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A Study of Disaster Preparedness of Rural Hospitals in the United States

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A STUDY OF DISASTER PREPAREDNESS OF RURAL HOSPITALS IN THE UNITED STATES

by

Barbara Cliff

A Dissertation Submitted to the Faculty of The Graduate College in partial fulfillment of the requirements for the Degree of Doctor of Philosophy Department of Interdisciplinary Health Studies Dr. Amy Curtis, Advisor

Western Michigan University Kalamazoo, Michigan December 2007
This dissertation examines disaster preparedness in the U.S. and explores the relationships between risk perception, funding from the Health Resources and Services Administration (HRSA), and preparedness. Secondary data analysis was conducted using the National Study of Rural Hospitals from Johns Hopkins University. The study, based on a random sample of rural hospitals, consisted of a mail questionnaire and a follow-up phone interview with the hospital’s Chief Executive Officer (n = 134).

A model of disaster preparedness was utilized to examine seven elements of preparedness. Risk perception was examined by seven risk threats, and HRSA funding was examined as a continuous and categorical variable.

The results indicated that rural hospitals were moderately prepared overall (78% prepared on average), with high preparedness in education/training (89%) and isolation/decontamination (91%); moderate preparedness in administration/planning (80%), communication/notification (83%), staffing/support (66%), and supplies/pharmaceuticals/laboratory support (70%); and low preparedness in surge capacity (64%).

The respondents reported greater risk perception from natural disasters (79% reported moderate to high risk) and vehicular accidents (77%) than from manmade
disasters (23%). Eighty-nine percent of the hospitals had received HRSA funding, ranging from $1,000 to $526,555.

Results obtained from logistic regression models indicated that there was no statistically significant difference in the odds of a hospital being prepared overall when comparing high versus low risk perception (OR = .61; 95% CI, .26–1.44) or high versus low HRSA funding (OR = 1.09; 95% CI, .50–2.39), and no interaction was found between HRSA funding and risk perception on preparedness. Positive associations were identified between risk perception and the subcategory of education/training (OR = 1.24; 95% CI, 1.05–1.27) and between HRSA funding and isolation/decontamination (OR = 1.26; 95% CI, 1.08–1.83). Additionally, positive associations were found between system affiliation and staffing/support, and supplies/pharmaceuticals/laboratory support; and between Joint Commission accreditation and administration/planning, education/training, and supplies/pharmaceuticals/laboratory support.

Rural hospitals reported being moderately prepared overall in the event of a disaster. Further research should be conducted to identify predictors of preparedness in rural hospitals in order to optimize readiness for potential disaster events.
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ACKNOWLEDGMENTS

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Barbara Cliff
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CHAPTER I

INTRODUCTION

This research explores the issue of disaster preparedness in rural hospitals in the United States (U.S.). The study is organized into five chapters; this first chapter provides the introduction and identifies the problem, the purpose, the significance, and the research questions. The second chapter will review the literature about disaster preparedness and related concepts. An outline of the research methodology will be contained in the third chapter. Chapter IV will be a presentation and interpretation of the data. The final chapter will present a discussion of the findings, strengths, and limitations of the study, and the significance of the results. The study will conclude with policy implications and recommendations for future research.

Disasters have plagued the world for many decades and they continue to increase in frequency; during the past 20 years alone, disasters have killed at least 3 million people worldwide and have affected 800 million more (Sundnes & Birnbbaum, 2003). In the U.S., the terrorist attacks of September 11, 2001, changed our country in many ways (McGlown, 2004) and forced the nation to reevaluate its state of readiness (Howitt & Pangi, 2003). In addition to preparedness for terrorism, the U.S. must also be prepared for a wide variety of other manmade disasters and natural disasters (National Research Council, 2006).

While disasters can occur in urban and rural areas, Gursky (2004) identified that within the U.S., the rural health care infrastructure is ill-prepared for a large scale disaster.
compared to urban areas because of limited capabilities. The Office of Rural Health Policy (2002) also identified that rural hospitals tend to have less capacity and resources than their urban and suburban counterparts and, therefore, may be more vulnerable to terrorism and other serious public health threats (Campbell, Frances, & Meit, 2004). In spite of these challenges, it is believed that there has not been adequate focus on disaster preparedness outside of urban areas (Institute of Medicine [IOM], 2006b).

Statement of the Problem

The concern for large-scale disasters resulting in mass casualties has grown steadily in the United States over the last decade (Barbera, Macintyre, & DeAtley, 2001; Gilmore Commission, 1999). These concerns have been heightened by the occurrence of several actual disasters, beginning with the manmade disasters from the terrorist attacks of September 11, 2001 (ASTHO, 2006), as well as natural disaster events such as Hurricane Katrina in 2005 (IOM, 2006a).

The focus of disaster preparedness has been largely centered in urban areas, in part because of the perception that more concentrated areas are likely to have an increased risk of a disastrous event (IOM, 2006b). Therefore, risk perception may be a contributing factor of adequate preparedness. Risk perception may not be as great in rural communities; however, rural communities do have unique characteristics that pose unprecedented challenges, such as proximity to potential terror targets, availability of food and water supplies, and a significant presence of international borders (Gursky, 2004; IOM, 2002). Since rural areas can also be a target of disasters and may not have
considered the likelihood of that occurrence, further exploration of the perception of risk in rural settings is necessary.

Rural America—like its urban counterpart—is vulnerable to terrorism and other manmade and natural disasters (Campbell et al., 2004; University of Pittsburgh Center for Rural Health Practice, 2004), but rural areas can actually suffer greater proportional losses than urban areas affected by the same disaster occurrence (Cross, 2001). Urban areas also have larger populations at risk but have the greatest resources to deal with disasters (Cross, 2001). Due to a lack of human resources, such as firefighters in a rural area as opposed to an urban area, rural areas may also be less prepared than their urban counterparts (Gursky, 2004).

In addition to human resources, rural areas face potential disasters with fewer economic, political, or technological resources (Cross, 2001). Financial constraints especially may limit rural hospital preparedness as adequate preparedness requires sustained, directed funding sources (Howitt & Pangi, 2003). Howitt and Pangi state that it is economically unjust to expect the cost of preparedness to be borne by these hospitals of limited means.

Regardless of the type of disaster, rural hospitals must be adequately prepared to meet the threats of all potential hazards (Campbell et al., 2004). Studies have been conducted primarily within urban settings (Government Accounting Office [GAO], 2003b), but there is need for research in rural hospitals of overall preparedness (Gursky, 2004). The associations between risk perception and rural hospital preparedness, funding and rural hospital preparedness, and risk perception and funding combined on rural hospital preparedness, need to be examined further as well.
Purpose of the Study

The primary purpose of this research study is to examine the current state of disaster preparedness in rural hospitals in the United States. This study also seeks to determine the relationship between perception of risk of a disaster event and the level of preparedness in rural hospitals. Since it has been suggested that there is a decreased perception of risk in rural areas (IOM, 2006b; Michigan Rural Health Association, 2003; Shadel, Chen, Newkirk, Lawrence, Clements, & Evans, 2004), does it hold that there is a minimal level of preparedness in rural hospitals that report minimal risk?

Other associations regarding preparedness will be examined as well. The relationships between funding and preparedness will be explored, as well as the combined effect of perception of risk and funding on disaster preparedness. Additionally, this study seeks to adopt a model for effectively measuring preparedness in rural hospitals. This knowledge would provide a foundation for more comprehensive planning and a broader discussion about standard approaches to preparedness.

Significance of the Study

This research study will contribute to the body of knowledge of the current state of rural hospital preparedness as these hospitals play a critical primary care role in the communities they serve (Gursky, 2004). Although an effective terrorist event is considered unlikely at this time (Karwa, Currie, & Kvetan, 2005), there is always the threat of natural disasters (IOM, 2006a). The focused attention on an all-hazards approach to rural hospital preparedness is also crucial (Salinsky, 2002). All hospitals need to
enhance their capacity to have an adequate emergency response should the need arise (GAO, 2004), and rural hospitals especially need to continue to improve their ability to respond to a major public health threat (Campbell et al., 2004).

This study will further the understanding of the importance of effective disaster preparedness in hospitals. Health services researchers, clinicians, and administrators must develop and analyze the best evidence-based models and tools to address these potentially devastating threats (Phillips, Burstin, Dillard, & Clancy, 2004). Furthermore, the results will provide policy makers with information useful in the advancement of innovative policy initiatives to address this public health concern (Phillips, Dillard, & Burstin, 2002).

Research Questions

Using a select framework, the survey data will be examined to determine the current state of disaster preparedness in rural hospitals. Other variables of interest are those of risk perception and funding for disaster preparedness from the U.S. Health Resources and Services Administration (HRSA). These variables will be examined to gain a better understanding of the perceived risk of each disaster event, and to gain a better understanding of HRSA funding for disaster preparedness.

In addition to the three descriptive questions related to the current state of disaster preparedness, risk perception and HRSA funding in rural hospitals, there are three inferential research questions. In seeking what determines how prepared a rural hospital is in the event of a disaster, the associations between preparedness and risk perception, and between preparedness and HRSA funding will be explored. Additionally, the combined effect of risk perception and HRSA funding on preparedness will also be examined.
In summary, the research questions have been formulated as:

1. Among rural acute care hospitals in the U.S., what is the perceived risk of disaster events, including natural disasters; mass casualty incidents; manmade disasters including chemical threats, biological threats, radiological threats, nuclear threats, explosive threats; and overall all-hazards?

2. Among rural acute care hospitals in the U.S., what is the amount of funding received from HRSA for preparedness activities?

3. Among rural acute care hospitals in the U.S., what is the status of disaster preparedness in the areas of administration and planning; patient capacity; education and training; communication and notification; staffing and support; isolation and decontamination; supplies, pharmaceuticals, and laboratory support; and overall preparedness?

4. Among rural acute care hospitals in the U.S., what is the association between risk perception and preparedness?

5. Among rural acute care hospitals in the U.S., what is the association between HRSA funding for preparedness activities and preparedness?

6. Among rural acute care hospitals in the U.S., what is the combined effect of all-hazards risk perception and HRSA funding for preparedness activities and overall preparedness?

Chapter Summary

The first chapter provided the introduction of this study of disaster preparedness in rural hospitals in the U.S. While disasters can occur in urban and rural areas, it is
believed that rural hospitals may be less prepared for a disaster. There has also appeared to be less focus on preparedness in rural areas.

The primary purpose of this research study is to examine the current state of disaster preparedness in rural hospitals. This study also examines the associations between risk perception, HRSA funding, and preparedness. This study contributes to the body of knowledge of the current state of rural hospital preparedness. The second chapter will review the literature about disaster preparedness and related other concepts.
CHAPTER II

LITERATURE REVIEW

This chapter provides a review of the literature. Topics of discussion include disasters, disaster preparedness, critical studies, previous disaster events, and perceptions of risk. It also includes a review of related factors pertaining to HRSA funding and other variables, rural hospitals, and the perspectives of hospital CEOs. The chapter closes with a discussion of secondary analysis of research data.

Disasters

A disaster indicates a low probability but high impact event that causes a large number of individuals to become ill or injured (IOM, 2006b) and may be an emergency of such severity and magnitude that it cannot be effectively managed by the application of routine procedures or resources (Landesman, 2001) (see definitions of terms in Appendix A). According to the Joint Commission (Joint Commission on the Accreditation of Healthcare Organizations [JCAHO], 2001), a disaster can also refer to an event that suddenly or significantly disrupts the environment of care, such as damage to the building and grounds; disrupts care and treatment, such as loss of utilities or civil disturbances; or changes or increases demands for the organization's services, such as with bioterrorist attacks.
Types of Disasters

Sundnes and Birnbaum (2003) have identified that there are two primary classifications of disasters: natural disasters and manmade disasters. Mass casualty incidents and all hazard events also are of importance in the identification of disasters (see definitions of terms in Appendix A).

Natural disasters are those events that are considered unavoidable (Sundnes & Birnbaum, 2003), often related to weather conditions (IOM, 2006a). These disasters refer to extreme events that may result in deaths and injuries such as earthquakes, extreme heat or extreme cold, winter storms, thunderstorms, floods, hurricanes, tornadoes, tsunamis, volcanoes, and mudslides (IOM), whereas manmade disasters are caused by hazards that have been created by human activities (Sundnes & Birnbaum, 2003) and may be intentional or unintentional (IOM, 2006a). Manmade disasters can be further broken down into five categories: chemical, biological, radiological, nuclear, and explosive (see definitions of terms in Appendix A), commonly referred to as CBRNE (IOM, 2006b).

A mass casualty incident is a situation involving a large number of ill or injured people, and can contribute to a disaster or be the result of a disaster (O'Leary, 2006). In addition to an association with a disaster event, a mass casualty incident can also, of itself, be considered a disaster as a result of various types of accidents, such as multi-vehicular crashes (IOM, 2006b). Although mass casualty incidents can be viewed as a predictor or as an outcome of any disaster event, it was specifically defined in the survey tool for this study as a mutually exclusive vehicular accident, whether air, bus, train, or automobile.
An all hazards event refers to any, and all, types of disaster events, including simultaneous emergencies (Farmer, 2006). It further refers to a conceptual and management approach that uses the same set of management arrangements to deal with any and all types of natural or manmade disasters (O’Leary, 2006) and can promote the effective use of resources in the dual capacity of responding to manmade disasters, as well as enhancing emergency capabilities for addressing natural disasters (Rudman, Clarke, & Metzl, 2003).

Disaster Phases

There are four time-related phases in coping with disasters, whether natural or manmade (Gillespie, Colignon, Banerjee, Murty, & Rogge, 1993; O’Leary, 2006). These phases include mitigation, preparedness, response, and recovery (see definitions of terms in Appendix A).

