preparedness
5. Infrastructure Failure/Outage Preparedness

Much of the data collected by the survey instrument will be either categorical or binary in nature. However, the data collected from these will serve as a mechanism by which preparedness can be scored numerically, both as a whole and individual as well as based in parts based on sections of the survey instrument. In the scoring methodology score each element as with a one or a zero, with a total of approximately 100-points divided over the 5-primary sections. In this methodology: yes, equals 1; no or do not know equals zero; and not applicable receive not points at all.

The survey will be administered to those individuals within survey population most responsible for the preparedness program at that facility with a link to the survey, which employed the Web-based Survey Monkey protocol. If this person cannot complete survey, the Preparedness Directors for each of the hospital organizations have agreed to complete the survey for the facility. In this eventuality, the individual will specify that they are answering of the facility by proxy. According to Rea and Parker (2005), there are both advantages and disadvantages to the Web-based survey. The advantages include convenience, rapid collection of survey, cost effectiveness, no time pressures, ease of follow-up, confidentiality and security, usefulness for specialized populations, and ability

to implement visual images and more complex questions. However, the disadvantages of the Web-based survey are the limitation to populations having access to e-mail, self-selection bias, and a lack of interviewer involvement.

Rea and Parker (2005) outlined a standard protocol for on-line surveys. These will be used for the present study and are as follows: 1) the survey description and invitation, including informed consent, and the survey questionnaire will be submitted to both hospital associations for approval. In preparation for this, meetings with the preparedness coordinators for each association were held at the outset of the prospectus process to propose the survey and garner support and buy-in for the project. Moreover, planning update meetings will be held at a regularly intervals to address concerns and to provide updates. After the final planning meeting, the description and invitation, including informed consent and the individuals within the member hospital were identified. These individuals will be provided a summary of the purposes, goals, and objectives of the survey via email. The survey questionnaire will contain a link to the Survey Monkey on-line survey platform and detailed instructions will be provided describing the navigation of survey questionnaire.

The researcher will be available by personal e-mail to address all potential questions related the survey questionnaire. The completed anonymous and confidential Survey Monkey survey data will be saved for data analysis on the researcher's password-protected computer and in the Survey Monkey cloud application. No one else will have access. The period of the survey for each facility will last from 6 to 8 weeks, with all

interested respondents completing the survey within that period of time. The contingency plan for low response relies on the preparedness directors for the two organizations to assist the facility in completing the assessment.

Data Collection

This section provides an explanation of the analytical framework used in the study, which includes: statement of hypotheses as they relate to each research question; variable coding methodology; description of statistical analyses and analytical tools; and a description of the data collection methods.

The research questions presented above may Preparedness for Chemical, Biological, Radiological, Nuclear, and Explosive Events be framed or re-framed as testable hypotheses:

RQ1: Is there correlation between overall hospital preparedness and the employment of a DPDC?

RQ2: Is there correlation between a hospital's reported level of preparedness for CBRN events and the employment of a DPDC?

RQ3: Is there correlation between a hospital's reported level of preparedness for a pandemic disease outbreak and the employment of a DPDC?

RQ4: Is there correlation between a hospital's reported level of preparedness for mass casualty events and the employment of a DPDC?

RQ5: Is there correlation between a hospital's reported level of preparedness for an infrastructure failure and the employment of a DPDC?

The research questions (RQs) above can be reframed and translated into measurable and testable hypotheses in the following manner:

$H_1$1 There is a correlation between overall preparedness and the employment of a DPDC.

$H_0$1 There is no correlation between overall preparedness and employment of a DPDC.

H_1^a There is a correlation between overall preparedness and access to resources and resources base.

$H_1$2 There is a correlation between hospital CBRN preparedness and employment of a DPDC.

$H_0$2 There is no correlation between CBRN preparedness and the employment of a DPDC.

H_2^a There is a correlation between CBRN preparedness and access to resources and resources base.

$H_1$3 There is a correlation between hospital preparedness for pandemic disease outbreaks and employment of a DPDC.

$H_0$3 There is no correlation between pandemic preparedness and employment of a DPDC.

H_3^a There is a correlation between pandemic preparedness and access to resources and resources base.

H_14 There is a correlation between hospital CBRN preparedness and employment of a DPDC.

H_04 There is no correlation between CBRN preparedness and the employment of a DPDC.

H_4^a There is a correlation between CBRN preparedness and access to resources and resources base.

H_15 There is a correlation between hospital preparedness for infrastructure failure or outages and the employment of a DPDC.

H_05 There is no correlation between preparedness for infrastructure failure and employment of a DPDC.

H_5^a There is a correlation between preparedness for infrastructure failure and access to resources and resources base.

The study variables and structure of research hypotheses present in the study lend themselves to quantitative analysis. These variables can be express and coded in by in numerical values. As it relates to this study, the answers to these questions will coded as a one or zero which provides a numerical output score that provides a pathway for quantitative analysis.

The Survey Monkey online survey tool provides data base structure that allows for the expeditious sorting, screening, and cleaning data. During the survey and

administration period, a weekly inspection of new survey submissions will be completed to ensure the accuracy of the data. Upon completion of the survey period, the data will be exported from the Survey Monkey platform into SPSS, already formatted. Once in SPSS, a final cleaning and accuracy check will be accomplished prior to any tabulation or statistical analysis is undertaken.

Data Screening and Analysis

Data will be entered into SPSS 22.0 for analysis. Data will be assessed for missing cases and univariate outliers. Data will be visually assessed for missing cases and participants who did not respond to large portions of the survey or skipped the survey item that asks, "Does your facility/system have a Designated Preparedness or Disaster Coordinator?" will be removed. Additionally, data will be assessed for univariate outliers by converting continuous variables to *z* scores. Converting data to *z* scores will standardize the data to a mean of zero and any cases with data more than 3.29 standard deviations from the mean will be removed (Tabachnick & Fidell, 2012). Final data analysis will be conducted on the remaining cases.

Descriptive Statistics

Descriptive statistics will be conducted to describe the sample. Frequencies and percentages will be presented to report whether or not the participants' facilities have a Designated Preparedness or Disaster Coordinator as well as other categorical variables of interest. Means and standard deviations will be presented to assess the continuous

variables of interest, such as overall hospital preparedness, and level of preparedness for CBRN, mass casualty, pandemic disease outbreak, and infrastructure failure.

Cronbach's Alpha

Cronbach's alpha values will be conducted to assess the internal consistency of overall hospital preparedness, as well as level of preparedness for CBRN, mass casualty, pandemic disease outbreak, and infrastructure failure. Values will be interpreted using the guidelines provided by George and Mallery (2010), where > .90 indicates excellent, > .80 indicates good, > .70 indicates acceptable, and > .60 indicated acceptable.

Research Questions

Research Question One

Is there a correlation between overall hospital preparedness and the employment of a DPDC?

$H1_0$: There is not a correlation between overall hospital preparedness and the employment of a DPDC.

$H1_a$: There is a correlation between overall hospital preparedness and the employment of a DPDC.

To assess research question one; a point biserial correlation will be conducted. The point biserial correlation is the appropriate analysis when the goal of research is to assess the relationship between a single continuous variable and a single dichotomous variable (Howell, 2010). In this analysis, the variables of interest will be overall hospital preparedness and the employment of a DPDC. Hospital preparedness will be measured

by the general hospital preparedness questions on the survey instrument. Responses will be averaged to create a hospital preparedness score. Scores will be treated as continuous data, and higher scores will indicate greater preparedness. Employment of a DPDC will be measured with the survey question that asks, "Does your facility/system have a Designated Preparedness or Disaster Coordinator?" Responses will be "yes" or "no" and will be treated as dichotomous data. The strength of the relationship will be assessed using Cohen's standard (1988), where coefficients between .10 and .29 represent a small association; coefficients between .30 and .49 represent a medium association; and coefficients above .50 represent a large association.

Prior to conducting the point biserial correlation, data will be assessed to be certain it meets the assumptions of normality and linearity. Normality assumes that the points are distributed in a bell shaped fashion and will be assessed with p-p plots. Linearity assumes a straight line relationship between both variables. Linearity will be assessed with the examination of scatter plots (Stevens, 2009).

Research Question Two

Is there a correlation between a hospital's reported level of preparedness for CBRN and mass casualty events and the employment of a DPDC?

$H2_0$: There is not a correlation between a hospital's reported level of preparedness for CBRN and mass casualty events and the employment of a DPDC.

$H2_a$: There is a correlation between a hospital's reported level of preparedness for CBRN and mass casualty events and the employment of a DPDC.

To assess research question two, two point biserial correlations will be conducted. One correlation will be conducted between hospital's reported level of preparedness for CBRN events and the employment of a DPDC. The other correlation will be conducted between hospital's reported level of preparedness for mass casualty events and the employment of a DPDC. CBRN events will be measured by the CBRN preparedness questions on the survey instrument. Responses will be averaged to create a CBRN preparedness score. Scores will be treated as continuous data, and higher scores will indicate greater preparedness. Mass casualty events will be measured by the mass casualty preparedness questions on the survey instrument. Responses will be average to create a mass casualty preparedness score. Scores will be treated as continuous data, and higher scores will indicate greater preparedness. Employment of a DPDC will be measured with the survey question that asks, "Does your facility/system have a Designated Preparedness or Disaster Coordinator?" Responses will be "yes" or "no" and will be treated as dichotomous data. Correlation coefficients will be evaluated using Cohen's (1988) standard. The same assumptions will be addressed prior to analysis.

Research Question Three

Is there correlation between a hospital's reported level of preparedness for a pandemic disease outbreak and the employment of a DPDC?

$H3_0$: There is not a correlation between a hospital's reported level of preparedness for a pandemic disease outbreak and the employment of a DPDC.

$H3_a$: There is correlation between a hospital's reported level of preparedness for a pandemic disease outbreak and the employment of a DPDC.

To assess research question three, a point biserial correlation will be conducted. In this analysis, the variables of interest will be hospital's reported level of preparedness for a pandemic disease outbreak and the employment of a DPDC. Hospital's reported level of preparedness for a pandemic disease outbreak will be measured by the pandemic disease outbreak questions on the survey instrument. Responses will be averaged to create a level of preparedness for a pandemic disease outbreak score. Scores will be treated as continuous data, and higher scores will indicate greater preparedness. Employment of a DPDC will be measured with the survey question that asks, "Does your facility/system have a Designated Preparedness or Disaster Coordinator?" Responses will be "yes" or "no" and will be treated as dichotomous data. Correlation coefficients will be evaluated using Cohen's (1988) standard. The same assumptions will be addressed prior to analysis.

Research Question Four

Is there correlation between a hospital's reported level of preparedness for an infrastructure failure and the employment of a DPDC?

$H4_0$: There is not a correlation between a hospital's reported level of preparedness for an infrastructure failure and the employment of a DPDC.

$H4_a$: There is correlation between a hospital's reported level of preparedness for an infrastructure failure and the employment of a DPDC.

To assess research question four, a point biserial correlation will be conducted. In this analysis, the variables of interest will be hospital's reported level of preparedness for an infrastructure failure and the employment of a DPDC. Hospital's reported level of preparedness for an infrastructure failure will be measured by the infrastructure questions on the survey instrument. Responses will be averaged to create a level of preparedness for an infrastructure failure score. Scores will be treated as continuous data, and higher scores will indicate greater preparedness. Employment of a DPDC will be measured with the survey question that asks, "Does your facility/system have a Designated Preparedness or Disaster Coordinator?" Responses will be "yes" or "no and will be treated as dichotomous data. Correlation coefficients will be evaluated using Cohen's (1988) standard. The same assumptions will be addressed prior to analysis.

Validity

Face validity refers to whether an indicator; or in this case a question in the research survey, and appears is a substantively accurate measure of a variable (Babbie, 2010). The questions presented in this survey for the dependent variable (level of hospital preparedness and designated DPDC) and the independent variables were separated categorically, and the questions were designed specifically by the researcher to provide a reasonable measure for the variables.

External validity is defined as the degree to which a study's conclusions would hold outside of a study's target population, in different setting, and at different places in time (Trochim & Donnelly, 2007). This should be a major planning consideration when

designing and executing a research study. Based on the universal measures used to assess the dependent variable and the independent measures used to access the correlational relationship between these measures and DPDC, this study has external validity. However, the sample population of hospitals may present some challenges. For example, these sample population hospitals are only those which border the Washington, D.C. area, thus they are not fully representative of every hospital within United States. Additionally, within the population, there may not be homogeneity among the hospitals – meaning the comparison may be difficult because of the differences between the hospitals and the way they operate their preparedness programs or the hospital make-up.

Construct validity is achieved by ensuring that the program is properly reflected in its construct and the measures are properly reflected in their construct (Trochim & Donnelly, 2007). In this research, the cause constructs are the independent variables of employment of a DPDC, accreditation, funding and resource base, training and exercises, inter-agency and intra-facility planning, training and exercises, and status and level of responsibility of the DPDC. The effect construct is the dependent variable level of reported hospital preparedness. These constructs were selected based on the review and research hypotheses and questions derived from the same. Except for the survey questions pertaining to hospital and preparedness program profile, the remaining questions operationalized these cause and effect constructs and asked the respondents, individuals who are responsible, at least in-part, for preparedness to provide specific data points that relate to the construct measures within their facility.

Threats to internal validity can be reasons, conclusions, or inferences of a study that may be incorrect (Trochim & Donnelly, 2007). They may occur in this study in the form of social interaction threats, where the survey respondents may not be completely objective due to fears of retribution from supervisors, managers, and administrators whom the respondents feel may have access to their survey responses (Trochim & Donnelly, 2007). Because of the nature of the study, it will be difficult to avoid this. The individuals in the study are ultimately accountable to the leadership of the hospital, and thus may feel pressured to embellish survey responses. As the mechanism to counter this, respondents will be made aware the date will be aggregated and no single hospital will be called out specifically. An additional measure employed to counter this particular threat was to garner the support and buy-in of the overarching hospital associations and enlist them as partners to the study.

Reliability

Reliability is an indicator of the quality of a measurement, and may be defined as the degree to which a measurement is consistent, dependable, or repeatable (Trochim & Donnelly, 2007). The primary types of reliability include: test-retest, internal-consistency reliability, and parallel-forms reliability.

Test-retest reliability refers to the consistency of a measure from one time to another, i.e. administering the same instrument to the same subject multiple times and getting the same answers (Troochim, 2006). Due to the nature of the study, it was not practical to use test-retest as a measure of validity because of the finite time frame and

availability of resources. However, it is possible to evaluate internal–consistency reliability due to the design of the survey; it employs multiple survey questions related to each of the independent variables and the dependent variable. Several distinct and interrelated questions address each of the independent variable subtypes, as well as questions related dependent variable as a research hypothesis. It is also important to note that this study presents all survey respondents with standardized questions. It is for this reason, the chances of unreliability of the measurements have been significantly reduced and inter-rater or inter-observer reliability is high. Additionally, questions selected from the master instruments been carefully crafted and previously evaluated, reviewed, and validated which greatly to reduce respondent unreliability significantly and eliminate the need to conduct a time-consuming parallel-forms reliability assessment.

Protection of Human Participants

Informed consent will be maintained in this study by providing a formal invitation to participate to all potential respondents prior to providing the survey, which will be linked to the invitation. The procedure for providing these documents to potential participants by e-mail was discussed in the preceding section. The invitation to participate included a detailed discussion of the purpose of the study and the research questions to be addressed. The voluntary nature of participation in the survey was emphasized, as well as the anonymity of the survey responses. A brief discussion of potential social threats was given, as well as the reasons these threats are minimal given the confidential nature of the survey data collected.

The participants in this survey will be protected by being afforded complete anonymity and confidentiality in the survey responses that they provided to the researcher through the survey administration via Survey Monkey. According to Babbie (2010), anonymity requires that the researcher and anyone reading the research findings would have no way of identifying a given response with a given respondent. Babbie further defined confidentiality in a research project as a guarantee by the researcher to the participants that even though the researcher may be able to identify a given subject's responses, the researcher promises not to do so publicly. The survey data obtained from the local emergency coordinators will be maintained in a secure manner by the researcher, on the researcher's password protected personal computer, and the response data was not and will not be released to any other individual without the express written consent of individual emergency management coordinators and their respective counties.

No deception – methods use to mislead study participants – of the participants in this survey was planned or deemed necessary. The participants were provided contact information for the researcher if any questions were raised by the participants. Although a formal debriefing of individual participants is not planned, presentation of the findings to the participating hospitals and Hospital Associations will be provided, where all survey respondents and other relevant individuals may read and review them, post study.

Dissemination of Findings

This researcher anticipates publication of the study findings in a scholarly journal. The Northern Virginia Hospital Alliance is also very interested in assisting in the

publication of the finding of this research project, thus may be a potential publication partner. The primary journals under consideration are the American Medical Association *Journal of Emergency and Disaster Medicine*. However, because of its potential application outside of public health and medical preparedness, including those dealing with emergency management, political science, public policy, decision science, engineering, this researcher has also considered publication in *the Journal of Homeland Security and Emergency Management* and potential other similar journals.

While every effort will be made to avoid or mitigate ethical issues, there are some potential ethical concerns. The main ethical concern in the present study is working so closely with trade/lobbying organizations. Both the NVHA and the Maryland hospital association are interested in using dissemination of the finding because they anticipated that they anticipate the outcome of the study will show a relationship between DPDCs and a specific facilities overall preparedness. However, if the null hypotheses prove to be true, both may seek to halt the dissemination or withdraw support for the study and its finding. While this would be a setback, it however, is not unexpected and therefore in not beyond some measure of control. The population and the sponsoring organizations have been appraised that the sample population is relatively small, therefore diluting the actual effect. Additionally, in the conversations leading up to their agreement to participate, both NVHA and the Maryland Hospital Association were in agreement that the results of the present study would only serve as an internal tool for refining their processes and models and would not result in any major policy shifts.

Summary

This chapter presented the research methodology leveraged in this study to determine the relationship between hospital preparedness and the employment DPDC and access to resources and resource base. The research design and approach section described the research questions, corresponding hypotheses, and the dependent and independent variables associated with those research questions. The present study is a survey-based quantitative assessment of the relationship between overall and specific hazardous event preparedness and the position of a DPDC. It will use a survey instrument adapted from survey instruments designed and employed by HHS to help inform policy decisions. The setting and sample section outlined the target populations and provided calculations for the sample population (n=12). The section on instrumentation and materials discussed the survey instrument and implementation protocols. The data collection and analysis section described the research hypotheses, level of measurement, statistical correlation methods, and considerations of validity and reliability. The final section in this chapter detailed ethical considerations and strategies for dissemination of the research findings.

The next chapter, Chapter 4, Results, presents the detailed results of the survey administered to the target population and the statistical analytical tests which determined the significance of the causal relationships proposed in the research hypotheses.