Mitigation

Mitigation refers to alterations that are conducted before a potential disaster occurs in order to lessen or decrease vulnerability (Sundnes & Birnbaum, 2003) and includes activities such as adoption of zoning ordinances, land use practices, and building codes (National Research Council, 1991). Mitigation begins by identifying potential hazards that may affect an organization’s operations or the demand for its services, followed by the implementation of strategies to support the perceived areas of vulnerability within the organization (JCAHO, 2001).
Preparedness

Preparedness represents the second phase of the disaster cycle and is defined as the process of turning awareness of risks into actions that improve the capability to respond to, and recover from disasters (National Research Council, 1991). Preparedness activities are implemented prior to a disaster to support and enhance mitigation (Institute for Crisis, Disaster, and Risk Management, 2007) even though the difference between mitigation and preparedness can be blurry (Drabek, 1986). Hospital preparedness activities include developing emergency response plans, training employees on what to do in an emergency situation, acquiring needed equipment, supplies, and materials, and conducting drills and exercises (Tierney, Lindell, & Perry, 2001). Preparedness will be discussed in further detail in the next section.

Response

The third phase of the disaster cycle refers to the totality of measures undertaken during and immediately after the disaster impact to address the situation to the degree possible (O’Leary, 2006), and includes such activities as search and rescue, medical care (Gillespie et al., 1993), taking action to contain ongoing threats, evacuating threatened populations, and providing emergency food and shelter (Tierney et al., 2001). Overall, this phase involves immediate actions to save lives, protect property, and meet basic human needs.
Recovery

The final phase of the disaster cycle involves post-response measures undertaken to restore normalcy (O’Leary, 2006). Bringing all of the components back to their pre-event functional status (Sundnes & Birnbaum, 2003) requires actions taken to repair, rebuild, and reconstruct damaged properties and to restore disrupted routines and activities (Tierney et al., 2001). Recovery actions can begin concurrently with response activities and may require a large amount of resources and time to complete. JCAHO (2001) underscores that recovery not only includes activities related to the facility, but also includes responding to lost revenues, support of staff, and dealing with community reaction.

Disaster Preparedness

Disaster preparedness, also referred to as preparedness or emergency preparedness or hospital preparedness, is a basic core concept in disaster research (Gillespie & Streeter, 1987; Kirschenbaum, 2002; Stallings, 2002) and includes numerous activities to improve readiness when faced with a disaster situation (Gillespie et al., 1993). Preparedness connotes a time-ordered phase which follows mitigation and precedes the impact of a disaster event; it also denotes a readiness to respond and suggests purposive or anticipatory action (Gillespie & Streeter, 1987). Furthermore, preparedness entails planning, establishing resources, skills in training and practicing, and almost any predisaster action which is assumed to improve the safety or effectiveness of a disaster response (Gillespie & Streeter, 1987). Quarantelli (1980) also shared the common belief
that adequate preparedness may actually increase effectiveness of the response to a real disaster.

Quarantelli (1982) identified 10 general principles of disaster planning to facilitate enhanced preparedness for a disaster. These principles are that planning: (a) is a continuous process; (b) entails attempting to reduce the unknowns in the anticipated disaster situation; (c) aims at evoking appropriate response actions; (d) should be based on what is likely to happen and what people are likely to do in an actual disaster situation; (e) must be based on valid knowledge, including knowledge of how people typically behave in emergencies, knowledge of the hazard itself, and knowledge concerning the resources needed to respond to the disaster event; (f) should focus on general principles while maintaining flexibility; (g) is partly an educational activity; (h) must overcome resistance; (i) must be tested; and (j) is distinct from disaster management, in that it is impossible to plan for specific problems that will develop when a disaster actually occurs. Appropriate disaster planning may contribute to an effective response in the event of a disaster.

Underscoring the importance of disaster planning, the Joint Commission has identified critical characteristics for success in a disaster event (Cappiello, 2006). These include: (a) substantial preparation; (b) reliable linkages outside of disaster area for food, water, supplies, and pharmaceuticals; (c) significant experience with the type of disaster; and (d) strong trust in a committed upper management. While three of these characteristics appear significant, experiencing a particular disaster may not always be possible; thus, it would seem that being prepared for any disaster would be more feasible.
Models of Disaster Preparedness in Hospitals

Drawing from the variety of definitions and elements of preparedness, Gillespie et al. (1993) conceptualized preparedness as a cycle starting with a preliminary level of awareness and followed by adequate knowledge of the potential threats. Knowledge can then contribute to organizational planning for disaster preparedness. The development of the disaster plan can be followed by practice or implementation and through implementation of the disaster plan, the strengths and weaknesses of preparedness can be assessed, which leads back to the first level of awareness and adds to it. Ideally, the five-stage cycle spirals upward with increasingly more refined levels of awareness, assessment, knowledge, preparation, and practice (Gillespie et al., 1993).

Previous research has further examined preparedness as a single overall construct (Larsson & Enander, 1997) or as an entity with a number of different subcategories (Kirschenbaum, 2002). Numerous attempts to develop a consistent model of preparedness have been undertaken (Asch et al., 2005; Covington & Simpson, 2006), but there is no consensus on key elements of preparedness (Nelson, Lurie, & Wasserman, 2007) and no nationally endorsed standardized system to assess and measure preparedness (Pezzino, Thompson, & Edgar, 2006). Without consistent measures, it is difficult to consistently assess preparedness efforts across hospitals.

The construction of a model for measuring disaster preparedness is primarily associated with the creation of measurements, or metrics (O'Leary, 2004) and Mason (2006) suggests that better metrics would enhance understanding of the dynamics of emergency preparedness. Simpson (2004) further cautions that the formulation of disaster
preparedness metrics and the construction of disaster preparedness models may not be the most effective means of measuring preparedness because of the complexity of the selection of data, indicators, index numbers, and mathematical formulas needed to develop the model. This difficulty may contribute to the lack of advancement in the development of a conceptual framework or a generally applicable disaster preparedness model (Nelson et al., 2007). It should be noted, however, that Simpson's work has been exclusive to community preparedness.

The absence of a clear consensus on the key elements of preparedness has not halted the development of tools and techniques for measuring preparedness (Nelson et al., 2007) and, therefore, an extensive review of preparedness tools and models was conducted. Assessment tools and models were selected for further analysis if they could be applied to hospital preparedness and not uniquely to community preparedness, such as the community model of Gillespie et al. (1993), or to public health preparedness, such as the public health models identified by RAND (2004) and the Centers for Disease Control and Prevention (Pezzino et al., 2006). Selected tools and models were reviewed and analyzed for fit prior to adopting a framework for this research study of rural hospital preparedness. Each one will be briefly discussed and an analysis across all models will follow.

*Agency for Healthcare Research and Quality*

The Agency for Healthcare Research and Quality (AHRQ) initiated a project in 2000 to develop and pilot test tools to assess the capacity of hospitals and health systems to respond to a disaster (2001, 2002a, 2005). The data collection tool and model criteria
included eight key elements of hospital preparedness regardless of the type of disaster:
(a) administration and planning; (b) surge capacity; (c) education and training; (d)
communication and notification; (e) staffing and support; (f) isolation and
decontamination; (g) supplies, pharmaceuticals and laboratory support; and (h)
surveillance (see definitions of terms in Appendix A).

This project was designed to assess and enhance the clinical care delivery system
in an attempt to develop evidence-based information aimed at improving preparedness
efforts (AHRQ, 2002b) but it appears that funding has not been available since 2003 to
further this initiative (AHRQ, 2003). AHRQ again released the tool in 2007 to assist
health care organizations in assessing preparedness but reinforced that they were not
administering the tool and would again not be collecting data from it (AHRQ, 2007).

American Hospital Association

The American Hospital Association (AHA) developed a framework to assist
hospitals in assessing their state of preparedness. Although this tool was provided to
member hospitals to be used to assess their preparedness for chemical and biological
incidents, it appears that it could be applied to any type of disaster (AHA, 2001b). It is
believed that this tool was also intended as a framework for individual hospitals who
were interested in developing their own models of disaster preparedness.

There are 10 key elements within this tool. Similar to the AHRQ tool, there was
consideration for surge capacity; training; communication; isolation and decontamination;
and supplies, pharmaceuticals, and laboratory support. This framework also contains 4
elements not included with the AHRQ tool including access to care, business continuity
planning, facility management, and psychiatric services and crisis counseling (see definitions of terms in Appendix A). Additionally, the AHA tool does not include the elements of administration and planning, staffing, and surveillance as contained in the AHRQ framework.

_Institute of Medicine_

The Institute of Medicine (2006b) identified five core elements of disaster preparedness for hospitals. These elements are all contained within the AHRQ framework and include planning, surge capacity, training and drills, isolation and decontamination, and surveillance. It appears that this was not intended to be an all-inclusive model and does not include three elements contained within the AHRQ framework, including communication and notification; staffing; and supplies, pharmaceuticals, and laboratory support.

_Personnel–Materials–Methods Model_

DeBoer (1997) attempted to develop a comprehensive model of disaster preparedness. Three systems were identified within this disaster preparedness model: the medical organization at the site, the transportation and distribution of victims, and the disaster procedures for the hospital. Each of these systems was individually conceptualized using a “personnel–materials–methods” model (see definitions of terms in Appendix A).

Personnel, materials, and methods each can be graded uniformly on a Likert scale from “1” through “5” with “1” representing no personnel, no materials, or no plan
available, up to "5" that represents personnel available, materials available, and a plan available. DeBoer (1997) further explains that by summing the scores for personnel, materials, and methods and dividing the sum of each of them by the different kinds of medical rescue workers, the various sorts of equipment to be utilized, and the number of plans available, a score ranging from "1" to "5" for personnel, materials, and methods can be obtained that is representative of the quality of disaster preparedness for hospitals.

*Kirschenbaum's Preparedness Model*

Alan Kirschenbaum has done extensive work in the development of a model for disaster preparedness (2002, 2005, 2006). His proposed model incorporates four independent components of disaster preparedness that include: (a) provisions, (b) skill level, (c) planning, and (d) protection. Because his model is based on community preparedness, the measures are also related to community. For example, a measure contained within "provisions" is a radio; within "skill level," first aid; within "planning," family evacuation plans; and within "protection," public shelter (Kirschenbaum, 2002).

In a personal correspondence with the researcher (April 12, 2007), Kirschenbaum shared that the preparedness model could be applied to hospitals. He further identified that the components of provisions, skill level, planning, and protection should be "upheld as generic codes for preparedness," whereas the individual variables could be "changed in accordance with the type of situation being studied." Although an attempt was made to list hospital preparedness indicators within the framework, there were numerous indicators that did not fit within the elements as defined, such as surge capacity, and it was therefore not considered for this study.
Structure–Process–Outcome Model

Nelson et al. (2007) identified a conceptual model for preparedness based on a public health model that utilized a “structure–process–outcome” framework (Donabedian, 1966) (see definitions of terms in Appendix A). This model views preparedness as a structure with interrelated processes to prepare for optimal response, thus minimizing harmful outcomes (Seid et al., 2007).

Strong consideration was given to adapting this public health model and applying it to this rural hospital preparedness study. However, there is too much focus on public health processes rather than key components of hospital preparedness; for example, there is no potential for inclusion of the important element of surge capacity. Additionally, this model appears to be applicable to all phases of the disaster cycle and not merely preparedness.

Rationale for Selection of Model

The six models were examined for fit for this study. Planning is believed to be a core component of preparedness and all but the AHA model included an element of planning. The AHA model mirrors the AHRQ tool in six of the elements and includes some additional facets such as care for vulnerable populations, business continuity planning, facility management, and psychiatric services. While these additional items are favorable, it does not include the core element of a disaster plan and was therefore not used for this study.
The IOM framework includes five important elements but it is not as comprehensive as the other models. It appears that this model does not include key elements of preparedness, such as staffing and support; communication and notification; supplies, pharmaceuticals, and laboratory support, and therefore was not used for this study.

Two of the models, including the personnel–material–methods model and the structure–process–outcome model were developed for public health preparedness but could be applied to hospital preparedness. However, when attempting to do so, several core elements of preparedness did not fit, such as surge capacity. Surge capacity as a core element of preparedness also did not fit into the individual model developed by Kirschenbaum.

Based on the tools and the models assessed, the framework outlined within the AHRQ tool appears to be the most applicable for this study of rural hospital preparedness because it is comprehensive and includes the major elements of preparedness, and it is specific to hospitals and can be applied to urban, as well as rural hospitals. Because each element must be effective to contribute to overall preparedness (AHRQ, 2005), it appears that a model based on equality of each element could assist in determining an overall measure of preparedness (see Figure 1). Utilizing the AHRQ tool, further assessment of critical studies and case studies has been conducted.
Critical Studies and Previous Disaster Events

Critical Studies

Little research has been conducted that focuses on disaster preparedness in hospitals (Walker, Bibb, & Elberson, 2005) and the majority of the studies regarding preparedness were conducted at urban settings (Gursky, 2004). An extensive review of
the available literature was conducted using the computerized databases of Medline, Scopus, and Google Scholar with publication dates from 2001 through May 2007; dates were limited to 2001 and beyond due to the changes in standards for preparedness that were released in 2001 (Farmer, 2006). Studies were selected if they contained information pertaining to hospital preparedness and encompassed more than a singular city or state to improve the generalizability to the entire United States. A limited number of studies were identified that pertain to disaster preparedness within hospital settings across the U.S. in the period near or after September 11, 2001, and most of these studies focused on manmade disasters and bioterrorism. Selected articles were read, abstracted, analyzed, and compiled.

_Wetter, Daniell, and Treser, 2001_

A study by Wetter, Daniell, and Treser (conducted in 1998 and published in 2001) examined hospital preparedness for manmade disasters involving chemical or biological weapons. A questionnaire survey was conducted of hospital emergency departments (ED) in four northwestern states (Alaska, Idaho, Oregon, and Washington). The self-administered survey questionnaire requested information about hospital and ED demographics; respondents’ awareness and opinions; planning, training, and drills within the last 24 months; patient isolation and decontamination resources available; and an inventory of treatment antidotes available. Of the 224 eligible hospitals surveyed, 186 returned the survey (83% response rate).