Chapter 4: Results

Introduction

As stated previously, the purpose of this study was to ascertain if a correlation existed between the DPDC position and a hospital's reported level of overall preparedness as well as for CBRN and mass casualty events, pandemics and disease outbreaks, and infrastructure failure. To that end, the following research questions and hypotheses were proposed, with an alternative research question added:

RQ1: Is there correlation between overall hospital preparedness and the employment of a DPDC?

$H_0$1: There is no statistically significant correlation between overall preparedness and employment of a DPDC.

$H_1$1: There is a statistically significant positive correlation between overall preparedness and employment of a DPDC.

RQ2: Is there correlation between a hospital's reported level of preparedness for CBRN and mass casualty events and the employment of a DPDC?

$H_0$2: There is no statistically significant correlation between CBRN preparedness and mass casualty event preparedness and the employment of a DPDC.

$H_1$2: There is a statistically significant positive correlation between CBRN preparedness and mass casualty event preparedness and the employment of a DPDC.

RQ3: Is there correlation between a hospital's reported level of preparedness for a pandemic disease outbreak and the employment of a DPDC?

$H_0$3: There is no statistically significant correlation between pandemic preparedness and employment of a DPDC.

$H_1$3: There is a statistically significant positive correlation between pandemic preparedness and employment of a DPDC.

RQ4: Is there correlation between a hospital's reported level of preparedness for a mass casualty event and the employment of a DPDC?

$H_0$4: There is no statistically significant correlation between mass casualty event preparedness and employment of a DPDC.

$H_1$4: There is a statistically significant positive correlation between mass casualty event preparedness and employment of a DPDC.

RQ5: Is there correlation between a hospital's reported level of preparedness for an infrastructure failure and the employment of a DPDC?

$H_0$5: There is no statistically significant correlation between preparedness for infrastructure failure and employment of a DPDC.

$H_1$5: There is a statistically significant positive correlation between preparedness for infrastructure failure and employment of a DPDC.

The data collection portion of this chapter describes the results of the data collection, provides descriptive and demographic properties of the sample, and describes an overall representation of the sample as it relates to the population. The actual results

section presents the descriptive statistics of the sample, the assumptions that were needed for statistical analyses, and in-depth reports of the research questions and outcomes. Tables of the descriptive and statistical analyses are included in the chapter. The final section includes an alternative hypothesis and a summary of the chapter.

Data Collection

Data collection took place over a 90-day period –January 1,-2015 and 1-April-2015. At the collection period end date, a total of 71 hospitals had responded to the survey. Data was visually assessed for missing cases and participants who did not respond to large portions of the survey or skipped the survey item that asked, "Does your facility/system have a Designated Preparedness or Disaster Coordinator?" were removed. After the exclusion criteria, there remained 48 completed surveys to analyze.

Participants were recruited from the pool of hospital administration and preparedness professionals in one of six groups on the professional networking website Linkedin.com. Of the approximately 1,100-combined members of the group, only roughly 400 were fully active within the groups during the collection period. An open invitation was placed on the list-serve of each group with the key stipulations related to being actively employed by a hospital or health care system and having oversight or direct responsibility for preparedness activities of the institution. Of the 400 active members during data collection, 71 responded, which is a response rate of 17.7%. Niska and Shimzu (2011) surveyed the universe of 5,212 hospitals with a response rate of roughly two percent. While this response rate within the context of the universe of

hospitals does not seem to be representative of all hospitals, the sampling in this study did take into consideration differences in rural, urban, and suburban, and teaching, private, and public (Niska & Shimzu, 2011) In the current study, the make-up of the group membership was not determined at the time of recruitment. However, descriptive data suggest that the participants represented a diverse cross-section of hospital facility diversity.

Reliability

A Cronbach's alpha test of reliability and internal consistency was conducted on the overall survey and each of the subscales. From the overall survey, questions 51, 77, 83, 143, 147 were removed due to zero variance. The modified survey received a Cronbach's alpha of .828. For the overall preparedness items, a Cronbach's alpha of .621 was achieved after questions 51, 55, 77, and 83 were removed. For level of preparedness for a CBRN, a Cronbach's alpha of .636 was computed. Pandemic disease items had an alpha of .401. Items for the mass casualty preparedness had an alpha of .544 after the removal of question 95. Infrastructure failure items had an alpha of .507 after the removal of questions 141, 143, and 147. Access to resources received an alpha of .296 after the removal of question 30. Overall hospital preparedness and preparedness for a CBRN had questionable coefficients as suggested by George and Mallory (2010). Mass casualty preparedness and infrastructure failure preparedness had poor reliability. Pandemic outbreak preparedness and access to resources had unacceptable coefficients based upon the same guidelines.

There are a few reasons for the low internal consistencies between the subscales. Underlying factors such as fatigue and level of seriousness while taking the survey may have biased the responses. Other limitations as discussed in the methodology could be causative factors of the low internal consistency. As such, caution should be taken in interpreting the results of the analyses.

Descriptive Statistics

The majority of participants fell into the category of one facility for number of facilities (36, 75%). Frequencies and percentages for nominal variables are presented in Table 1.

Table 1.

Frequencies and Percentages for Nominal Variables

Variables	*N*	%
Number of facilities		
More than one	12	25
One	36	75
Employment of DPDC		
No DPDC	2	4
DPDC employed	46	96
DPDC employment status		
Part-time	8	17
Full-time	38	79
None	2	4

Note. Due to rounding error, percentages may not add up to 100.

Means and Standard Deviations

For a hospital's overall reported level of preparedness (GEN), scores ranged from 18.00 to 27.00, with an average score of 23.50 (SD = 2.48). For a hospital's reported level

of preparedness for a mass casualty event (MASS), scores ranged from 2.00 to 7.00, with an average score of 6.15 (*SD* = 1.11). For a hospital's reported level of preparedness for a CBRN event (CBRN), scores ranged from 5.00 to 12.00, with an average score of 10.15 (*SD* = 1.87). For a hospital's reported level of preparedness for a pandemic disease outbreak (PAN), scores ranged from 2.00 to 6.00, with an average score of 4.71 (*SD* = 1.13). For a hospital's reported level of preparedness for infrastructure (INFR), scores ranged from 4.00 to 7.00, with an average score of 6.73 (*SD* = 0.61). For a hospital's reported access to resources (ResAcc), scores ranged from 1.00 to 3.00, with an average score of 2.21 (*SD* = 0.71). Means and standard deviations for continuous variables are presented in Table 2.

Table 2

Means and Standard Deviations for Independent Variables

Variable	*M*	*SD*
GEN	23.50	2.48
MASS	6.15	1.11
CBRN	10.15	1.87
PAN	4.71	1.13
INFR	6.73	0.61
ResAcc	2.21	0.71

Research Question 1

To assess research question 1, a point biserial correlation was conducted. The point biserial correlation (r_{pb}) is appropriate when the research purpose is to evaluate if a relationship exists between a continuous variable and a dichotomous variable, and to find the magnitude of that correlation or the strength of that relationship (Howell, 2010). Prior

to analysis, the assumptions of the point biserial correlation were assessed. Point biserial correlation assumptions include normality and homoscedasticity. Normality was assessed using a normal P-P plot, and the assumption was met. Homoscedasticity was assessed with a residuals scatterplot, and this assumption was also met.

Results of the point biserial correlation were not significant, (r = -.04, p = .78). Because significance was not found, null hypothesis 1 could not be rejected. This finding suggested that no relationship exists between overall hospital preparedness and the employment of a DPDC. Table 3 below shows the correlations between employment of DPDC and the different subscales.

Research Question 2

To assess research question 2, a point biserial correlation was conducted. Prior to analysis, the assumptions of the point biserial correlation were assessed and also met.

Results of the point biserial correlation were not significant, (r = .02, p = .91). Because significance was not found, null hypothesis 2 could not be rejected. This finding suggested that no relationship exists between a hospital's CBRN preparedness and the employment of a DPDC. Table 3 below shows the correlations between employment of DPDC and the different subscales.

Research Question 3

To assess research question 3, a point biserial correlation was conducted. Prior to analysis, the assumptions of the point biserial correlation were assessed and also met.

Results of the point biserial correlation were not significant, (r = .13, p = .37). Because significance was not found, null hypothesis 3 could not be rejected. This finding suggested that no relationship exists between a hospital's preparedness for pandemic disease outbreak and the employment of a DPDC. Table 3 below shows the correlations between employment of DPDC and the different subscales.

Research Question 4

To assess research question 4, a point biserial correlation was conducted. Prior to analysis, the assumptions of the point biserial correlation were assessed and also met.

Results of the point biserial correlation were not significant, (r = -.07, p = .65). Because significance was not found, null hypothesis 4 could not be rejected. This finding suggested that no relationship exists between a hospital's preparedness for a mass casualty event and the employment of a DPDC. Table 3 below shows the correlations between employment of DPDC and the different subscales.

Research Question 5

To assess research question 5, a point biserial correlation was conducted. Prior to analysis, the assumptions of the point biserial correlation were assessed and also met. Results of the point biserial correlation were not significant, (r = -.09, p = .53). Because significance was not found, null hypothesis 5 could not be rejected. This finding suggested that no relationship exists between a hospital's preparedness for an infrastructure failure and the employment of a DPDC. Table 3 below shows the correlations between employment of DPDC and the different subscales.

Table 3

Correlations Between Employment of DPDC and Independent Variables

		DPDC	GEN	CBRN	PAN	MASS	INFR
DPDC	Pearson Correlation	1	-.038	.016	.132	-.060	-.088
	Sig. (2-tailed)		.797	.912	.370	.687	.554
	N	48	48	48	48	48	48
GEN	Pearson Correlation	-.038	1	.621**	.465**	.586**	.384**
	Sig. (2-tailed)	.797		.000	.001	.000	.007
	N	48	48	48	48	48	48
CBRN	Pearson Correlation	.016	.621**	1	.464**	.595**	.412**
	Sig. (2-tailed)	.912	.000		.001	.000	.004
	N	48	48	48	48	48	48
PAN	Pearson Correlation	.132	.465**	.464**	1	.352*	.298*
	Sig. (2-tailed)	.370	.001	.001		.014	.040
	N	48	48	48	48	48	48
MASS	Pearson Correlation	-.060	.586**	.595**	.352*	1	.424**
	Sig. (2-tailed)	.687	.000	.000	.014		.003
	N	48	48	48	48	48	48
INFR	Pearson Correlation	-.088	.384**	.412**	.298*	.424**	1
	Sig. (2-tailed)	.554	.007	.004	.040	.003	
	N	48	48	48	48	48	48

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Alternative Hypothesis

To assess the alternative hypotheses, Pearson correlations were conducted. Prior to the analyses, assumptions of the Pearson correlation were assessed, including linearity and homoscedasticity. Linearity assumes a straight line relationship between the independent and dependent variables and homoscedasticity assumes that scores are

normally distributed about the regression line. Linearity and homoscedasticity were assessed by examination of scatter plots and all assumptions were met.

Results of the Pearson correlation were significant for CBRN (r = .36, p = .01), PAN (r = .31, p = .04) and INR (r = .34, p = .02). These finding suggested that a positive relationship exists between a hospital's access to resources and CBRN, pandemic outbreak, and infrastructure failure preparedness. Table 4 below shows the correlations between access to resources and the different subscales.

Table 4

Correlations Between Access to Resources and the Independent Variables

		ResAcc	DPDC	GEN	CBRN	PAN	MASS	INFR
ResAcc	Pearson Correlation	1	.170	.203	.359*	.305*	.171	.343*
	Sig. (2-tailed)		.247	.165	.012	.035	.245	.017
	N	48	48	48	48	48	48	48
DPDC	Pearson Correlation	.170	1	-.038	.016	.132	-.060	-.088
	Sig. (2-tailed)	.247		.797	.912	.370	.687	.554
	N	48	48	48	48	48	48	48
GEN	Pearson Correlation	.203	-.038	1	.621**	.465**	.586**	.384**
	Sig. (2-tailed)	.165	.797		.000	.001	.000	.007
	N	48	48	48	48	48	48	48
CBRN	Pearson Correlation	.359*	.016	.621**	1	.464**	.595**	.412**
	Sig. (2-tailed)	.012	.912	.000		.001	.000	.004
	N	48	48	48	48	48	48	48
PAN	Pearson Correlation	.305*	.132	.465**	.464**	1	.352*	.298*
	Sig. (2-tailed)	.035	.370	.001	.001		.014	.040
	N	48	48	48	48	48	48	48
MASS	Pearson Correlation	.171	-.060	.586**	.595**	.352*	1	.424**
	Sig. (2-tailed)	.245	.687	.000	.000	.014		.003
	N	48	48	48	48	48	48	48
INFR	Pearson Correlation	.343*	-.088	.384**	.412**	.298*	.424**	1
	Sig. (2-tailed)	.017	.554	.007	.004	.040	.003	
	N	48	48	48	48	48	48	48

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

Ancillary Analyses

Since significant correlations were not found in the different subscales by employment DPDC, two ancillary analyses were conducted. The first analysis sought to uncover any differences in scores by the number of facilities a hospital answered for, while the second look for any correlations in the subscales and whether a DPDC was employed as a full or part-time employee.

Classifying responses by one facility (n = 36) and multiple facilities (n = 12), correlations were assessed for the subscales and employment of a DPDC. A point biserial correlation was conducted between the subscales and the amount of facilities answered for, and the assumptions of linearity and homoscedasticity were met.

The results of the correlations were only significant for pandemic outbreak preparedness for respondents that answered for only one facility (r = .42, p = .01). This finding suggested a positive relationship between employment of a DPDC and pandemic outbreak preparedness, for singular hospitals. The results of the correlations between employment of a DPDC and the different subscales by number of facilities answered for are presented below in Table 5.

Table 5

Correlation Between Employment of DPDC and Independent Variables by Number of Facilities

Number of Facilities			DPDC	GEN	MASS	CBRN	PAN	INFR
More than one	DPDC	Pearson Correlation	1	-.084	.047	.115	-.290	-.135
		Sig. (2-tailed)		.794	.884	.723	.361	.676
		N	12	12	12	12	12	12
	GEN	Pearson Correlation	-.084	1	.626*	.645*	.576*	.792**
		Sig. (2-tailed)	.794		.029	.023	.050	.002
		N	12	12	12	12	12	12
	MASS	Pearson Correlation	.047	.626*	1	.796**	.665*	.908**
		Sig. (2-tailed)	.884	.029		.002	.018	.000
		N	12	12	12	12	12	12
	CBRN	Pearson Correlation	.115	.645*	.796**	1	.616*	.884**
		Sig. (2-tailed)	.723	.023	.002		.033	.000
		N	12	12	12	12	12	12
	PAN	Pearson Correlation	-.290	.576*	.665*	.616*	1	.676*
		Sig. (2-tailed)	.361	.050	.018	.033		.016
		N	12	12	12	12	12	12

	INFR	Pearson Correlation	-.135	.792**	.908**	.884**	.676*	1
		Sig. (2-tailed)	.676	.002	.000	.000	.016	
		N	12	12	12	12	12	12
One	DPDC	Pearson Correlation	1	-.030	-.131	-.074	.417*	-.078
		Sig. (2-tailed)		.864	.446	.667	.011	.650
		N	36	36	36	36	36	36
	GEN	Pearson Correlation	-.030	1	.465**	.582**	.433**	.309
		Sig. (2-tailed)	.864		.004	.000	.008	.066
		N	36	36	36	36	36	36
	MASS	Pearson Correlation	-.131	.465**	1	.583**	.317	.476**
		Sig. (2-tailed)	.446	.004		.000	.060	.003
		N	36	36	36	36	36	36
	CBRN	Pearson Correlation	-.074	.582**	.583**	1	.407*	.389*
		Sig. (2-tailed)	.667	.000	.000		.014	.019
		N	36	36	36	36	36	36
	PAN	Pearson Correlation	.417*	.433**	.317	.407*	1	.208
		Sig. (2-tailed)	.011	.008	.060	.014		.223
		N	36	36	36	36	36	36
	INFR	Pearson Correlation	-.078	.309	.476**	.389*	.208	1
		Sig. (2-tailed)	.650	.066	.003	.019	.223	
		N	36	36	36	36	36	36

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

After classifying responses by employment of a DPDC and then by whether the DPDC was a full (*n*=8) or part-time (*n*=38) employee, additional correlations were assessed for the subscales. A point biserial correlation was conducted between the subscales and the employment status of the DPDC, and the assumptions of linearity and homoscedasticity were met.

The results of the correlation showed no significance in employment status of a DPDC and the different subscales. These findings suggest that no relationship exists between the employment status of a DPDC and the different subscales. Table 6 below represents the correlations between the employment status of a DPDC and the different subscales.

Table 6

Correlations Between Employment Status of a DPDC and the Independent Variables

			Employee Status	GEN	CBRN	PAN	MASS	INFR
DPDC	Employee Status	Pearson Correlation	1	.004	.007	.213	-.238	-.103
		Sig. (2-tailed)		.979	.965	.154	.111	.496
		N	46	46	46	46	46	46
	GEN	Pearson Correlation	.004	1	.626**	.511**	.588**	.382**
		Sig. (2-tailed)	.979		.000	.000	.000	.009
		N	46	46	46	46	46	46
	CBRN	Pearson Correlation	.007	.626**	1	.549**	.593**	.418**
		Sig. (2-tailed)	.965	.000		.000	.000	.004
		N	46	46	46	46	46	46
	PAN	Pearson Correlation	.213	.511**	.549**	1	.430**	.337*
		Sig. (2-tailed)	.154	.000	.000		.003	.022
		N	46	46	46	46	46	46
	MASS	Pearson Correlation	-.238	.588**	.593**	.430**	1	.423**
		Sig. (2-tailed)	.111	.000	.000	.003		.003
		N	46	46	46	46	46	46
	INFR	Pearson Correlation	-.103	.382**	.418**	.337*	.423**	1
		Sig. (2-tailed)	.496	.009	.004	.022	.003	
		N	46	46	46	46	46	46

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Summary

The results of the research questions showed no significant relationships between employment of a DPDC and the different subscales of hospital preparedness. The alternative hypothesis showed positive relationships between a hospital's access to resources and CBRN, pandemic outbreak, and infrastructure failure preparedness. An ancillary analysis was conducted and a significant positive relationship was found between employment of a DPDC and pandemic outbreak preparedness in respondents that answered for one facility. A second ancillary analysis was conducted and no significant relationships were found to exist between the employment status of a DPDC and the different subscales. As stated earlier, any findings of this study should be cautiously interpreted due to the low internal consistency of the different subscales of hospital preparedness.

In Chapter 5, the Discussion, an in-depth interpretation of the findings will be presented and the limitations of this study will be examined. The chapter will describe the ways in which the findings can be used to extend the knowledge of this topic and will present recommendations for future research.