The researchers examined the data for statistical associations between preparedness and location (urban vs. rural), emergency department annual census, and
proximity to the United States army chemical weapons depot in Umatilla, Oregon. Of the respondents, 61% of the hospitals were located in a rural area. Furthermore, 58% of the respondents were aware of local or state plans to respond to a biological or chemical attack. In general, respondents from urban hospitals reported higher levels of awareness than those reported by respondents from rural hospitals, and respondents from larger urban hospitals reported the greatest awareness (Wetter et al., 2001).

With respect to administrative plans and training, again urban hospitals were shown to be more prepared. Overall, 80% of the hospitals responding stated that they had plans in place for dealing with hazardous materials, yet only 17% had incorporated plans for biological disasters, and 12% had plans for chemical disasters. Consistent with previous results, urban hospitals (38% for biological disasters and 43% for chemical disasters) were more apt to have conducted training for a biological or chemical attack than rural hospitals (8% for biological disasters and 11% for chemical disasters). The study also indicated that only 21% of all hospitals surveyed had an emergency department area with an isolated ventilation system, a decontamination shower, and a water containment system. Again, it was noted that urban hospitals (40%) were more likely than rural hospitals (14%) to report having any form of respiratory protective equipment (Wetter et al., 2001).

The findings of this survey indicate that hospital EDs are not adequately prepared to treat victims of chemical or biological disasters, Moreover, the levels of preparedness were low in all areas surveyed, including awareness, plans and training, physical resources, and medication inventories. Of significance, urban hospitals were overall better prepared than rural hospitals.
This study provides a snapshot of hospital emergency departments in the northwest part of the United States in the pre-September 11 era. When comparing this assessment with the later AHRQ tool, it appears that this study primarily focused on the elements of administration and planning, and education and training. Based on the results, it appears that hospital EDs are not adequately prepared to treat victims of chemical or biological disasters, with rural hospitals less prepared than urban hospitals. Although this study was of the EDs and not entire hospitals, it may nonetheless indicate that rural hospitals overall are less prepared than their urban counterparts. Regardless, hospitals close to chemical depots may be more likely to be prepared for chemical disasters and this could suggest that there is a relationship between perception of risk of certain disasters and preparedness.

_Treat, Williams, Furbee, Manley, Russell, and Stamper, 2001_

Another study took a qualitative approach to assess the level of preparedness for hospitals in the event of a biological or chemical disaster. Treat, Williams, Furbee, Manley, Russell, and Stamper (2001) conducted the study in the Federal Emergency Management Agency (FEMA) Region III; this region includes West Virginia, Pennsylvania, Maryland, Virginia, and the District of Columbia. Qualitative interviews were completed with 30 hospitals (22 rural hospitals, 8 urban hospitals) during a 30-day period. Data collected focused on level of preparedness, mass decontamination capabilities, training of hospital staff, and limited other areas.

Of the responding sites, no hospital believed that their facility was fully prepared to handle a biological incident: 73% believed that their facility was not prepared at all,
and 27% (all urban hospitals) believed that their facility was somewhat prepared. With regards to decontamination, 73% of facilities had at least one decontamination room, while 13% (all rural) reported no capacity for decontamination. Additionally, hospital-wide disaster preparedness plans that included guidance for biological and chemical disasters were in place at only 27% of the facilities (Treat et al., 2001).

With respect to other areas of focus, all except one facility had plans in place for patient overflow to other medical facilities to accommodate seasonal fluctuations in patient census, yet none reported having specific agreements delineated for managing mass casualties in disaster situations. Furthermore, with regard to pharmacy stockpiling, only the tetanus vaccine was stockpiled by those facilities that reported stockpiling drugs. Only 20% of the hospitals reported participating in a disaster drill that was aimed specifically at an attack of a biological or chemical nature. Additionally, all participants reported a need for further training on disaster preparedness (Treat et al., 2001).

This study reflected an assessment of at least six elements of the AHRQ tool with the exception of the staffing and support element and the supplies, pharmaceuticals, and laboratory support, except in regards to pharmaceutical stockpiling. It does appear that, overall, hospitals in the sample were not prepared to handle emergency events, especially in such areas as mass decontamination, mass medical response, surge capacity, and awareness among health care professionals.

The results may be of significance in the noted lack of emergency preparedness in rural areas. However, it is important to note that the researchers did not intend that the sample be statistically representative of the region. Instead, it represented a snapshot of activities, plans, and attitudes within the region. The researchers suggest that further
research be conducted to amass a statistically representative sample that can be
generalized on a national level (Treat et al., 2001).

Government Accounting Office Studies

From September 2001 through December 2003, the GAO prepared four reports on
disaster preparedness and emergency services (Russ & Jones, 2005). Two of these studies
met inclusion criteria for further analysis.

GAO, 2003 April. The first study was conducted from December 2001 through
March 2002 (GAO, 2003a). The researchers visited seven unnamed urban cities in the
U.S. that were selected to provide wide variation in geographic location, population size,
and experience with natural disasters. Their objective was to examine state and local
levels of preparedness for a biological disaster. To address this objective, they conducted
multi-day site visits to the seven cities and their respective state governments. They
utilized document review and in-person interviews of officials from state and local public
health departments, local emergency medical services, state and local emergency
management agencies, local fire and law enforcement agencies, and hospitals and
national public health care associations. The sites were compared across 25 elements of
preparedness with no further statistical analysis noted.

The comparative results indicate varying levels of preparedness across the seven
cities. The study found that all seven of the cities had responded to some type of public
health emergency within the previous 5 years. It can be surmised that their previous
experience may have heightened their awareness and/or increased their perception of
disaster risk. The results also indicated through self-report that none of the hospitals had undergone sufficient disaster response training and none reported sufficient equipment for disaster response. Furthermore, communication between emergency responders was found to be effective during public health emergencies in only one of the hospitals (14%). However, 86% of the hospitals did have drug stockpiles (GAO, 2003a). Workforce shortages and inadequate laboratory facilities were also identified in the narrative results but were not indicated in the data tabulation.

Overall, the results for these seven urban sites indicate deficiencies in capacity, communication, and coordination elements essential to hospital preparedness. The only areas of this assessment that were consistent with the AHRQ tool were in the elements of education and training; communication and notification; and supplies, pharmaceuticals, and laboratory support. It should also be noted that while this has some applicability to hospital preparedness, the primary area of focus was within the public health arena.

GAO, 2003 August. The second applicable study of preparedness by the GAO was conducted between May and September 2002 (GAO, 2003b). This study of hospital preparedness was conducted through the use of a survey questionnaire of more than 2,000 short-stay, nonfederal, general medical and surgical hospitals with emergency departments in urban areas of the U.S., with survey hospitals located in the 50 states and the District of Columbia. The survey questionnaire contained three parts. The first and second parts addressed routine emergency room processes and will not be further discussed here, whereas the third part of the survey addressed hospital preparedness, primarily in the areas of planning, training of staff, and overall ability to respond to a
disaster. The response for the third part of the survey was 1,482 hospitals of the 2,021 hospitals surveyed, for a response rate of 74% (GAO).

Using the data collected by surveyed urban hospitals, the researchers completed a descriptive analysis of the extent of emergency preparedness and also examined the relationships between the extent of preparedness and the size of the hospital as indicated by the number of inpatient staffed beds. However, the results are displayed per state without further statistical analysis so it cannot be determined if there is an association between preparedness and hospital size.

In comparison to the AHRQ framework, elements assessed included administration and planning; education and training; and supplies, pharmaceuticals, and laboratory support. The results indicated that most of the hospitals participated in basic planning and coordination activities for emergency preparedness and most also provide some training to their personnel. Approximately 80% of the hospitals reported having a written preparedness plan in place, but fewer than half of the hospitals had conducted drills or exercises simulating response to a disaster. Deficiencies were found with the disaster plans; there were minimal linkages with external entities, such as laboratories, and hospitals also reported that they lacked the medical equipment necessary, such as ventilators, for a large influx of patients (GAO, 2003b).

Although not included in the data, the narrative results indicate that larger hospitals reported more planning and training activities than smaller hospitals. These results could further indicate that rural hospitals, as smaller hospitals, may also conduct less planning and training activities than their urban counterparts.
In another study, Braun, Darcy, Divi, Robertson, and Fishbeck (2004) conducted a national survey on the effect of community linkages on disaster preparedness of hospitals. The study, conducted as a pretest/posttest design both shortly before and shortly after September 11, surveyed hospitals scheduled for accreditation by the Joint Commission on Accreditation of Healthcare Organizations. It is important to note, however, that the same hospitals were not surveyed in the before and after periods (Braun et al., 2004).

The mail survey questionnaire of 51 items was used to assess hospitals’ linkage with their communities related to training and drills, equipment, surveillance, laboratory testing, surge capacity, incident management, and communication. In 2001, 68 of 82 hospitals surveyed returned responses (82% response rate) and 97 of 141 (69% response rate) hospitals returned surveys in the 2002 mailing (Braun et al., 2004).

The study looked at two independent samples over time, and even though the response rate changed, there were not significant demographic differences between the 2001 and 2002 surveys. The other questions specific to preparedness were then compiled and assessed for significance (Braun et al., 2004).

The greatest improvement was found in the presence of a disaster plan specific to bioterrorism from 2001 to 2002. In 2001, 47% of the hospitals surveyed had such a plan in place, whereas in 2002, 91% had a plan in place. Perception of collaboration with the community also showed large gains as the percentage increased by 43% from 2001 to 2002, but a community disaster plan was more likely to be found in larger communities (Braun et al., 2004). Overall, planning related items showed the greatest improvement,
whereas items related to equipment, communication, and training showed the least improvement. Although several of these elements reflect the AHRQ hospital preparedness assessment tool, it is noted that most of the questions in this survey are in relation to the linkages with the community and not strictly an assessment of the hospitals.

Gursky, 2004

Elin Gursky, a Senior Fellow for Biodefense and Public Health at the Institute for Homeland Security, released a study of rural hospital preparedness in 2004 (Gursky, 2004). In it, Gursky pointed to the critical need for all of the nation’s healthcare entities to be prepared in the event of a bioterrorist attack, and also pointed to their inadequacies in planning and training for such an attack. In addition, she pointed out that these deficits are even more acutely experienced by the nation’s rural hospitals due to limited resources and unique vulnerabilities (Gursky, 2004).

Gursky (2004) studied a total of five hospitals located in rural locations around the country and deliberately chose one rural hospital from each of the five geographic regions in order to have representatives from all areas, yet did not intend the results to be a true representation of rural hospitals. Each hospital took part in a 2-day site visit that was comprised of meetings with key hospital and community leaders, as well as open-ended interviews to gather the requested qualitative data on the bioterrorism preparedness activities of the hospital. The literature was not specific in the data requested but it appears that there were likely questions related to administration and planning, surge
capacity, education and training, communication, staffing, and supplies and pharmaceuticals.

The results indicated an overall improvement in preparedness activities and levels of preparedness for the five hospitals since 2001, but identified that more planning and preparedness activities still needed to be undertaken. Additionally, hospital leaders pointed to a promise for funding that had yet to arrive as a barrier to such improvements (Gursky, 2004). This suggests a potential association between external funding and preparedness.

*Niska and Burt, 2005*

In 2005, Richard Niska and Catharine Burt from the Division of Health Care Statistics within the Centers for Disease Control and Prevention (CDC) released a comprehensive study of hospital preparedness that they had conducted in 2003 (Niska & Burt, 2005). This was a survey of hospitals regarding their preparedness for treating patients from bioterrorism attacks or mass casualty incidents and was based on a probability sample. A mail survey questionnaire was utilized and responses were received from 399 of the 462 (86% response rate) non-federal general and short-stay hospitals in the United States, including all 50 states and the District of Columbia. The study examined the content of hospital disaster preparedness plans; whether those plans had been updated since September 11, 2001; collaboration of hospitals with outside organizations; clinical training in the management of biological, chemical, explosive, and nuclear exposures; drills on the response plans; and equipment and bed capacity (Niska & Burt, 2005).
The results specific to the element of preparedness plans revealed that nearly all hospitals had disaster preparedness plans and the majority of hospitals had revised their plans since September 11, 2001 (92%). Only teaching hospital status was associated with a greater likelihood of having a revised plan (chi square, $p < 0.05$) (Niska & Burt, 2005). It does not appear that they looked at rural versus urban hospitals, but because teaching hospitals are affiliated with universities providing medical education, it can be assumed that the majority of teaching hospitals are in urban locations and, thus, rural hospitals would be less likely to be included with this greater potential of having a revised plan.

Among those hospitals with a disaster preparedness plan, 97% addressed natural disasters, 86% addressed chemical disasters, 85% addressed biological disasters, 77% addressed nuclear or radiological disasters, 77% addressed explosive disasters, and 64% of the hospitals addressed all five of the disaster types. This may indicate that there is more preparedness planning for natural disasters than for manmade disasters or all-hazard disasters. Almost all hospitals (95%) had provisions in their plans to collaborate with outside entities. The most frequently identified external contacts were state or local public health departments (82%), whereas only 46% of respondents had memoranda of understanding with outlying hospitals to accept inpatients during a declared disaster (Niska & Burt, 2005). If these results hold true for rural hospitals, lack of necessary coordination with outlying hospitals could create further barriers in a disaster and may indicate that independent hospitals have less coordination than system hospitals.

Hospitals varied widely in their plans for surge capacity with 73% of the respondent hospitals identifying they would cancel elective procedures and admissions during an emergency. However, only 37% of the hospitals identified that they would
convert their postanesthesia care unit to augment intensive care capacity, and only 27% were able to activate decommissioned space during an emergency (Niska & Burt, 2005). The majority of hospitals (60%) also provided for coordinated supply chain management of critical supplies and pharmaceuticals in their disaster preparedness plans, but less than half (44%) of the hospitals had plans to stockpile antibiotics and other supplies. If these results hold true for smaller rural hospitals, it raises concern of where an influx of patients would be physically cared for in a disaster and whether supplies and pharmaceuticals would be available.