Chapter 5: Conclusion and Recommendations

Introduction

The purpose of this quantitative study was to assess the relationship between the hospital preparedness in general, hospital preparedness for CBRN events, hospital preparedness for mass casualty events, hospital preparedness for pandemic disease outbreaks, hospital preparedness for pandemic infrastructure failure, and the employment of a designated hospital preparedness coordinator, with the hypothesis that there was a correlation between the employment of these individuals and the reported level of preparedness for special hazard category. An additional hypothesis was put forward in the current study, as well, to assess the relationship between access to resources and the reported level of preparedness for the same hazard categories. This chapter provides analysis of the research finding and limitations, a discussion on the implications for social change, as well as recommendations for future research and action.

Background and Study Summary

The current study is modeled after a study conducted by Kano and Bourque (2008) that attempted to identify the correlates of school preparedness in Los Angeles Unified School District (Kano & Bourque, 2008). The current study used a similar research construct to attempt to identify a correlation between the employment of a DPDC, or alternatively, a hospital's access to resources. The study examined five key research questions and corresponding hypotheses, and five alternative research questions and hypotheses. Each research question, hypotheses and alternatives focused on hospitals

preparedness for CBRN incidents, mass casualty events, pandemic disease events, and infrastructure failure, as well as overall preparedness.

Using Kano and Bourque (2008) as a model, the study identified two specific correlates of preparedness associated with school preparedness and applied them to hospital preparedness to identify a correlation between effects of the two independent variables on the five dependent variables. It is worth noting that while several studies including Higgins et al. (2004), Kaji et al. (2008), and Nelson, Lurie, Wasserman, & Zakowski (2007) have attempted to ascertain if hospitals have complied with new mandates and if federal grant dollars spent were used to bolster preparedness, no statistical rigor has, to this point, been applied to identifying such a relationship. This is especially true as it relates to spending on personnel and its influence on the way a hospital reported overall preparedness and preparedness for the special hazard categories.

Analysis of Findings

The current study used as a convenience sample of members of several Linkedin.com group members associated with hospital and health care preparedness. While the groups had a combined membership of roughly 1,100 members, only 400 were truly active. As a result, the global population was N=400. Seventy-one specific hospital facilities were represented by the respondents with a total number of 48 individuals responding (n=48). Twelve (25%) of the 48 total respondents responded for two or more facilities. Forty-six (96%) employed a preparedness coordination at least part-time, with

38 (79%) reporting full-time employment. Only two facilities did not employ a disaster preparedness coordinator.

Research Questions

To assess research question one through five, point biserial correlations were conducted. The point biserial correlation (rpb) is appropriate when the research purpose is to evaluate if a relationship exists between a continuous variable and a dichotomous variable, and to find the magnitude of that correlation or the strength of that relationship (Howell, 2010). Correlation values close to +1 indicate a strong relation between the dependent and independent variables. The following research questions, null hypotheses and alternative hypotheses were tested:

RQ1: Is there correlation between overall hospital preparedness and the employment of a DPDC?

$H_0$1: There is no statistically significant correlation between overall preparedness and employment of a DPDC.

$H_1$1: There is a statistically significant positive correlation between overall preparedness and employment of a DPDC.

RQ2: Is there correlation between a hospital's reported level of preparedness for CBRN and mass casualty events and the employment of a DPDC?

$H_0$2: There is no statistically significant correlation between CBRN preparedness and mass casualty event preparedness and the employment of a DPDC.

$H_1$2: There is a statistically significant positive correlation between CBRN preparedness and mass casualty event preparedness and the employment of a DPDC.

RQ3: Is there correlation between a hospital's reported level of preparedness for a pandemic disease outbreak and the employment of a DPDC?

$H_0$3: There is no statistically significant correlation between pandemic preparedness and employment of a DPDC.

$H_1$3: There is a statistically significant positive correlation between pandemic preparedness and employment of a DPDC.

RQ4: Is there correlation between a hospital's reported level of preparedness for a mass casualty event and the employment of a DPDC?

$H_0$4: There is no statistically significant correlation between mass casualty event preparedness and employment of a DPDC.

$H_1$4: There is a statistically significant positive correlation between mass casualty event preparedness and employment of a DPDC.

RQ5: Is there correlation between a hospital's reported level of preparedness for an infrastructure failure and the employment of a DPDC?

$H_0$5: There is no statistically significant correlation between preparedness for infrastructure failure and employment of a DPDC.

$H_1$5: There is a statistically significant positive correlation between preparedness for infrastructure failure and employment of a DPDC.

Results of the point biserial correlations were not significant for research questions one through five: RQ_1 = (r = -.04, p = .78); RQ_2 = (r = .02, p = .91); RQ_3 = (r = .02, p = .91); RQ_4 = (r = -.07, p = .65); RQ_5 = (r = -.09, p = .53). Because significance was not reached, null hypotheses could not be rejected for RQ1-5. This finding suggested that no relationship exists between overall hospital preparedness, preparedness for CBRN events, mass casualty events, pandemic disease outbreaks, infrastructure failures, and the employment of a DPDC.

Additional Analysis

Since no significant correlation was found, an additional set of hypotheses and research questions were analyzed to identify if there was a correlation between each of the reported special hazard scores and the full-time (n = 36) or part-time (n = 8) employment status of the preparedness coordinator. Additionally, analysis was conducted to assess the correlation between the number of hospitals for which a respondent answered for more than one facility (n = 12) and the special hazard scores. When assessing by full- or part-time employment status, pandemic preparedness and full-time employment of a preparedness coordinator reached significance. When assessing by number of hospitals responded, there was no significant correlation between number of hospitals responded and any of the special category subscales.

Alternative Hypothesis

To assess the alternative hypothesis, access to preparedness related resources correlates to the level of reported preparedness, Pearson's Correlation analysis was conducted to assess the following questions, null hypotheses, and hypotheses:

1. Is there correlation between Overall Hospital Preparedness and access to preparedness related resources?

   $AH1_o$: There is no statistically significant correlation between overall preparedness and access to preparedness related resources.

   $AH1_a$: There is a statistically significant positive correlation between overall preparedness and access to preparedness related resources.

2. Is there correlation between a hospital's reported level of preparedness for CBRN and mass casualty events and the employment of a DPDC?

   $AH2_o$: There is no statistically significant correlation between CBRN preparedness and access to preparedness related resources.

   $AH2_a$: There is a statistically significant positive correlation between CBRN preparedness and access to preparedness related resources.

3. Is there correlation between a hospital's reported level of preparedness for a pandemic disease outbreak and access to preparedness related resources?

   $AH3_o$: There is no statistically significant correlation between pandemic preparedness and access to preparedness related resources.

$AH3_a$: There is a statistically significant positive correlation between pandemic preparedness and access to preparedness related resources.

4. Is there correlation between a hospital's reported level of preparedness for a mass casualty event and access to preparedness related resources?

   $AH4_o$: There is no statistically significant correlation between mass casualty event preparedness and access to preparedness related resources.

   $AH4_a$: There is a statistically significant positive correlation between mass casualty event preparedness and access to preparedness related resources.

5. Is there correlation between a hospital's reported level of preparedness for an infrastructure failure and the employment of a DPDC?

   $AH5_o$: There is no statistically significant correlation between preparedness for infrastructure failure access to preparedness related resources.

   $AH5_a$: There is a statistically significant positive correlation between preparedness for infrastructure failure and access to preparedness related resources.

Pearson correlation were significant for CBRN ($r = .36$, $p = .01$), PAN ($r = .31$, $p = .04$) and INR ($r = .34$, $p = .02$), suggesting that a positive relationship exists between a hospital's access to resources and CBRN, pandemic outbreak, and infrastructure failure preparedness.

Discussion

As previously mentioned, the current study was modeled after Kano & Bourque (2008). In their study, Kano & Bourque found that school in the Los Angeles Unified School System reported higher levels of preparedness when they had access, which they defined as at least one source of funding (Kano & Bourque, 2008). They also found that hospitals with at least part-time access to a preparedness coordinator reported greater access to preparedness equipment and supplies. Kano & Bourque also found that schools were more likely to have implemented and met state and county preparedness requirements when access to a preparedness coordinator was available

In this current study, all but one of the primary hypotheses was disproven. Only pandemic preparedness and the full-time employment of disaster preparedness coordinator showed a positive relationship. Conversely, results of the analysis of the alternative hypotheses show that there is a positive relationship between preparedness resources and preparedness for CBRN incidents, pandemic disease outbreaks, and infrastructure failure, but no relationship between availability of resources and overall preparedness or mass casualty events.

Designated Preparedness Coordinator and Pandemic Preparedness

In the current study, no correlation was found between the employment of a designated preparedness coordinator and the reported level of preparedness for general preparedness or any of the special hazards, which led to the rejection of all five of primary research hypotheses. However, when conducting an alternative analysis of the

relationship between the preparedness coordinators, general preparedness, and special hazards, looking at full-time versus part-time coordinators, the results found a correlation between full-time preparedness coordinators and pandemic preparedness. This was the only special hazard that correlated with the employment of a designated hospital preparedness coordinator.

These finding are fully in line with current national priorities and the concept of operations established by the U.S. CDC and adopted by states and local health authorities, and hospitals and health care providers. Even before the 2009 pandemic outbreak of H1N1 Influenza, U.S. DHHS had already established the recommendation, in its *2006 Medical Offices and Clinic Pandemic Influenza Checklist,* to designate a person who is responsible for coordinating all activities related to pandemic preparedness and response (CDC, 2006). This is really the only place in the literature where a designated coordinator is recommended or mentioned for a specific hazard for health care providers. This provides a potential strong basis for the positive relationship between a full-time disaster preparedness coordinator and pandemic preparedness. This may also explain why in the analysis of the five original research questions, this relationship had the highest positive relationship even though significance was not reached.