The survey element of training in emergency response revealed overall favorable results. Three-quarters (75%) of the hospitals had key hospital personnel trained to implement a formal incident command system and staff members at most hospitals (89%) had received training since September 11, 2001, in the identification, diagnosis, and treatment of any of the biological agents studied in the survey (Niska & Burt, 2005).

Regarding the survey element of mass casualty drills, the results indicated that nearly 9 out of 10 hospitals (88%) had participated in an internal mass casualty drill since September 11, 2001, and the most common scenario was a natural disaster (70%). Conversely, drills involving severe epidemics were staged by only 7% of respondent hospitals (Niska & Burt, 2005). This could indicate an overall lack of preparedness for a pandemic illness or biological disaster.

Niska and Burt's study provides a descriptive summary of preparedness and can be generalized to all U.S. hospitals. The assessment appears comprehensive and was closely aligned with the AHRQ framework but with minimal attention to communication or isolation. Additionally, the hospitals in the study were of all sizes and locations and
were, on average, larger than most rural hospitals with a mean of 20.3 intensive care beds. Only 40% of the hospitals in the study were in rural areas and, therefore, the results may be skewed to urban hospitals.

*Manley et al., 2006*

William Manley et al. released a study in 2006 related specifically to disaster preparedness in rural hospitals (Manley et al., 2006). This study examined disaster preparedness in rural hospitals specific to their experiences, training priorities, and response capabilities. In comparing the study elements to the AHRQ framework, it appears that this study was limited to education and training, and surge capacity.

A mail survey questionnaire composed of 20 questions was addressed to ED nurse managers for all hospitals in the sample and data were collected over a 3-month period. This survey yielded a response of 941 of 1964 rural hospitals (48% response rate) (Manley et al., 2006). Statistical methods utilized could not be ascertained.

The results pertaining to the survey element of experiences revealed that 37% of the respondents indicated that a mass casualty incident had overwhelmed their hospital ED at least once in the prior 2 years. However, it was also identified by 95% of the respondents that it would take only 10 patients to overwhelm their capacity (Manley et al., 2006).

In rank order of the most frequently experienced disaster by these rural hospitals, 36% identified the greatest frequency of mass casualty incidents were caused by vehicular crashes. Additionally, the greatest need for training was identified in the areas of decontamination of patients and response personnel exposed to chemical agents (28%).
and the lowest ranked training need was identified as the interaction and relationship with local health departments and emergency medical service agencies (5%) (Manley et al., 2006).

Hospital ED nurse managers were also asked to rank how well trained and equipped their ED personnel were to deal with a number of different disasters. Clearly, respondents expressed more confidence in dealing with mass casualty incidents from motor vehicle trauma (64%) but expressed little confidence (less than 5%) in their preparedness for treating victims of chemical or explosive disasters (Manley et al., 2006).

There were some identified limitations in this study, primarily that the survey was completed by the nurse manager of the emergency department who may not have the generalized hospital knowledge beyond the specific department. Also, as identified by the authors, the survey was a self-reported instrument and validation of training responses was not conducted (Manley et al., 2006). However, based on these results overall, it appears that rural hospitals may have limited capacity for dealing with disasters.

Previous Disaster Events

Tierney et al. (2001) have confirmed that the overall objective of disaster preparedness in hospitals is to enhance the ability of hospital personnel to respond when a disaster occurs. The effectiveness of disaster preparedness can be evaluated, in part, through previous research and previous disasters. There are limitations in the research about disaster planning and preparedness such as the focus on single-impact disasters (Stallings, 2002). Another limitation is that the unexpected nature of disasters leads to retrospective data collection on response to disasters creating difficulties with before-and-
after comparisons of the event (Tierney et al., 2001). Several of the documented case studies are dated with adoption of significant changes in planning and preparedness since their publication (Auf der Heide, 2006). Additionally, few disaster events are actually documented. For example, the Joint Commission has conducted over 70 post-disaster debriefings in North America since 2001 but do not maintain a record of such actual cases (J. Cappiello, personal communication, July 27, 2007).

The final limitation identified is that prevention has not been carefully documented. When preparedness is successful, the disaster that didn’t happen is rarely remembered or documented (Colmers, 2007). It can also be surmised that if a hospital fails in their disaster response, they may be unlikely to publish their results and bring unwanted attention to the organization.

Despite the limitations, preparedness can be improved by incorporating lessons learned from previous disasters (Landesman, 2007). Because of the 2001 hospital accreditation changes that guide preparedness (Farmer, 2006), case studies explored will be limited to four actual large-scale hospital-based disasters identified from within North America in the 21st century. To the extent possible, these cases have been evaluated according to the core elements of the AHRQ framework.

Terrorist Attacks on the World Trade Center, 2001

St. Vincent’s Manhattan Hospital (SVMH) in New York City was the trauma center that received the most casualties after the terrorist attacks on the World Trade Center (WTC) on September 11, 2001 (Kirschenbaum, Keene, O’Neill, Westfal, & Astiz, 2005), with over 1,400 patient visits in the first 3 days after the event (New York City
Department of Health, 2001). The events of September 11 tested the disaster plan of SVMH, a 550-bed hospital located within one mile of the WTC (St. Vincent Catholic Medical Centers, n.d.).

The hospital’s disaster plan, which had apparently been previously tested through numerous mock drills, was activated within minutes of the attack and the incident command center was thus assembled. By the time patients began to arrive, the multifaceted disaster plan had been fully implemented (Kirschenbaum et al., 2005). Additional supplies were secured, additional beds were established through the implementation of surge guidelines, a separate facility was established across the street for the large volume of victims requiring eye washes, and additional human resource pools were also established (Kirschenbaum et al., 2005). According to hospital reports, the Emergency Department at SVH saw approximately 300 patients from the disaster in the first 2 hours, plus 248 disaster-related patients seen in the adjacent eye wash facility (Kirschenbaum et al., 2005).

Comprehensive disaster preparedness was believed to contribute to optimal response in the immediate aftermath of the terrorist event (Kirschenbaum et al., 2005), but numerous opportunities for improvement were also identified. Communication systems were challenged by the loss of phone systems, cellular service, and computer communication lines. Although two-way radios were utilized as per the disaster plan, there was still a disruption in intrahospital communications as a result of an inadequate number of radios (Pesola, Dujar, & Wilson, 2002). Additionally, water pressure dropped from 130 to 10 pounds per square inch; this challenge had not been anticipated and necessitated the urgent procurement of external water tanks (Kirschenbaum et al., 2005).
Several other unexpected issues arose that have since been built into the hospital's disaster preparedness plan. According to Kirschenbaum et al. (2005), the hospital was apparently not equipped to handle casualties from attacks involving nuclear, biological, or chemical weapons. Other vulnerabilities that were identified for inclusion in future disaster preparedness were the need for a program for smallpox vaccinations for first responders, availability of stockpiles to antidotes against chemical weapons, and emergency credentialing of medical personnel (Kirschenbaum et al., 2005). Berman and Lazar (2003) reported that as a result of the terrorist attacks of September 11, hospital administration and clinical leaders at SVMH and throughout the nation have initiated a series of activities designed to prepare for, prevent, and provide protection against future disasters.

*Rhode Island Fire, 2003*

Since the terrorist attacks of September 11, 2001, all states have developed programs to prepare themselves for a large-scale disaster with some annual progress noted, according to Trust for America’s Health (2003a, 2004, 2005, 2006) and most hospitals have also implemented disaster preparedness plans (Farmer, 2006). A fire-related mass casualty incident is an uncommon event (Gutman, Biffl, Suner, & Cioffi, 2003) but can be used to test a hospital’s disaster preparedness plan. Such was the case of a 2003 nightclub fire in Warwick, Rhode Island, that caused a mass casualty disaster with 215 victims requiring treatment at area hospitals (Mahoney, Harrington, Biffl, Metzger, Oka, & Cioffi, 2005), including Rhode Island Hospital (RIH), a 719-bed acute care trauma hospital (Rhode Island Hospital, 2007).
Before this event, disaster drills and disaster planning had been performed at RIH as part of regional disaster drills with simulated disasters that were depicted with fictitious victims of plane crashes and toxic gas exposure. After each drill, the response was critiqued for response time, accuracy, and efficiency, and areas of improvement were identified (Mahoney et al., 2005). Subsequently, changes were made to the disaster plan as a result of these re-evaluation sessions.

RIH was first notified to expect 200-300 fire victims (Mahoney et al., 2005) and the Hospital’s Emergency Incident Command System was immediately activated. Because the incident occurred at the same time as the evening night shift change was occurring, ample nursing staff was initially available (Mahoney et al., 2005). Normally, few health care organizations have the optimal number of staff needed for a disaster at this time of night (Farmer, 2006). However, to avoid disturbing patients and guests, hospital policy limits overhead paging after 11:00 P.M. so word of the pending disaster event was spread in-house via phone to all nursing units. Unfortunately, without the overhead page, certain essential departments such as the laboratory and pharmacy were unaware of the emergency. Only one pharmacist was on duty and did not know to call in extra help, while the lab was suddenly flooded with requests but did not know why (Farmer, 2006).

Suboptimal surge capacity occurred in preparation for the incoming wounded by rapidly transferring patients within the hospital and opening a closed wing of the hospital (Mahoney et al., 2005) but with apparent limited intrahospital communication. Additional supplies and equipment were anticipated and quickly brought to the Emergency Department (Farmer, 2006) and additional ventilators needed to be secured due to the
large number of severe inhalation injuries (Dacey, 2003). The disaster event continued at RIH until the return to pre-event status 16 hours later (Farmer, 2006).

It appears that RIH benefited from the planning and performance of disaster drills (Farmer, 2006; Mahoney et al., 2005), but there were several opportunities for improvement and lessons learned. The disaster plan provided little guidance in the way of specific instructions as to the means for moving patients and personnel within the hospital to accommodate the incoming injured (Mahoney et al., 2005). Specific steps that must be taken during a disaster have since become part of the disaster plan. Planning and frequent drilling of all staff while using the details of the disaster plan is also imperative to attempt to avoid mistakes and confusion during the actual event.

Communication was also problematic and this was both within the hospital and between the hospital and the emergency and fire personnel (Dacey, 2003; Gutman et al., 2003; Mahoney et al., 2005) and also between hospitals (Farmer, 2006). As a result, a centralized communication system has been established that links a central command center with regional hospitals and prehospital personnel (Mahoney et al., 2005).

SARS, 2003

Biological disasters, such as severe acute respiratory syndrome (SARS), also offer valuable lessons in preparedness for hospitals. The SARS pandemic affected 8,096 patients in 29 countries over a short period from November 2002 to July 2003 (World Health Organization, 2003) and represented the first pandemic of the 21st century (Brookes, 2005). Beginning in the spring of 2003, the largest outbreak of SARS outside of Asia occurred in Toronto, Ontario, Canada (Public Health Agency of Canada, 2003)
with 90 confirmed cases and more than 620 potential cases of SARS in Toronto (Loutfy et al., 2004). The main Toronto hospital involved during this outbreak was North York General Hospital (NYGH), a 420-bed acute care hospital (North York General Hospital, 2007).

SARS posed a tremendous challenge because of nosocomial transmission, resulting in staff attrition and the closure of "infected" facilities (Fowler et al., 2003; Wenzel & Edmond, 2003), and intense resource requirements for controlling and preventing future spread (Srinivasan et al., 2004). As a result of these challenges, Ontario declared a provincial emergency (IOM, 2004), and all affected hospitals, including NYGH, activated their emergency response plans (Health Canada, 2003; IOM, 2004) and thus established their incident command centers (Loutfy et al., 2004).

A multidisciplinary approach apparently contributed to a successful control of the outbreak (Dessmon, 2006; Farmer, 2006; Loutfy et al., 2004). Other positive perspectives from the implementation of the emergency response plan included the institution of infection control measures (Farmer, 2006), such as personal protective equipment (Brookes, 2005; Health Canada, 2003; Loutfy et al., 2004), the establishment of isolation units (Health Canada, 2003), and an increase in the capacity of infection control practitioners and services (Loutfy et al., 2004). Other positive facets of the plan’s implementation included the strength of ongoing communication (Loutfy et al., 2004), and just-in-time education and training on aspects of communicable disease (Brookes, 2005; Loutfy et al., 2004). Overall, it appears that the hospital’s preparedness plan and response were moderately effective in responding to the SARS epidemic, with some opportunities for improvement.
There were some challenges and lessons learned regarding the SARS epidemic. There was inadequate surge capacity based on the number of isolation beds needed (Schull, Stukel, Vermeulen, Guttmann, & Zwarenstein, 2006), insufficient nursing personnel as a result of the high intensity of care needs and transmission of the disease (Loutfy et al., 2004), and problems associated with laboratory capacity, such as outdated facilities, equipment, and communication systems and also inadequate training and staffing of laboratory personnel (Trust for America’s Health, 2003b).

In response to the SARS outbreak, the GAO suggested that most hospitals lack the capacity to respond to a large-scale infectious disease outbreak due to a lack of adequate equipment (GAO, 2003c), such as ventilators, isolation facilities, and staff to treat a large increase in the number of patients (GAO, 2003d). Other deficiencies identified in the GAO reports related to SARS were workforce shortages and gaps in disease surveillance and laboratory facilities (GAO, 2003c, 2003d). Although there have been few cases of SARS reported in the U.S. (Trust for America’s Health, 2003b), continued diligence in responding to, and managing, infectious diseases is imperative in preparation for the potential of a biological disaster in the U.S.

_Hurricane Katrina, 2005_

Disaster preparedness is something most hospitals “do,” especially the ones in hurricane-prone areas such as the Gulf Coast of the United States, according to Bovender and Carey (2006). Furthermore, hospitals in the New Orleans area have extensive experience in preparing for—and responding to—natural disasters and also have emergency plans in place that include evacuation protocols should the need arise.
(Rodriguez & Aguirre, 2006). The lead time that a hurricane provides gives a health care facility time to prepare (Farmer, 2006), unlike a terrorist attack, and it appears that hospitals in the region were prepared for the anticipated impact of Hurricane Katrina in 2005. However, as a consequence of the hurricane and subsequent flooding, there were significant disruptions in hospitals (Rodriguez, Trainor, & Quarantelli, 2006) which necessitated the evacuation of some hospitals (Quarantelli, 2006) when 9 of New Orleans’ 11 hospitals were incapacitated (Franco, Toner, Waldhorn, Maldin, O’Toole, & Inglesby, 2006).

Rodriguez et al. (2006) identified how hospitals prepared for, and responded to, Hurricane Katrina beginning with the initial response of hospitals reacting as they had done in the past. They activated their disaster plans and assured extra supplies of water, food, blood, and medical supplies were stored on scene. Assuming that electric power might be lost in a major impact, extra fuel was brought in for use by emergency generators. The general expectation was that the hospital would return to more or less normal operations after 4 days or so (Rodriguez et al., 2006).

Rodriguez et al. (2006) further explained that within 24 hours, the floodwaters from the levee breaks created a whole new disaster, necessitating evacuation. This disaster raised a number of concerns about the preparedness of health care providers and hospitals (GAO, 2005). Disaster drills had been regularly done at hurricane-prone hospitals, but the drills apparently did not prepare the hospitals for a disaster of such epic proportions; furthermore, evacuation scenarios for hospitals were incorporated into plans but needed to be incorporated into disaster drills as well (Eckes-Roper, Kennedy, & Weisul, 2005).
Many other deficiencies in preparedness were identified from the events of Hurricane Katrina. Emergency plans did not ensure that critical hospital systems, such as electricity and backup power sources, would continue to be available (Franco et al., 2006) if emergency generators were incapacitated due to being in flooded lower levels (Bovender & Carey, 2006). New Orleans' hospitals also had little functioning backup communication systems, and although ham radios were the one piece of communications equipment that could be consistently relied upon, there were very few of these radios and even fewer personnel who knew how to operate them (Franco et al., 2006). Backup power and backup communication systems were addressed in disaster plans but also needed to be incorporated into disaster drills.

There were also long delays in the deployment of medical supplies and pharmaceuticals (Franco et al., 2006) even though disaster planning should include provisions for stockpiling anticipated supplies and drugs (Farmer, 2006). They also lacked a coordinated system to recruit, deploy, and manage physician and nursing volunteers (Franco et al., 2006) and, as a result, a plan for emergency credentialing of healthcare personnel is now a required component of disaster planning (Farmer, 2006).

Hurricane Katrina was a catastrophic event (Quarantelli, 2006) that represented the most destructive natural disaster in U.S. history (White House, 2006). Rodriguez and Aguirre (2006) summarized the overall strategies for disaster preparedness based on the lessons learned from Hurricane Katrina when they underscored that disaster planning and management strategies must consider how medical and healthcare facilities will maintain their operations and functionality in the absence of essential services and during the disruption of interorganizational systems. Rodriguez and Aguirre further reinforced that
strategies must be developed and set in place for the effective and immediate evacuation of patients, particularly those with severe or chronic diseases and injuries. It appears that all eight elements of the AHRQ framework could be assessed as ineffective with Hurricane Katrina. Deficiencies were identified in administration and planning; surge capacity; education and training; surveillance; staffing and support; isolation and decontamination; communication and notification; and supplies, pharmaceuticals, and laboratory support.

Review of Studies

Previous research studies and real-life case studies in disaster preparedness appear to indicate that most hospitals have disaster preparedness plans and there are regular drills. Although plans are an important element in overall preparedness (Tierney et al., 2001), being prepared is distinct from the development of a written plan (Dynes, Quarantelli, & Kreps, 1981). Thus, to varying degrees in these studies, although written disaster plans existed, the hospitals were not fully ready for the disasters due to insufficient preparedness. Additionally, it appears that drills were conducted, but there was a failure to thoroughly test the processes to include off-shift drills and evacuation.

Compared to the AHRQ framework, these research and case studies reveal other key areas of gaps as well. Some of the gaps include communication systems and backup plans for water and utilities; stockpiles of supplies and drugs, including prophylactic and therapeutic counter measures; availability of laboratory services; adequacy of isolation facilities and respirators; optimal surge capacity; adequacy of the healthcare human resources; and disease surveillance. It should also be noted that most of these cases are
from large, urban hospitals, and so it is surmised that rural hospitals may be even more
challenged due to the further limitations in resources.

Perceptions of Risk

In addition to enhancing preparedness through learning from previous research
and case studies, the perception of risk of an event may impact preparedness. Risk
perception refers to the subjective assessment of the probability of a specified type of
accident happening and how concerned an individual is with the consequences. It
includes evaluations of the probability, as well as the consequences of a negative outcome
(Sjoberg, Moen, & Rundmo, 2004).

The concept of risk perception has long played a central role in explaining why
people respond the way they do to disaster risks and warnings, just as it may help explain
preparedness actions taken before disaster strikes (Tierney et al., 2001). Heightened
perception of risk stems from the personal belief that a hazardous event is likely to occur
and that the event will have adverse consequences (Williams & Magsumbol, 2007). Risk
perception is considered fundamental for the behavior toward risks of any kind (Plapp &
Werner, 2006) and some studies have found correlations between an individual’s risk
perception and preparedness (Lindell & Perry, 2000).

The literature does, however, contain some contradictory findings. Jackson (1977,
1981) found that expectations about future earthquake losses did not predict the adoption
of preparedness measures, and Lindell and Prater (2000) also found no evidence of a
relationship between risk perception and preparedness. While these studies attempt to
refute a relationship between risk perception and preparedness, it should be noted that the
studies are at the individual level, specific to earthquakes and in a limited geographical area. Conversely in other studies related to earthquakes, Drabek (1986) concluded that the greater the frequency that communities experience disasters, the more extensive their planning and preparation will be, and other studies suggest that seismic emergency preparedness is directly related to experience with earthquake events (Dooley, Catalano, Mishra, & Serxner, 1992; Lindell & Perry, 2000; Russell, Goltz, & Bourque, 1995).

One study of risk perception was identified in healthcare but within public health and specific to bioterrorism. This study of public health professionals' bioterrorism risk perception was conducted in October 2000 and repeated in November 2001 (n = 3,074 public health departments). Compared to the 2000 survey, the 2001 survey suggested that the perceived risk of a bioterrorism attack in the U.S. increased dramatically after September 11, 2001 (Shadel et al., 2004). Of particular note in this national study is that the public health professionals from rural communities reported that they felt it was unlikely that a bioterrorist event would occur in their communities (Barnett et al., 2005). This is consistent with the perspective of the Michigan Rural Health Association (2003) and Aako (2004) in their similar finding that rural health care providers express complacency about terrorism due to a perceived lower threat than their urban counterparts.

Previous experience is also a factor in risk perception (Tierney et al., 2001), and experience through many previous hurricanes without devastating results may have contributed to the low perception of risk identified by individuals (Eisenman, Cordasco, Asch, Golden, & Glik, 2007) and hospitals (Rodriguez & Aguirre, 2006) with Hurricane Katrina. Conversely, Tierney et al. (2001) suggested that prior experience may engender
higher levels of preparedness as threats are taken more seriously and necessary activities are carried out more effectively in subsequent crises. Aguirre, Dynes, Kendra, and Connell (2005) further suggested that the activation of the disaster plan in hospitals is the result of the hospital staff's perception of the actual and/or potential disaster. Overall, it appears that there may be a positive association between risk perception and disaster preparedness in hospitals.

Bradbury (1989) stated that common sense dictates that the greater the perceived risk, the more likely preparation will be made to ameliorate the harm. In conjunction with perception of risk, funding needs to also be available for preparedness efforts (Maldin et al., 2007). Inadequate funding may lead to inadequate preparedness, regardless of risk perception. Therefore, risk perception needs to be examined alone, in addition to examining the combined effect of risk perception with funding.

HRSA Funding

Following the events of September 11, 2001, Congress passed the Public Health Security and Bioterrorism Preparedness and Response Act of 2002 (GAO, 2007). A critical component of this legislation was the National Bioterrorism Hospital Preparedness Program (NBHPP), which was administered by the Health Resources and Services Administration until December 2006, at which time it was moved under the Office of the Secretary for Health and Human Services (HHS) (Maldin et al., 2007). This program provides funding to ready hospitals and other health care systems to deliver coordinated and effective care to victims of terrorism and other public health emergencies (GAO) in meeting its vision of providing immediate and effective healthcare through a
well-trained and equipped workforce to minimize morbidity and mortality in the event of a terrorist attack or other public health emergency (HRSA, n.d.).

The NBHPP began issuing formula grants in 2002 to most states (HRSA, n.d.) and four metropolitan areas including New York City, Chicago, Washington D.C., and Los Angeles (Maldin et al., 2007) in order to enhance and support healthcare preparedness. Maldin et al. further clarified that, originally, the monies were specifically directed toward bioterrorism preparedness, but since 2003, the priorities have expanded to include preparedness and response plans for infectious disease emergencies, as well as chemical, radiological, nuclear, and explosive incidents and coastal storm planning. The priorities appear to incorporate the elements of administration and planning, and isolation and decontamination.

According to HRSA (n.d.), the funding has contributed to enhanced preparedness with the following improvements cited within the Fiscal Year 2005 funding applications: 94% of jurisdictions have at least one negative pressure isolation room; 87% have personal protective equipment; 97% have portable or fixed decontamination systems; and 81% have access to pharmaceuticals for emergency first responders, their families, and for the general community. It appears that each of these areas represents an improvement in preparedness over a several year time span.

Rubin (2004) identified obstacles in preparedness efforts, regardless of funding. He cited issues of staff and equipment shortages, and lack of surge capacity, coupled with limited funding. Maldin et al. (2007) is also not as encouraged about the progress associated with NBHPP funding. They conducted a qualitative study in 13 states over a 12-week period between June and August 2006. This study revealed that although people...
expressed appreciation for the NBHPP funding, there is no template for developing and operating regional hospital coordination, and limited guidance or literature exists on how communities can develop and sustain these critical partnerships (Maldin et al., 2007).

Although there are some challenges, Rubin (2004) further states that the current cycle of HRSA preparedness funding is an important step in the right direction but that it needs to evolve into a secure funding stream and be tied to measurable, sustainable improvements in preparedness to include equipment, planning, initial training, refresher training and exercises. Overall, funding may be positively associated with disaster preparedness, especially in the areas of administration and planning, and isolation and decontamination.

**Other Variables**

Three other variables were used in this study: geographic identifiers, system affiliation, and Joint Commission accreditation.

*Geographic Identifiers*

The U.S. Census Bureau (2000a) has grouped the 50 states in the country into nine divisions: New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, Pacific; and into four regions: Northeast, Midwest, South, and West. Geographic location may be a factor in the likelihood of a natural disaster, whereas the location of a manmade disaster cannot be predicted (IOM, 2006a).
In the U.S., California is more prone to earthquakes (Rubin, 2007), but even though earthquakes are thought of as a West coast phenomenon, the majority of states in the U.S. are at moderate to high risk of earthquakes (IOM, 2006a). Tornadoes are primarily focused in states located in the Midwest, whereas flooding has occurred in every state in the country (IOM, 2006a). Hurricanes are more likely to impact states along the Gulf of Mexico and the Atlantic seaboard (Rubin, 2007). Because the location of a disaster cannot be predicted, it is surmised that geographic location may not be a significant predictor of disaster preparedness and, thus, hospital location by geographic region was utilized only in the descriptive analysis.

*System Affiliation*

A system refers to two or more hospitals owned, leased, sponsored, or contract managed by a central organization (AHA, 2006b). Being part of a system through affiliations and mergers allows hospitals to improve administrative coordination and operational efficiencies (Bogue, Shortell, Sohn, Manheim, Bazzoli, & Chan, 1995) and to achieve cost savings not otherwise considered possible (Bazzoli, LoSasso, Arnould, & Shalowitz, 2002). In 2005, 3,337 (AHA, 2007a) of the nation’s 5,756 (AHA, 2007b) hospitals (58%) were part of a health care system, compared to 54% in 2002 (AHA, 2004, 2007b) and 52% in 1999 (AHA, 2001a, 2007b).

When compared to independent hospitals, system hospitals have enhanced their productivity and efficiency through increased coordination of activities, specialization of personnel and equipment, standardization of manpower staffing, and other procedures based on system-wide experience and increased volume purchase discounts (Levitz &
Brooke, 1985). Therefore, it can be surmised that system hospitals would also have improved disaster preparedness systems and processes.

**Joint Commission Accreditation**

The Joint Commission (formerly known as the Joint Commission on Accreditation of Healthcare Organizations or JCAHO) is an independent organization that develops standards and other performance measures (O'Leary, 2006) to evaluate the patient care quality and safety of nearly 15,000 health care organizations (Joint Commission, n.d.). Of those organizations, Joint Commission accredits 4,288 of a total of 4,704 (91%) acute care hospitals in the U.S., but does not maintain statistics of accreditation by urban acute care hospitals versus rural acute care hospitals; this number is exclusive of any other type of hospital, such as Critical Access Hospitals (J. Cappiello, personal communication, July 27, 2007). Although Joint Commission accreditation is voluntary, being surveyed by an accrediting body as a requirement of Medicare and Medicaid certification is not voluntary (Centers for Medicare and Medicaid Services, n.d.).