Access/Availability of Resources

While it would seem to be common sense that resources and funding would correlate to greater reported preparedness, the current study only found positive relationships with three out four special hazards and not with overall preparedness and

mass casualty preparedness. Resource availability does provide greater opportunities to purchase training equipment and other resources. However, the relative amount of funding versus the simple indication of a source of funding resource maybe a better indicator of preparedness and explain the lack of a positive relationship between the other factors. It may also indicate that resources alone do not equal an increase level of hospital preparedness.

As Kano & Bourque (2008), pointed out, schools in L.A. Unified were more likely to spend funds on targeted preparedness initiatives, which may have been peculiar to that school. This is almost certainly true for hospitals as well. Hospitals, as part of accreditation requirements and HHS grant funding process are required to conduct hazard and risk assessments. Since September 11, 2001, several events have placed sharp focus on special hazards, specifically, those focused on in the current study, including: 1) the anthrax attacks in 2002; 2) Hurricanes Katrina and Sandy; and 3) H1N1 Pandemic Influenza – 2009 (CDC, 2013, Khan & Ashford, 2001; 2000; and Ziskin & Harris, 2007). This may provide an explanation as to why this study found a positive relationship between hazards most closely related with these events and access to resources. Recent history and national priorities may have and continue to potentially bias the perception of individuals conducting these assessments at the hospital's operational level.

Hartwell (2013) highlights another potential explanation for the positive correlative relationship between reported CBRN preparedness, pandemic preparedness, and infrastructure failure. Hartwell highlights 'recency effect' as a reason why hospitals

in the post 9/11-post-Katrina era have been focused on specific hazards (Hartwell, 2012). In her study of hospital preparedness policy, she found that state and local hospital preparedness initiatives and policy have tended to mirror national policy and priorities as opposed to local priorities (Hartwell, 2013). September 11th, Amerithrax, Hurricane Katrina, Superstorm Sandy, Pandemic H1N, and imported Ebola cases have shaped U.S. preparedness and response policy and priorities, including those related to hospital preparedness. These ever-evolving and mounting focuses have prompted state and local governments to shift policy initiatives and mandates for hospitals to prepare for these events.

Context of the Theoretical Framework

The theoretical framework for this study was complexity theory. In this study, we viewed hospitals as complex adaptive systems, which are a macroscopic collection of micro-level and semi-related components. Preparedness within these multi-level, connected and interrelated systems become increasing more and more complex as each new layer of regulation, hazard, risk, and operational tempo increase. The primary hypotheses for this study assumed these ever-increasing complex networks required the management, oversight, expertise, and coordination of an individual or staff that could navigate the preparedness landscape and response for the special hazards discussed in this paper. However, what the current study highlights is that access to resources is a better predictor of level of preparedness. It may also be the case that considering the

preparedness coordinator a resource may also better explain the finding in the current study, which were demonstrated by Kano & Bourque (2008).

Limitations

No study is without limitations or things that would potentially call into question its validity or ability to be generalized to a global population. This study is not without its own limitations. The current study's two main potential limitations are its sample size and sampling methodology and low internal consistency of two of the subscales – mass casualty events and infrastructure failure. This section will discuss the potential limitations of this study, explanation, and mitigation measures.

Sample and Sampling Methodology

The sample was a convenience sample. The population was a captive audience that was all too willing to assist in the research. However, this may have led to a very heterogeneous sample of hospitals that employed preparedness coordinators – highlighted by the only two hospitals reporting not employing coordinators. An additional limitation related to sampling is sample size. Seventy-one hospitals were represented in the study. However, there are more than 5,000 studies in the United States (Niska & Shimzu, 2011). This small sample size does present a challenge to generalizing the results. However, they do provide at least some baseline and a potential road map for future research.

Internal Consistency

Internal consistency describes how closely related individual items on an instrument are related to the overall construct (Bruin, 2006). In the current study used

Cronbach's Alpha to measure internal consistency of the overall instrument and its subscales. However, mass casualty preparedness and infrastructure failure preparedness had poor reliability. Pandemic outbreak preparedness and access to resources had an unacceptable coefficient. However, Cronbach's Alpha and other measures of internal consistency are very good at measuring very narrow constructs (Sijtsma, 2009). The current study used very broad constructs across each of the sub-scales due the very broad nature of each of the special hazards. An additional factor, the lends weight to the effectiveness of the measures is the fact that the current study used combined assessments used by Niska & Shimzu (2008) to assess overall hospital preparedness, and by HRSA in 2007 to assess CBRNE preparedness of U.S. hospitals.

Implications for Social Change

This current study is almost certainly the first of its kind to apply statistical rigor to identifying correlates to hospital preparedness, or at least hospital preparedness for special hazards including CBRN events, pandemic disease outbreaks, and infrastructure failures. While collected from a limited sample population, the data illustrates a positive relationship between the employment of a full time hospital preparedness coordination and pandemic preparedness; as well as a positive correlation between access to resources and reported levels of CBRN preparedness, pandemic preparedness, and infrastructure failure. The study is consistent with finding of previous studies of school preparedness, which were used to shape policy in Los Angeles Unified School system.

The current study highlights how complex the construct of hospital and health care preparedness are. It also highlights the importance of continued investment and access to resources with regards to hospital the preparedness, especially for those special hazards highlighted in this study. While not borne out by the data collected and analyzed in this study, there is most likely some intangible, and maybe unmeasurable effect of a hospital preparedness coordinator on a hospitals overall preparedness and for the special hazard outlined in this paper, pandemic preparedness notwithstanding. This study shows that manipulation of these factors can positively or negatively impact the reported level of preparedness of a hospital and the real operational preparedness of a hospital to respond to catastrophic events.

In context of this research, the achievement of positive social change may be considered to be development and implementation of policies that incentivize hospitals as private entities to bear most of the cost burden for being part of a whole community approach to preparedness. This potentially would facilitate a sustainable model of hospital preparedness resourcing and program management for the full-spectrum of hazard response, which would almost certainly increase both the security in and resilience of U.S. communities.

In the context of positive social change, this study highlights that the current system of grant funding hospital preparedness may not be sustainable over time. As national-level priorities change or the perception of risk changes for any given hazard, so will the amount of money invested by government into preparedness related ventures.

The challenge lies at the owner-operator and strategic government level. The key to positive social change will be the innovative methods, initiative, and policy prescriptions that provide communities with a resilient health care delivery system that is able to withstand, adapt, overcome, and continue to serve the community before, during, and after catastrophic event.

Recommendations for Action

Research conducted at the cross roads between health security and public policy should never be just an academic exercise, which lends only abstract concepts and ideas. Such research should be used to inform sound policy in those areas under study. With this as a salient fact, the following recommendations for action are provided.

The preliminary results and findings of the current study will be shared with the Department of Homeland Security's Assistant Secretary of Health Affairs and Chief Medical Officer and the Senior Advisor for Community Health Resilience. They will also be shared with the Principle Deputy Assistant Secretary for Policy with the Office of the Assistant Secretary for Preparedness and Response within DHHS, as well as the primary Senior Executives for the Hospital Preparedness Program. Additionally, the current study will be shared with the current Dean of the Saint Louis University School of Public Health and the Director of the Institute for Biosecurity. As an additional recommended action, an offer has been made to brief these findings to the DHHS Sector Specific Lead for Healthcare Delivery, the American Hospital Association, the National Association of

Public Hospitals and Health Systems, and state and local hospital coalitions and associations.

While the focus of the current study is limited to hospital preparedness, it has potential applicability to other emergency management and preparedness functions, and therefore should be disseminated to the widest audience possible. The recommended action is to publish the results and conclusions of the research in one or more professional and/or academic journals. The *Journal of the American Medical Association* and the *Journal of Homeland Security of Emergency Management* which are both primary journals for peer-reviewed research in health security and emergency management.

Recommendations for Future Research

While the current study had participants from across the spectrum of hospitals and regions of the country, the sample size in comparison to the total global population was extremely small. Seventy-one hospitals were represented in the current study, which is roughly 1.4% of the over 5000 hospitals in the United States. As a result, the study may have an under representation of hospitals without designated disaster preparedness coordinators, which would potentially change the finding. A future iteration of this study would release it to a larger more formal sample population.

As previously mentioned, this study was modeled after a study conducted by Bourque and Kano (2008) that looked at the correlates of preparedness in schools. In their study, the preparedness coordinator was considered a resources and not a standalone element. The current study treated the preparedness coordinator as independent variable

unto itself. Based on our theoretical framework for this study, complexity theory, including the hospital preparedness coordinator as part a package or pool of resources may provide a better picture of what specific resources correspond to which aspects of preparedness. For instance, in the model study Kano & Bourque found that access to a coordinator correlated with greater access to preparedness related equipment and supplies (Kano & Bourque, 2008). They also found, as did a previous study, that schools with access to programs coordinators were more likely to comply with state and federal guidelines for the respective programs. A future iteration of this study would look at what specific individual attributes and resources correlate to preparedness across the five subscales in the current study. Essentially, the future study would analyze the relationship between resources and the preparedness coordinator, and individual aspects of resource availability and analyze the relationship to each of the special hazards and overall preparedness.