Hospitals accredited by the Joint Commission have been required to have—and exercise—emergency preparedness plans for many years (Rubin, 2004). In January, 2001, with anticipated future terrorist attacks, Joint Commission introduced new emergency management standards building on its long-standing disaster preparedness requirement (JCAHO, 2001). The revised standards also require hospitals to test their emergency management plans twice a year, including at least one community-wide practice drill to assess communications, coordination, and the effectiveness of command structures.
Either actual emergencies or planned drills are acceptable, and they are to be conducted at least 4 months and no more than 8 months apart (Hsu et al., 2004). With the Joint Commission’s emphasis on disaster management in its accreditation standards, it may follow that accredited hospitals are more prepared for a disaster.

Rural Hospitals

The unit of study for this research is rural acute care, non-Critical Access, hospitals. According to Coburn, MacKinney, McBride, Mueller, Slifkin, and Wakefield (2007), there is no universally preferred definition of rural that serves all policy purposes. The U.S. Census Bureau (2000b) defines rural as those territories, populations, and housing units not classified as urban, whereas the U.S. Office of Management and Budget (OMB) defines rural as a nonmetropolitan statistical area (non-MSA) (OMB, 2006) (see definitions of terms in Appendix A). For the purposes of this study, the OMB definition of rural as a non-MSA, with micropolitan areas and noncore counties, has been adopted (L. Engineer, personal communication, May 23, 2007).

A rural hospital, therefore, is generally a small facility that is located within a nonmetropolitan statistical area (Joint Committee on Administrative Rules, 2004). Moscovice (2003) added that the 1990s were a period of significant change and substantial challenge for rural hospitals in the United States. Legislation passed during the last half of this decade to include the Balanced Budget Act of 1997 (BBA), the Balanced Budget Refinement Act of 1999 (BBRA), and other legislation and regulation significantly changed Medicare and Medicaid reimbursement to hospitals for their services. Rural hospitals also experienced increased competition from managed care
organizations, demographic shifts with important implications for patient volume and mix of services, continued technological advancements and changes in medical practice (Moscovice, 2003).

Rural hospitals have faced these challenges with various strategies; among the more dramatic is the rapid increase in participation in the Critical Access Hospital (CAH) program, a hospital category that provides cost-based inpatient and outpatient reimbursement from Medicare (Moscovice, 2003). To qualify as a CAH, a hospital has to be at least 15 miles by secondary road and 35 miles by primary road from the next nearest hospital or be declared a “necessary provider” by the state—an option that effectively allows for a waiver of the distance requirement (L. Morlock, personal communication, June 18, 2007). The CAH program has grown rapidly from a few hospital conversions in 1997 to 1,288 CAHs as of June 2006 (Flex Monitoring Team, 2006); however, CAHs were excluded from this research as they are being studied by many others, whereas other rural hospitals are included in few studies (L. Morlock, personal communication, June 18, 2007).

Because of their potentially small size and remote locations, rural hospitals face a number of challenges that could directly impact their disaster preparedness. Even where health care facilities exist, rural emergency rooms tend to be staffed by a single physician that may limit capacity, and issues related to surge capacity can be particularly difficult due to space and staffing constraints (Campbell et al., 2004). Campbell et al. further identify a shortage of health care providers throughout rural U.S., although other studies identify health care personnel shortages across all urban and rural geographic areas

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The issue of surveillance capacity is also particularly challenging for rural areas as it would be difficult for these facilities to identify an unexpected increase in cases prior to a large outbreak because the number of affected individuals initially would likely be small (University of Pittsburgh Center for Rural Health Practice, 2004). According to the Institute of Medicine (2006b), although fewer individuals may be exposed to a disaster in a rural area compared to an urban area, mass disasters are relative depending on the size of the local population and capacity of the hospital. They further provide an example that the demand for health and hospital care by 200 people could overwhelm a 20-bed facility, whereas it may only minimally challenge a large, urban facility.

Rural facilities also tend to be limited in medical supplies such as ventilators, and auxiliary power sources (Gursky, 2004). Compounding all of these concerns is the simple reality that rural areas have less access to technology and training resources (University of Pittsburgh Center for Rural Health Practice, 2004) and communication systems may be unreliable because of geography and terrain (Gursky, 2004). Because of these differences in rural hospitals versus urban hospitals and the fewer studies of rural hospitals, it reinforces that there may be greater benefit in exploring rural hospital preparedness separate from urban hospitals.

Perspectives of Hospital CEOs

The Joint Commission requires that senior leadership collaborate in planning, designing, implementing, and improving the emergency management plan (JCAHO,
Hospital Chief Executive Officers (CEO) are also under more pressure than ever to make sure their hospitals participate in preparedness efforts (Beranek, 2007) as strong administrative leadership has been found to be a determinant of effective preparedness (Lurie, Wasserman, & Nelson, 2006). Lurie et al. further identified that the hospital leader is important in facilitating organizational change, motivating staff, developing relationships with key community groups and other constituencies, and training staff to assume other backup roles in the event of a disaster.

In a study conducted by Mick et al. (1993), they suggest that rural hospital administrators may play a key role in strategic management and, thus, must adapt their structure and behavior to changing environmental circumstances; this appears that it could be applied to disaster preparedness as well. Mick et al. further identified that individual changes often necessitate rearrangement of the hospital’s structure as well and this may be consistent with potential rearrangements in the event of a disaster. Because the role of healthcare leadership is to lead strategic management initiatives (Mick et al., 1993), it would hold that one of the goals of leadership is, therefore, to lead preparedness initiatives and interact with the public (Thompson & Van Gorder, 2007).

The American College of Health Care Executives (ACHE), an international professional society of more than 30,000 healthcare executives who lead hospitals, healthcare systems, and other healthcare organizations (ACHE, n.d.), released a public policy statement for their members in 2006 on the healthcare executive’s role in emergency preparedness (ACHE, 2007). In the statement, ACHE stresses that healthcare executives should actively participate in, and lead, disaster planning and preparedness activities. They further encourage healthcare executives to pursue the following actions...
on an ongoing basis: (a) establish a process to understand and stay current regarding applicable national standards for emergency preparedness; (b) adopt an all-hazards framework to analyze the operational issues that would arise in relevant emergency situations; (C) coordinate and integrate organizational resources to address a full spectrum of actions (mitigation, preparedness, response and recovery), and ensure that the organization has the appropriate programs, trained and credentialed staff, supplies, and equipment in place to quickly respond to events that their organization might face; (d) ensure active involvement in interagency planning efforts with all relevant organizations; (e) develop policies and processes to ensure that all reasonable efforts are made to protect employees, patients, and families while maintaining quality patient care to the best of the organization’s ability during a crisis; (f) ensure that services are provided equitably and impartially, including supporting the development of mental health response plans for patients, families, employees, and their families; and (g) adopt an incident command system and support the integration of a nationwide standardized approach to incident management and response (ACHE, 2007). Additionally, they identify that healthcare executives should be active leaders in planning for all-hazards events that they may face. It is believed that hospitals are better prepared for disasters when their healthcare leaders choose a path of awareness and actively prepare for disasters (McGlown, 2004).

Basis for Secondary Analysis of Research Data

This research is based on secondary analysis of survey data from the Preparedness Module of the National Study of Rural Hospitals, conducted by Johns Hopkins Bloomberg School of Public Health (JHSPH) (AHRQ, n.d.). Secondary analysis is further
exploration of information that has already been obtained (Stewart & Kamins, 1993),
with the primary advantage of its potential for resource savings (Kiecolt & Nathan, 1985).

Surveys provide a highly viable and excellent source of data before, during, and
after disasters (Stallings, 2002). A survey can be of major importance to both descriptive
and exploratory research methods (Gill & Johnson, 1997) and is an effective system for
collecting information from people or about people to describe, compare, or explain their
knowledge, attitudes, and behaviors (Fink, 2003b). It also provides the means for
exploring why certain factors exist and helps to describe characteristics of the population
under investigation (Fink, 2003c).

Data can be gathered in a number of ways, with one being through a self-
administered mail survey. Bourque and Fielder (2003a) identified that self-administered
mail surveys allow for wider geographic coverage in a short period of time and are more
convenient to complete for the respondent. However, one of the greatest disadvantages of
using mail surveys is their low response rate, expected at no greater than 20% (Bourque
& Fielder, 2003a).

Following up the mail survey with a telephone interview is an effective means of
gathering further data in a complex survey (Bourque & Fielder, 2003b). The interviewers
should utilize best practice interviewing techniques such as skills at establishing a
comfortable dialogue, use of noncommittal responses, and effective prompting (Bourque
& Fielder, 2003b).

Overall, the survey research process appears to be effective in obtaining relatively
complete data from those respondents who express a willingness to participate.
Therefore, the survey questionnaire provides an effective technique for collecting data
from the Chief Executive Officers across rural hospitals in the United States in an effort to describe and explore issues related to preparedness.

Chapter Summary

This chapter provides a review of the literature. Topics of discussion included disasters, disaster preparedness, critical studies and previous disaster events, and perceptions of risk. Related factors pertaining to HRSA funding and other variables, rural hospitals, the perspective of hospital CEOs, and research based on secondary data analysis were also reviewed.

Any disaster event can have a devastating impact on hospitals, but rural hospitals may have an even greater vulnerability than their urban counterparts. Rural hospitals appear to have less capacity and resources than urban hospitals. Disaster preparedness receives less attention in rural hospitals even though preparedness has been identified as a critical success factor in a disaster event.

Disaster preparedness includes numerous activities to improve readiness when faced with a disaster situation. Previous studies indicate greater success in those areas where preparedness was greatest, such as in administration and planning and infection control measures, but challenges were often identified in such areas as communication and availability of pharmaceuticals.

At least two variables may impact preparedness. Perception of risk may play a factor since there may be more concern of a disaster with the subjective assessment of the probability of such an event, and this perception may lead to increased preparedness. HRSA funding has been provided to hospitals to enhance and support preparedness and,
as a result, disaster preparedness may be positively impacted by HRSA funding. While each variable may independently contribute to preparedness, variables may need to be combined in order to effectively impact preparedness. Therefore, risk perception and HRSA funding need to be examined alone, and in combination. Other variables need to be taken into consideration as well, such as geographic location, system affiliation, and Joint Commission accreditation.

The AHRQ framework was selected to be utilized for this study of rural hospital preparedness. Because of the comprehensive nature of the tool for application to hospital preparedness, it may provide the best fit in examining the data. Therefore, utilizing the AHRQ framework, the survey data have been examined to determine the current state of disaster preparedness in rural hospitals and to examine the association between the variables of risk perception, HRSA funding and disaster preparedness in rural hospitals in the U.S. The next chapter will describe the methodology.
CHAPTER III

METHODOLOGY

This chapter provides the research questions along with the corresponding hypotheses. In addition, it presents the research methodology and procedures utilized in conducting this research. Accordingly, this chapter includes the research methods, historical perspective, design and sample, survey development, research instrumentation and administration, and informed consent considerations. The chapter closes with the identification of the study variables and the plan for data analysis.

Descriptive Research Questions

This study sought to answer three descriptive research questions. Descriptive research questions seek to describe what exists (Trochim, 2001). The questions include:

1. Among rural acute care hospitals in the U.S., what is the perceived risk of disaster events, including natural disasters; mass casualty incidents; manmade disasters including chemical threats, biological threats, radiological threats, nuclear threats, explosive threats; and overall all-hazards?

2. Among rural acute care hospitals in the U.S., what is the amount of funding received from HRSA for preparedness activities?

3. Among rural acute care hospitals in the U.S., what is the status of disaster preparedness in the areas of administration and planning; patient capacity; education and training; communication and notification; staffing and support;
isolation and decontamination; supplies, pharmaceuticals, and laboratory support; and overall preparedness?

Inferential Research Questions and Hypotheses

This study also sought to answer three inferential research questions. Inferential research questions use evidence to explore facets of an issue (Crosby, DiClemente, & Salazar, 2006). The questions include:

1. Among rural acute care hospitals in the U.S., what is the association between risk perception and preparedness?
2. Among rural acute care hospitals in the U.S., what is the association between HRSA funding for preparedness activities and preparedness?
3. Among rural acute care hospitals in the U.S., what is the combined effect of all-hazards risk perception and HRSA funding for preparedness activities and overall preparedness?

In assessing these research questions and comparing them to the literature reviewed, the researcher formulated the following directional hypotheses for the inferential research questions:

Hypothesis 1. There is a positive association between risk perception and preparedness.

Hypothesis 2. There is a positive association between HRSA funding for preparedness activities and preparedness.

Hypothesis 3. There is a positive combined effect of all-hazards risk perception and HRSA funding for preparedness activities and overall preparedness.
Research Methods

This research study had a descriptive and inferential focus and, therefore, sought to describe and explore the current state of disaster preparedness in rural acute care hospitals. Furthermore, this research allowed for the examination of the multiple variables of risk perception, HRSA funding for preparedness, and status of disaster preparedness. Additionally, hypothesis testing was utilized to explore the relationships between these variables and preparedness.

This research was based on secondary analysis of survey data from the Preparedness Module of the National Study of Rural Hospitals, conducted by Johns Hopkins Bloomberg School of Public Health. A survey questionnaire was utilized in this research to gather information directly from the CEOs in rural acute care hospitals in the United States in an effort to describe and explore issues related to preparedness.

Historical Perspective

The National Study of Rural Hospitals was funded by the Agency for Healthcare Research and Quality as *Rural Hospitals: Environment, Strategy and Viability* (R01H011444), beginning in Fiscal Year 2002 (AHRQ, n.d.). The general objectives of this project were to examine the impact of federal policy changes and healthcare market forces on the organizational and management strategies, financial viability, and clinical performance of U.S. rural hospitals (Maine Rural Health Research Center, n.d.). The analysis was based primarily on a study of rural hospitals first surveyed through telephone interviews with hospital CEOs during the late 1980s. CEOs were re-surveyed in 2006-
2007, with adjustments to the survey questionnaire, including the addition of Module F: Hospital Preparedness (L. Morlock, personal communication, February 8, 2007).