Conclusion

The current study identified at least two correlates of specific aspects of hospital preparedness, illustrating that preparedness program management and resourcing are important to at least some aspects of preparedness. Based on an analysis on a body of literature on hospital preparedness, this is probably the first study to apply statistical rigor to examining this relationship. While the population of the study was only a small representation the total number of hospital in the U.S., the study provides some baseline and a potential roadmap to assess hospital in a broader context. The identification of a

correlation between resources, coordinators, and some aspects of hospital preparedness, illustrates a continued need for investment, especially if we place a high priority on these hazards and a hospital's role in a community's ability to respond to and recover from these types of disasters. The Federal government is the largest investor in hospital preparedness. However, the level of investment continues to decline as we get farther and farther removed from the seminal event that led to increased government spending on preparedness (Pine, Pilkington, & Seabury, 2014; Fisher & Duffman, 2014). Based on the current finding reductions in funding will almost certainly affect the ability of hospitals to prepare and respond to the needs of a community in disaster. The relationship between resources and preparedness highlights the some of the inherent challenges associated with the current model and calls into question the long-term sustainability of the current model where the Federal government is in the main source of preparedness funding for many hospitals. Change and more specifically social change can only be achieved and sustained to when state, local, and federal policy and hospital owner operators develop a sustainable comprehensive plan and policy prescriptions to address these issues.

Reference

Achour, N., Miyajima, M., Pascale, F., & DF Price, A. (2014). Hospital resilience to natural hazards: Classification and performance of utilities. *Disaster Prevention and Management*, *23*(1), 40-52.

Adams, L. M. (2009). Exploring the concept of surge capacity. *Online Journal of Issues in Nursing* USA. *Vol 14, No. 2.*

Adida, E., Delaurentis, P., & Lawley, M. (2011). Hospital stockpiling for disaster management. *IIE Transactions*, *43*(5), 348-362. May2011.

American Society of Health Engineering. (2013). ASHE advocacy report, 2013 edition. American Hospital Association Press. Retrieved from http://www.ashe.org/resources/pdfs/ashe_advocacy_report_2013.pdf

Agency for Healthcare Research and Policy. (2011). Accreditation Requirements. In Agency for Healthcare Research and Policy, Healthcare Preparedness Exercise Guidebook. New York, NY. Weill Cornell Medical College.

Ansell, C., Boin, A., & Keller, A. (2010). Managing transboundary crises: Identifying the building blocks of an effective response system. *Journal of Contingencies and Crisis Management*, *18*(4), 195-207.

Avery, G. H., & Zabriskie-Timmerman, J. (2009). The impact of federal bioterrorism funding programs on local health department preparedness activities. *Evaluation & the Health Professions*. 32(2):95-127

Babbie, E. R. (1998). The practice of social research (Vol. 112). Belmont, CA: Wadsworth publishing company.

Balicer, R., Barnett, D., Thompson, C., Hsu, E., Catlett, C., Watson, C., & ... Links, J. (2010). Characterizing hospital workers' willingness to report to duty in an influenza pandemic through threat- and efficacy-based assessment. *BMC Public Health*, *10*(436). Doi: 10.1186/1471-2458-10-436.

Balicer, R. D., Catlett, C. L., Barnett, D. J., Thompson, C. B., Hsu, E. B., Morton, M. J., ... & Links, J. M. (2011). Characterizing hospital workers' willingness to respond to a radiological event. *PLoS One*, *6*(10), e25327.

Barbera, J. A., Yeatts, D. J., & Macintyre, A. G. (2009). Challenge of hospital emergency preparedness: analysis and recommendations. *Disaster Medicine and Public Health Preparedness*, *3*(S1), S74-S82.

Barnett, D.J., Balicer, R.D., Blodgett, D.W., Everly, Jr, G.S., Omer, S.B., Parker, C.L., & Links, J.M. (2005). Applying risk perception theory to public health workforce preparedness training. *Journal of Public Health Management Practice, 11*(6), S33-S37.

Beigi, R. H., Davis, G. G., Hodges, J. J., & Akers, A. A. (2009). Preparedness planning for pandemic influenza among large US maternity hospitals. Emerging Health Threats, *21*(5). doi:10.3134/ehtj.09.002

Bennett, R. L. (2006). Chemical or biological terrorist attacks: an analysis of the preparedness of hospitals for managing victims affected by chemical or biological

weapons of mass destruction. *International Journal of Environmental Research and Public Health*, *3*(1), 67-75.

Bruin, J. 2006. What is Cronbach's Alpha. UCLA: Statistical Consulting Group. Retrieved from http://www.ats.ucla.edu/stat/stata/ado/analysis/

CDC. (2006). Prevention and control of influenza: recommendations of the advisory committee on immunization practices. Morbidity and Mortality Weekly Report , *55*(Early Release):1–41.

Cilliers, P. (2001). Boundaries, hierarchies and networks in complex systems. *International Journal of Innovation Management*, *5*(02), 135-147.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). St. Paul, MN: West Publishing Company.

Comfort, L. K. (2007). Crisis management in hindsight: Cognition, communication, coordination, and control. *Public Administration Review*, *67*(s1), 189-197.

Coiera, E. (2011). Why system inertia makes health reform so difficult. *BMJ*, *342*, d3693.

Courtney, B., Toner, E., Waldhorn, R., Franco, C., Rambhia, K., Norwood, A.,& O'Toole, T. (2009). Healthcare coalitions: The new foundation for national healthcare preparedness and response for catastrophic health emergencies. *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science*, *7*(2), 153-163.

Fisher, S. & Duffman, N. (2014). Hospital preparedness budget cuts could severely impact emergency response. *Emergency Management Magazine – Online*.

Retrieved from http://www.emergencymgmt.com/health/Hospital-Preparedness-Program-Budget-Cuts.html.

Gausche-Hill, M., Schmitz, C., & Lewis, R. J. (2007). Pediatric preparedness of U.S. emergency departments: A 2003 survey. *Pediatrics*, *120*(6), 1229-1237.

George, D., & Mallery, P. (2003). SPSS for Windows step by step: A simple guide and reference 11.0 update (4th ed.). Boston, MA: Allyn & Bacon.

Greenberg, M. (2011). *Occupational Emergency Medicine*. John Wiley & Sons.

Gregg, M. B. (2008). *Field epidemiology*. Oxford University Press, Hoboken, NJ, USA.

Grimes, D.E., & Mendias, E.P. (2010). Nurses' intentions to respond to bioterrorism and other infectious disease emergencies. *Nursing Outlook, 58,* 10-16.

Hartwell, W. T. (2013). Community management of natural hazards. In *Encyclopedia of Natural Hazards* (pp. 112-117). Dordrecht,Netherlands: Springer Netherlands..

Hashikura, M. & Kizu, J. (2009). Stockpile of Personal Protective Equipment In Hospital Setting. *American Journal of Infection Control*, *Volume 37, Issue 9*, *November 2009*, Pages 759-765.

Heinrichs, W. L., Youngblood, P., Harter, P. M., & Dev, P. (2008). Simulation for team training and assessment: Case studies of online training with virtual worlds. *World Journal of Surgery*, *32*(2), 161-170.

Hick, J., Christian, M., & Sprung, C. (2010). Chapter 2. Surge capacity and infrastructure considerations for mass critical care. Recommendations and standard operating procedures for intensive care unit and hospital preparations for an influenza

epidemic or mass disaster. *Intensive Care Medicine*, *36 Suppl 1*S11-S20. doi:10.1007/s00134-010-1761-4.

Hilhorst, D. (2003). Responding to disasters. Diversity of bureaucrats, technocrats and local people. *International Journal of Mass Emergencies and Disasters*, *21*(1), 37-56.

Hood, J., Fernandes-Flack, J., & Larranaga, M. D. (2011). Effectiveness of hospital-based decontamination during a simulated mass casualty exposure. *Journal of Occupational and Environmental Hygiene*, 8 (12), D131-D138. doi:10.1080/15459624.2011.626267.

Howell, D. C. (2010). *Statistical methods for psychology* (7th ed.). Belmont CA: Wadsworth Cengage Learning.

Kaji, A. Koenig, K. & Lewis, R. (2007). Current Hospital Disaster Preparedness. *Journal of the American Medical Association*, *298*(18):2188-2190.

Kaji, A. H., Langford, V., & Lewis, R. J. (2008). Assessing hospital disaster preparedness: a comparison of an on-site survey, directly observed drill performance, and video analysis of teamwork. *Annals of emergency medicine*, *52*(3), 195-201.

Kaji, A. & Lewis, R. (2006). Hospital Disaster Preparedness in Los Angeles County. *Academy of Emergency Medicine*, 2006; 13:1198–1203

Kano, M. & Bourque, L. (2008). Correlates of school disaster preparedness: main effects of funding and coordinator role. *Natural Hazards Review*, *9* 1(49), 49-59..

Keim, M. E. (2008). Building human resilience: the role of public health preparedness and response as an adaptation to climate change. *American journal of preventive medicine*, *35*(5), 508-516.

Khan, A. S., & Ashford, D. A. (2001). Ready or not—Preparedness for bioterrorism. *New England journal of medicine*, *345*(4), 287-289.

Lee, J., McKinney, M., & Landen, R. (2013). Preparedness under Assault. *Modern healthcare*.

Macintyre, A. G., Barbera, J. A., & Brewster, P. (2009). Health care emergency management: establishing the science of managing mass casualty and mass effect incidents. *Disaster medicine and public health preparedness*, *3*(S1), S52-S58.

Markiewicz, Bevc, Hegle, Horney, Davies, & MacDonald. (2012). Linking public health agencies and hospitals improved emergency preparedness: North Carolina public health epidemiologist program. *Biomed Central Public Health,* 2012; 12:141, doi:10.1186/1471-2485-12-141.

McInerney, J. E., & Richter, A. (2010). Strengthening hospital preparedness for chemical, biological, radiological, nuclear, and explosive events: clinicians' opinions regarding physician/physician assistant response and training. *American journal of disaster medicine*, *6*(2), 73-87.

Moen, A., Kennedy, P. J., Cheng, P. Y., & MacDonald, G. (2014). National Inventory of Core Capabilities for Pandemic Influenza Preparedness and Response: Results

from 36 countries with reviews in 2008 and 2010. *Influenza and other respiratory viruses*, *8*(2), 201-208.

Nelson, C., Lurie, N., Wasserman, J., & Zakowski, S. (2007). Conceptualizing and defining public health emergency preparedness. *American journal of public health*, *97*(Supplement_1), S9-S11.

Nemeth, C., Wears, R.L., Patel, S., Rosen, G. & Cook, R. (2011). Resilience is not control: healthcare, crisis management, and ICT. *Cognition, Technology & Work, 3*, 189-202.

Niska & Shimizu. (2011). Hospital preparedness for emergency response: United States, 2008. *National Health Statistics Reports, 37*. Hyattsville, MD: National Center for Health Statistics.

Obama, B. (2010). *National Security Strategy of the United States (2010)*. Washington, D.C. DIANE Publishing.

Office of the Assistant Secretary for Preparedness and Response. (2012). National Guidance for Healthcare System Preparedness. U.S. Department of Health and Human Services.

Office of the Assistant Secretary for Preparedness and Response. (2013). Fiscal Year 2013 Year In Review. U.S. Department of Health and Human Services.

O'Sullivan, T. L., Kuziemsky, C. E., Toal-Sullivan, D., & Corneil, W. (2013). Unraveling the complexities of disaster management: A framework for critical social

infrastructure to promote population health and resilience. *Social Science & Medicine*, *93*, 238-246.

Peleg, K., & Kellermann, A. L. (2009). Enhancing hospital surge capacity for mass casualty events. *JAMA*, *302*(5), 565-567.

Phalen, D. (2013). Hospital Preparedness for Conventional Terrorist Attacks. Assessed on October 20, 2012 at: http://www.thehalocorp.com/hospital-preparedness-for-conventional-terrorist-attacks-2/#!/.

Pines, J. M., Pilkington, W. F., Cabarrus County, N. C., & Seabury, S. A. (2014). Value-based models for sustaining emergency preparedness capacity and Capability in the United States. *Institute of Medicine. January*.

Plsek, P. E., & Greenhalgh, T. (2001). The challenge of complexity in health care. *British Medical Journal*, *323*(7313), 625.

Plsek, P. E., & Wilson, T. (2001). Complexity, leadership, and management in healthcare organisations. *British Medical Journal*, *323*(7315), 746.

Rebmann, Terri. (2010). Papers from the Fifth Decennial International Conference on Healthcare-Associated Infections *Infection Control and Hospital Epidemiology* , Vol. 31, No. S1, (November 2010) , pp. S63-S65.

Rebmann, T., Carrico, R., & English, J. F. (2007). Hospital infectious disease emergency preparedness: a survey of infection control professionals. *American journal of infection control*, *35*(1), 25-32.

Rebmann, T., Wilson, R., LaPointe, S., Russell, B., & Moroz, D. (2009). Hospital infectious disease emergency preparedness: a 2007 survey of infection control professionals. *American journal of infection control*, *37*(1), 1-8.

Rambhia, K. J., Waldhorn, R. E., Selck, F., Mehta, A. K., Franco, C., & Toner, E. S. (2012). A survey of hospitals to determine the prevalence and characteristics of healthcare coalitions for emergency preparedness and response. *Biosecurity and bioterrorism: biodefense strategy, practice, and science*, *10*(3), 304-313.

Rea, L. M., & Parker, R. A. (2014). *Designing and conducting survey research: A comprehensive guide*. John Wiley & Sons.

Russell, M. & Williams, E. (2008). *The Emergency Management Coordinator's Hamdbook for Hospitals*. Marblehead, MA. HCPro, Inc.

Satell, Greg. (2013). Why we shouldn't be surprised that managers don't embrace complexity. *Forbes Magazine: Tech Blog*. Posted May 13, 2013. http://www.forbes.com/sites/gregsatell/2013/05/18/why-we-shouldnt-be-surprised-that-managers-dont-embrace-complexity/#1d7f05985dbd

Schur, C., Berk, M., Mueller, C. (2004). Perspectives of Rural Hospitals on Bioterrorism Preparedness Planning. *Policy Anal Brief W Series 4*, 2004; (4):1– 6.

Scott, L. A., Maddux, P. T., Schnellmann, J., Hayes, L., Tolley, J., & Wahlquist, A. (2012). High fidelity multi-actor emergency preparedness training for patient care providers. *American Journal of disaster Medicine*, *7*(3), 175.

Sijtsma, K. (2009). On the Use, the Misuse, and the Very Limited Usefulness of Cronbach's Alpha. *Psychometrika*, *74*(1), 107–120. http://doi.org/10.1007/s11336-008-9101-0.

Sosin, D. & Besser, R. (2008). Terrorism Preparedness and Emergency Response. In Gregg, M., *Field Epidemiology* (pp. 439 – 458). New York, NY: Oxford University Press.

Spieler, S., Singer, M., & Cummings, L. (2007a). Dedicated coordinators boost . preparedness efforts in safety net hospitals. Accessed on October 20, 2011 at http://www.naph.org/Main-Menu-Category/Publications/Emergency-Preparedness/EP-Coordinators.aspx?FT=.pdf

Spieler, S., Singer, M., & Cummings, L. (2007b). Emergency Preparedness in Hospital: Complete Findings of the 2006–2007 Emergency Preparedness Study. National Association of Public Hospitals and Health Systems. Accessed on October 20, 2011 at http://www.naph.org/Main-Menu-Category/Publications/Emergency-Preparedness/EP-Coordinators.aspx?FT=.pdf

Stevens, J. P. (2009). *Applied multivariate statistics for the social sciences* (5th ed.). Mahwah, NJ: Routledge Academic.

Sauer, L. M., McCarthy, M. L., Knebel, A., & Brewster, P. (2009). Major influences on hospital emergency management and disaster preparedness. *Disaster medicine and public health preparedness*, *3*(S1), S68-S73.

Tabachnick, B. G. & Fidell, L. S. (2012). *Using multivariate statistics* (6th ed.). Boston, MA: Pearson.

Toner, E., Waldhorn, R., Franco, C., Courtney, B., Rambhia, K., Norwood, A., ... & O'Toole, T. (2009). Hospitals rising to the challenge: the first five years of the US Hospital Preparedness Program and priorities going forward. *Prepared by the Center for Biosecurity of UPMC for the US Department of Health and Human Services under Contract No. HHSO100200700038C*.

Trochim, W. & Donnelly, J. (2007). The Research Methods Knowledge Base, (3rd ed.). Atomic Dog Publishing.

Trust for American Health. (May, 2014). Investing in america's health: A state-by-state look at public health funding & key health facts. Accessed on 1 January 2015 at http://healthyamericans.org/report/114/.

U.S. Centers for Disease Control and Prevention. Bioterrorism Overview. Emergency Preparedness & Response: Specific Hazards: Bioterrorism. Accessed on October 23, 2013 at http://www.bt.cdc.gov/bioterrorism/overview.asp

U.S. Department of Labor – Occupational Safety and Health Administration. Emergency Preparedness and Response – Chemical Terrorism. Accessed on October 23, 2013 at https://www.osha.gov/SLTC/emergencypreparedness/chemical_sub.html

Valesky, W., Silverberg, M., Gillett, B., Roblin, P., Adelaine, J., Wallis, L., . . . Arquilla, B. (2011). Assessment of Hospital Disaster Preparedness for the 2010 FIFA

World Cup using an Internet-based, Long-distance, Tabletop Drill. *Pre-hospital Disaster Medicine*, 2011; 26(3):194–197.

Valle Jr, V. (2000). *Chaos, complexity and deterrence*. National Defense University, Washington, DC. Retrieved from http://www.dtic.mil/get-tr-doc/pdf?AD=ADA432927

Vogt, W. P. (2007). *Quantitative research methods for professionals*. Allyn & Bacon.

Waldrop, M. M. (1993). Complexity: The emerging science at the edge of order and chaos. Simon and Schuster.

Wetter, D, Daniell, W, & Tresser C. (2001). Hospital Preparedness for Victims of Chemical and Biological Terrorism. *American Journal of Public Health*; 2001, May *91*(5); 710-716.

Yarmohammadian, M. H., Atighechian, G., Haghshenas, A., Iranian Hospitals: A Necessity for Better Response to Disasters. *Iranian Red Crescent Medical Journal*, *15*(12).

Zhong, S., Clark, M., Hou, X. Y., Zang, Y., & FitzGerald, G. (2014). Validation of a framework for measuring hospital disaster resilience using factor analysis. *International Journal of Environmental Research and Public Health*, *11*(6), 6335-6353.

Ziskin, L. Z., & Harris, D. A. (2007). State health policy for terrorism preparedness. *American Journal of Public Health*, *97*(9), 1583-1588.

Zusman, E. E., & Marghella, P. D. (2013). Disaster management in the era of lean healthcare. *Neurosurgery*, *72*(2), N11-N14.

& Shams, L. (2013). Establishment of Hospital Emergency Incident Command System (HEICS) in