Study Design and Sample

A nonexperimental, cross-sectional research design was used that consisted of a mail survey and follow-up interview to explore the current status of disaster risk perception, HRSA funding, and disaster preparedness in rural hospitals in the United States. This study was characterized as a nonexperimental design because variables were measured as they existed without manipulation (Crosby et al., 2006) and it was cross-sectional because it consisted of measurement at one point in time (Creswell, 2003).

There were 1,021 rural hospitals identified in the primary National Study of Rural Hospitals in the late 1980s (B. Clark, personal communication, February 8, 2007), based on a national stratified random sample (AHRQ, n.d.). In applying location within a non-Metropolitan Statistical Area (non-MSA) as inclusion criteria for consideration as a rural acute care hospital and excluding hospitals that had closed, merged, or converted to nonacute care facilities or Critical Access Hospitals, the revised sample size for inclusion in the 2006 CEO interviews was 403 hospitals. The following reasons contributed to exclusions from the original 1,021 rural acute care hospitals: conversion to CAH \((n = 417)\), closure \((n = 95)\), merger \((n = 44)\), area converted to an MSA \((n = 32)\), hospitals converted to a nonacute care facility \((n = 17)\), and hospitals were both in an MSA and converted to a CAH \((n = 13)\).

Thus, the sample size for the CEO survey in 2006 was 403 rural acute care hospitals. These rural facilities were further verified as acute care hospitals (L. Engineer,
personal communication, December 20, 2006), utilizing the AHA Guide (AHA, 2006a), an annual directory of hospitals released by the American Hospital Association. The responses were from 134 of 403 hospitals, for a response rate of 33%.

Survey Development

The preparedness survey module was developed by the principal investigator and the co-investigators of the National Study of Rural Hospitals during the time frame of Fall 2004 through Spring 2006 (L. Engineer, personal communication, December 5, 2006). Questions in this module were developed based on reoccurring concepts and variables identified in the literature and many of the survey questions were adapted from a combination of other previous surveys (see Appendix B). Gaps in previous surveys were identified, such as the absence of questions regarding risk perception and funding sources, and were, therefore, developed and incorporated into the survey. In developing the preparedness module, the investigators also attempted to expand specific elements, such as surge capacity, from previous surveys and create a unique survey tool that was specific to rural hospitals (L. Engineer, personal communication, February 9, 2007).

The senior scientist of the research team assisted with the development of the survey tool by designing some of the questions and refining the wording and format. She assessed for content validity and also conducted the training for the administration of the surveys to assure interrater reliability between the two interviewers (A. Skinner, personal communication, February 8, 2007).
Research Instrumentation

A comprehensive survey questionnaire was utilized to explore characteristics of rural hospitals. There were nine modules contained in the complete National Study of Rural Hospitals. These modules included:

- Module A: General Questions
- Module B: Hospital Services
- Module C: Hospital Financial Experience and Impact of Legislation
- Module D: Hospital Professionals and Workforce
- Module E: Information Technology
- Module F: Hospital Preparedness
- Module G: CEO Characteristics
- Module H: Quality and Safety Module
- Module I: Nursing Module

This research study was limited to two of the modules with only two questions from Module A: General Questions. These questions included:

10. Is your hospital a member of a health care system?
16. Is your hospital accredited by the JCAHO?

Module F: Hospital Preparedness was the primary survey module used for this study. This module contained a total of 30 questions with open- and closed-ended questions. Nearly 80% of the questions were nominal response format. The module sought answers pertaining to risk perception, funding, and preparedness of rural acute care hospitals in the U.S.
Survey Administration

Data were gathered from rural, acute care hospital CEOs for the National Study of Rural Hospitals through a self-administered mail survey, followed by a telephone interview to review the responses. A pilot study was initially conducted of nearly 3% of the total population to be surveyed (L. Engineer, personal communication, February 9, 2007). A cover letter with the nine modules was sent out to CEOs at rural acute care hospitals \((n = 11)\) in the U.S. The response rate was 82%. Completion of the pilot study resulted in slight modifications to the survey tool.

A cover letter was then constructed and sent with the survey modules to the CEOs of the remaining rural acute care hospitals \((n = 392)\) in the sample population. This cover letter provided an outline of the significance of the research and the knowledge to be derived from the results (see Appendix C).

One of the two co-investigators then conducted a telephone follow-up within only a few days of anticipated receipt of the modules to arrange an appointment with the CEO for a telephone interview. Interviews were scheduled in consideration of adequacy of time to complete the review and completion of the modules, and according to the availability of the CEO. One hour interviews were scheduled and conducted from August through December 2006. In an attempt to increase the response rate, follow-up letters were sent, the deadline for the interviews was extended through February 2007, and in 52 of the 134 responses (39%), completed mail surveys were accepted in the absence of a telephone interview (L. Engineer, personal communication, February 8, 2007).
The scheduled telephone interviews were conducted by one of the two co-investigators. As discussed in Chapter II, the interviewers utilized best practice interviewing techniques, including establishing a comfortable dialogue, use of noncommittal responses, and effective prompting as reinforced in their training (A. Skinner, personal communication, February 8, 2007). The interviews were scheduled to be completed within 1 hour. A follow-up letter was then sent out to the CEO respondents to thank them for their contributions (see Appendix D).

Informed Consent Procedures

Because human subjects were not involved, Human Subjects Institutional Review Board’s (HSIRB) authorization was not necessary for this secondary research. A letter was received from the HSIRB of Western Michigan University on October 10, 2006, that stated, in part: “approval is not required to conduct this project because the study is of hospital systems and not gathering information about individuals” (see Appendix E).

JHSPH had secured written informed consent for the National Study of Rural Hospitals and has been complying in full with their IRB requirements. Thus, confidential information, such as names of hospitals, has not been released to this researcher.

Variable Definitions

This study utilized several different variables for analysis of preparedness in rural acute care hospitals. The variables were grouped according to independent variables (risk perception, HRSA funding), dependent variable (preparedness), and potential confounding variables (system affiliation, Joint Commission accreditation).
Independent Variables

The independent variable is hypothesized to cause or influence the dependent variable (Polit & Hungler, 1991). In this study, risk perception and HRSA funding were the independent variables that were hypothesized to influence the dependent variable of preparedness.

Risk Perception

For this study, risk perception referred to the perception of the probability of a specified type of accident happening according to the self-assessment of hospital CEOs in rural acute care hospitals in the U.S. As defined in Chapter II, seven disaster events were included in this study: natural disasters (ND); mass casualty incidents or vehicular accidents (VA); and manmade disasters (MD) related to chemical threats (CT), biological threats (BT), radiological threats (RT), nuclear threats (NT), and explosive threats (ET). Each event was self-reported as low, moderate, or high risk and coded as a “1,” “2,” or “3,” respectively.

An all-hazards event referred to any, and all, types of risk. Using the seven risk indicators and an inductive approach to the relative importance of individual measures, the following weighting system yielded an All-Hazards Measure (AHM), whereby

\[ AHM = 5(ND) + 5(VA) + 1(CT + BT + RT + NT + ET) \]

Subcategories of MD, including “CT,” “BT,” “RT,” “NT,” and “ET,” were grouped together because manmade events can be thought of as the combination of chemical threats, biological threats, radiological threats, nuclear threats, and explosive threats.
threats. The remaining events were left independent. The weighting decision was based on a very broad basis, using a factor of 5 to represent the equal importance of natural disasters, manmade disasters, and vehicular accidents. The range of possible responses was from 15 to 45, with 15-25 representing low risk, 26-35 as moderate risk, and 36-45 as high perception of risk, coded as a “1,” “2,” and “3,” respectively. The categorical measure was based on low AHM (< 30) and high AHM (≥ 30). These measures were selected based on the midpoint of possible responses for perception of risk.

**HRSA Funding**

HRSA funding was defined as a continuous and categorical measure. The continuous measure was the amount of funding in whole dollars. The categorical measure was based on low HRSA funding (< $77,670) and high HRSA funding (≥ $77,670). The cut off points of the categorical measures were selected based on the mean HRSA funding received of $77,670.

**Risk Perception/HRSA Funding**

A new indicator was developed that combined AHM and HRSA funding. AHM was coded as low AHM (< 30) and high AHM (≥ 30). HRSA funding was coded as low HRSA (< $77,670) or high HRSA (≥ $77,670). The four values were low AHM/low HRSA, coded as a “1”; low AHM/high HRSA, coded as a “2”; high AHM/low HRSA, coded as a “3”; and high AHM/high HRSA, coded as a “4.”
Dependent Variable

The dependent variable is the outcome variable of interest (Polit & Hungler, 1991) and the one hypothesized to be affected by the independent variable (Sullivan, 2001). In this study, preparedness was the dependent variable that was hypothesized to be affected by risk perception and HRSA funding.

Preparedness

The AHRQ framework discussed in Chapter II includes eight subcategories of preparedness. The secondary data utilized for this study has no questions specific to surveillance; thus, there were only seven subcategories of preparedness for this study. There were 42 indicators within the seven subcategories of preparedness (see Appendix F). Each indicator was a nominal variable with a yes/no scale based on the self-reported responses. Each “no” response was coded as a “0” and each “yes” response was coded as a “1.” Five indicators (surge capacity for burn/trauma units, plan addresses increasing bed availability, receive patients through National Disaster Medical System, how many drills have been conducted, plan is revised as a result of drills) were deleted from the study due to too small of a sample size for the indicator or because of missing data of greater than 10% and, therefore, the revised number of variables for preparedness equaled 37.

The responses of each indicator were added to establish a total subscore for each subcategory; therefore, the possible range of responses for each were administration and planning (AP), 0 to 20; surge capacity (SC), 0 to 3; education and training (ET), 0 to 2; communication and notification (CN), 0 to 4; staffing and support (SS), 0 to 1; isolation
and decontamination (ID), 0 to 3; and supplies, pharmaceuticals, and laboratory support (SP), 0 to 4.

The total for each subcategory was then divided by the number of hospitals and the number of indicators for the respective subcategory to determine a score for each subcategory with a range of 0 to 1. Each subcategory was viewed as equal in importance as, ideally, it was believed that all elements need to be effective in order to reflect optimal preparedness. Collectively, the model for preparedness (with the number of indicators per subcategory) can be depicted (see Figure 2).

Subcategories:

- **AP** = Administration and Planning
- **SC** = Surge Capacity
- **ID** = Isolation and Decontamination
- **ET** = Education and Training
- **CN** = Communication and Notification
- **SP** = Supplies, Pharmaceuticals, and Laboratory Support

*Figure 2. Model of Disaster Preparedness*
Using the seven preparedness subcategories and recognizing the equality of each, an Overall Preparedness Measure (OPM) was formulated, whereby

\[
OPM = \frac{(AP + SC + ET + CN + SS + ID + SP)}{7}
\]

The range of responses for the preparedness measures was from 0.0 (not prepared) to 1.0 (optimally prepared) with \( \leq 0.65 \) representing low preparedness, 0.66 to 0.85 as moderate preparedness, and \( > 0.85 \) as high preparedness, based on the midpoint of expected responses for overall preparedness, plus and minus 0.1 (Sullivan, 2001) and coded as a “1,” “2,” and “3,” respectively. The categorical measure was based on low OPM (< 0.75) and high OPM (\( \geq 0.75 \)) and was also selected based on the midpoint of expected responses for overall preparedness.

**Potential Confounding Variables**

A confounding variable is one that is associated with the predictor variable and is independently associated with the outcome variable; it can be an alternative explanation to cause-effect (Hulley, Cummings, Browner, Grady, Heart, & Newman, 2001). As discussed in Chapter II, there were two potentially confounding variables examined in this study.

**System Affiliation**

System affiliation referred to whether a hospital in the study population is part of a health care system, as opposed to an independent hospital. This is a dichotomous variable with a yes/no scale. Each “no” response was coded as a “0,” whereas each “yes” response was coded as a “1.”
Joint Commission Accreditation

This accreditation is recognized nationwide as a symbol of quality that reflects an organization’s commitment to meeting certain performance standards and for this study, the standards of interest pertained to disaster preparedness. This is a dichotomous variable with a yes/no scale. Each “no” response was coded as a “0,” whereas each “yes” response was coded as a “1.”

Data Analysis

The Statistical Package for the Social Sciences (SPSS, Inc., version 15.0, Chicago, IL) was used for all analyses. Secondary analysis was conducted on the dataset from JHSPH.

Power

Power can be defined as the ability of a test to detect an effect, given that the effect actually exists (Field, 2005) and a power analysis can be defined as a procedure for estimating the sample size requirements (Polit & Hungler, 1991). A statistical power analysis takes into consideration: (a) significance level, (b) power to detect an effect, (c) effect size, (d) variation in the response variable, and (e) sample size (High, 2000).

It was expected that the variables would be moderately associated in this study based on the literature review with an effect size of 0.3 (Polit & Hungler, 1991). Given the effect size, a significance level of 0.5, and a power of 0.8 (High, 2000), the sample size was computed using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007). The results
indicated that the sample size needed to be 111 cases, less than the 134 cases in this study, thus an adequate sample size with a power of 0.8 was obtained.

Data Management

Standard coding methods were utilized to prepare the dataset for statistical analysis and are described below. The methods for handling missing data and outliers were also determined.

Coding

Coding refers to the process of transforming raw data into a standardized form for data processing and analysis (Polit & Hungler, 1991). For this study, a fully numerical coding scheme was developed. The original codebook was completed by the research team at JHSPH (B. Clark, personal communication, February 8, 2007) and then an adjusted codebook was created by this researcher.

Twenty-seven of the 42 preparedness indicators selected for this study were originally coded as “0” for “no” and “1” for “yes.” This part of the coding schema was retained.

Seven of the 42 indicators were originally coded as “0” for “no,” “1” for “no, but currently in planning,” and “2” for “yes.” Because this study measured what was currently in place at the time of the survey and because it was unknown where an indicator may be in the planning cycle, the coding was altered for this study to “0” for “no” or “no, but currently in planning,” and “1” for “yes.”

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Six of the 42 preparedness indicators originally had four codes represented as "0" for "no," "1" for "no, but currently in planning," "2" for "no, but other arrangements," and "3" for "yes." As above, the coding was altered for this study to "0" for "no" or "no, but currently in planning." Additionally, the intent was to determine whether an indicator was being addressed, either directly through the hospital or through an arrangement with another entity and therefore for this study, "1" was recoded to reflect "no, but other arrangements" and "yes."

**Missing Data**

Prior to examining the data for the amount and distribution of missing values, the nonresponse category of "don't know" was considered noninformation and was recoded to missing (Munro, 2005). The data were then examined and for those nominal variables with fewer than 10% missing data and randomly missed data (Munro, 2005), the expectation maximization (EM) method was utilized. EM is an iterative process that proceeds in two discreet steps: (a) the conditional expected value of the variable is computed, and then (b) these expected values are substituted for the missing data and maximum likelihood estimation is computed as though there were no missing data (Tabachnick & Fidell, 2007). For the 4% of missing data for the continuous variable of the amount of HRSA funding, the mean replacement method was utilized whereby the mean of the normal distribution was substituted for the missing value (Munro, 2005).

Five of the variables had greater than 10% missing data: the hospital is designated to receive patients through the National Disaster Medical System (45% missing); the disaster plan addresses increasing bed availability (18% missing); the number of drills in
the past 5 years (10% missing); and the plan is revised as a result of the drills (10% missing). Surge capacity for burn/trauma units was also excluded because of 96% missing data, but it should be noted that only five hospitals (4%) have burn/trauma units and, therefore, this variable was excluded due to the small sample and not strictly the missing data. These five variables were deleted from the dataset due to exceeding a predetermined 10% cutoff (Munro, 2005) and, therefore, the adjusted number of preparedness indicators was reduced to 37.

Outliers

Outliers are values that are extreme relative to the bulk of scores in the dataset (Munro, 2005) and appear to be inconsistent with the rest of the dataset (Fink, 2003a). The source of an outlier may be the result of data entry mistakes, coding problems, or reporting errors (Polit & Hungler, 1991), or it may be an actual extreme value from an unusual subject (Munro, 2005).

All variables were examined for possible outliers and the minimum and maximum values, means, and standard deviations of the variables were inspected for plausibility (Tabachnick & Fidell, 2007). On further examination, the data were normally distributed and, although there are some extremes, the data appeared to be valid. As a result, no adjustments were made to account for potential outliers.

Descriptive Analyses

Univariate and bivariate descriptive analyses were conducted on the first three research questions pertaining to the current state of preparedness, risk perception, and
HRSA funding. Descriptive statistics, used to summarize or describe data (Trochim, 2001), were first computed for all study variables. These include frequency counts and percentages for all categorical variables of risk perception and preparedness, and measures of central tendency (means, medians, modes) and dispersion (standard deviations) for the continuous variable of HRSA funding (Stockburger, 2001).

Stratification, as an analysis strategy, was utilized for controlling the influence of the potential confounding variables of system affiliation and Joint Commission accreditation. Stratification ensures that only cases with similar levels of a potential confounding variable are compared (Hulley et al., 2001). Hulley et al. further identify that stratification involves segregating the subjects into strata (subgroups) according to the level of the potential confounder and then examining the relation between the predictor and the outcome variables separately in each strata.

Inferential Analyses

Binary Logistic Regression

Multivariable binary logistic regression was used to predict a categorical variable from a set of predictor variables (Wuensch, 2006) and, in this study, regression analyses tested for associations between the All Hazards Measure (AHM) and all eight of the preparedness measures, and between HRSA funding and preparedness. Regression methods were used to find the “best fit” between the continuous and categorical independent variables and the categorical dependent variable (Field, 2005) and, according
to Wuensch (2006), logistic regression is the preferred data analytic tool of choice when
the equation to be estimated has a dichotomous dependent variable.

The forced entry method was used to build models using binary logistic regression
for the independent variables of risk perception and HRSA funding, as well as system
affiliation and Joint Commission accreditation. Forced entry is a method in which all
predictors are forced into the model simultaneously (Field, 2005). The forced entry
method took all the independent variables and built models to determine how well they
could predict those variables that would be the best indicators of preparedness. A “yes”
for preparedness was coded as the predicted outcome (Chan, 2004). Reference groups
were set at the lowest coded category (Chan) of low risk perception, low HRSA funding,
no system affiliation, and no Joint Commission accreditation.

The values from the Omnibus Tests of Model Coefficients tested whether or not
the variables entered in the model had a significant effect and chi-square values were
provided. The Cox and Snell $R^2$-Square and Nagelkerke $R^2$-Square indicated the percent of
the variation in the outcome variable that could be explained by the logistic model.

To test the hypotheses concerning the relationships between the variables using
the binary logistic regression procedure, the level of significance was set at alpha equal to
0.05. In situations where the level of significance was less than 0.05, the research
hypothesis was supported and the conclusion was stated that there was a significant
relationship between the variables in the sample.

Logistic regression is sensitive to multicollinearity (Tabachnick & Fidell, 2007),
defined as the interrelatedness of the independent variables (Munro, 2005). To screen for
multicollinearity, the magnitude of the standard error (SE) of each variable (except the
constant) was inspected to omit those with SE greater than 5.0. A large SE implies that multicollinearity exists and the model is not statistically stable (Chan, 2004).

Chapter Summary

This chapter identified three descriptive research questions pertaining to the current state of disaster preparedness in rural hospitals in the U.S., as well as the perceived risk of disaster events and the amount of HRSA funding for preparedness activities. Three inferential research questions with corresponding hypotheses were also identified. These pertained to the associations between risk perception and preparedness, HRSA funding and preparedness, and the combined risk perception/HRSA funding and preparedness.

This research is based on secondary analysis of survey data from the Preparedness Module of the National Study of Rural Hospitals, conducted by Johns Hopkins Bloomberg School of Public Health. A survey questionnaire was utilized in this research to gather information directly from the CEOs in rural acute care hospitals in the U.S. in an effort to describe and explore issues related to preparedness. This study utilized a nonexperimental, cross-sectional research design.

Several different variables were utilized for analysis of preparedness in rural acute care hospitals, including risk perception, HRSA funding, preparedness, and the potential confounding variables of system affiliation and Joint Commission accreditation. Descriptive analyses were completed to examine univariate/bivariate associations. Multivariable binary logistic regression analyses were also conducted to examine factors...
hypothesized to be associated with preparedness. The next chapter provides the results of the data analyses.
CHAPTER IV
RESULTS

The purpose of this chapter is to share the results of the study, beginning with an overall profile of the sample hospital characteristics. Following the description of the sample characteristics, results are presented according to the research questions and corresponding hypotheses.

Hospital Characteristics

Of the 403 hospitals, 134 responded, for a response rate of 33%. Hospital size varied from 12 licensed acute care beds to 400 beds, with a mean of 87, median of 66, and a mode of 30. It should be noted, however, that the mean and median number of staffed beds, representing the operational capacity, is lower than the respective numbers for licensed beds. The number of staffed beds varied from 10 to 400 beds, with a mean of 65, median of 45, and, again, a mode of 30 (see Figure 3).

The sizes of the Intensive Care Units (ICU) varied widely as well. The licensed and staffed bed capacity of the ICUs varied from zero to 54 beds. The mean of the licensed beds was 8.2, with a median of 6.5 and a mode of 8, whereas the mean number of staffed beds was 7.6, with a median of 6.0 and a mode of 8 (see Figure 4).
Figure 3. Distribution of Hospitals by Number of Licensed and Staffed Beds

Figure 4. Distribution of Hospitals by Number of Licensed and Staffed ICU Beds
Less than 4% of the respondent hospitals had designated burn or trauma beds. Of the five hospitals that did, the licensed bed capacity was equal to the staffed bed capacity and ranged from one bed to 12 beds (see Figure 5).

![Figure 5. Distribution of Hospitals by Number of Licensed and Staffed Burn/Trauma Beds](image_url)

Respondents were from 38 states with the greatest number from Texas with 21 respondent hospitals. The respondents were also from all nine census divisions and all four census regions of the United States. Respondent hospitals by region were: South Region (62 hospitals), Midwest Region (42 hospitals), Northeast Region (16 hospitals), and West Region (14 hospitals) (see Figure 6).
<table>
<thead>
<tr>
<th>State</th>
<th>Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alaska</td>
<td>1</td>
</tr>
<tr>
<td>Louisiana</td>
<td>5</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>2</td>
</tr>
<tr>
<td>Alabama</td>
<td>1</td>
</tr>
<tr>
<td>Maryland</td>
<td>2</td>
</tr>
<tr>
<td>Oregon</td>
<td>1</td>
</tr>
<tr>
<td>Arkansas</td>
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</tr>
<tr>
<td>Maine</td>
<td>1</td>
</tr>
<tr>
<td>Pennsylvania</td>
<td>7</td>
</tr>
<tr>
<td>Arizona</td>
<td>2</td>
</tr>
<tr>
<td>Michigan</td>
<td>12</td>
</tr>
<tr>
<td>S. Carolina</td>
<td>3</td>
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<tr>
<td>California</td>
<td>3</td>
</tr>
<tr>
<td>Minnesota</td>
<td>1</td>
</tr>
<tr>
<td>S. Dakota</td>
<td>2</td>
</tr>
<tr>
<td>Colorado</td>
<td>1</td>
</tr>
<tr>
<td>Missouri</td>
<td>4</td>
</tr>
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<td>Tennessee</td>
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</tr>
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<td>Florida</td>
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</tr>
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<td>Mississippi</td>
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</tr>
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<td>Texas</td>
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</tr>
<tr>
<td>Georgia</td>
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</tr>
<tr>
<td>N. Carolina</td>
<td>2</td>
</tr>
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<td>Utah</td>
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</tr>
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<td>Nebraska</td>
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</tr>
<tr>
<td>Virginia</td>
<td>4</td>
</tr>
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<td>Idaho</td>
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<tr>
<td>N. Hampshire</td>
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</tr>
<tr>
<td>Washington</td>
<td>2</td>
</tr>
<tr>
<td>Illinois</td>
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<td>New Mexico</td>
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<td>Kansas</td>
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</tr>
<tr>
<td>New York</td>
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<tr>
<td>W. Virginia</td>
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</tr>
<tr>
<td>Kentucky</td>
<td>6</td>
</tr>
<tr>
<td>Ohio</td>
<td>5</td>
</tr>
</tbody>
</table>

(U.S. Census Bureau, 2000)

Figure 6: Respondents by State, Division and Region Within the United States

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System Affiliation

Of the respondent hospitals, 32% were affiliated with a health care system. This is below the national average for all acute care hospitals of 58%, as cited in Chapter II; however, those data are available for acute care hospitals of any size and are not differentiated by urban or rural affiliations. Eight reasons were cited for these rural hospitals to stay independent, with the most frequently identified reason reported as a lack of strategic reason for affiliation (66%), followed by the concern about losing the ability to function independently (53%). Six other reasons for not affiliating were reported and 65 hospitals (72%) cited more than one reason for this decision. It should be noted that six of the respondent hospitals (7%) were in the process of seeking affiliation at the time of the data collection (see Table 1).

Table 1

Reasons Cited for Staying Independent and Not Affiliating

<table>
<thead>
<tr>
<th>Reason</th>
<th>Number (%) Hospitals Citing Reason*</th>
</tr>
</thead>
<tbody>
<tr>
<td>No strategic reason for affiliation</td>
<td>59 (66%)</td>
</tr>
<tr>
<td>Concern about losing ability to function independently</td>
<td>48 (53%)</td>
</tr>
<tr>
<td>Unique market condition with no major competitor</td>
<td>24 (27%)</td>
</tr>
<tr>
<td>Neighbors not close by</td>
<td>18 (20%)</td>
</tr>
<tr>
<td>Did not find appropriate partner with similar vision</td>
<td>16 (18%)</td>
</tr>
<tr>
<td>No partner to affiliate with</td>
<td>7 (8%)</td>
</tr>
<tr>
<td>In process of seeking affiliation</td>
<td>6 (7%)</td>
</tr>
<tr>
<td>Neighbors already formed affiliation</td>
<td>4 (3%)</td>
</tr>
</tbody>
</table>

* Responses are not mutually exclusive; responders could choose more than one reason.
Joint Commission Accreditation

Seventy-five percent of the respondent hospitals were accredited by the Joint Commission, compared to the national average of 91% for all acute care hospitals in the U.S., as discussed in Chapter II. It should be noted that the Joint Commission does not retain data on urban versus rural hospitals. Twenty-six of the 33 hospitals (79%) that were not accredited by the Joint Commission reported their primary reason for not pursuing accreditation. The majority (58%) reported cost factors within their primary reason (cost prohibitive, 35%; minimal effect on quality for cost, 15%; no benefit for cost, 4%; cost and administrative burden, 4%), while 23% cited accreditation by Medicare instead of Joint Commission (see Table 2).

Table 2

Reasons Cited for Not Pursuing Accreditation by Joint Commission

<table>
<thead>
<tr>
<th>Primary Reason</th>
<th>Number (%) Hospitals Citing Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost prohibitive</td>
<td>9 (35%)</td>
</tr>
<tr>
<td>Medicare accredited</td>
<td>6 (23%)</td>
</tr>
<tr>
<td>Not effective in quality improvement</td>
<td>5 (19%)</td>
</tr>
<tr>
<td>Minimal effect on quality for cost</td>
<td>4 (15%)</td>
</tr>
<tr>
<td>No benefit for cost</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Cost and administrative burden</td>
<td>1 (4%)</td>
</tr>
<tr>
<td>Total</td>
<td>26 (100%)</td>
</tr>
</tbody>
</table>

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Descriptive Research Questions

Descriptive Research Question 1

Among rural acute care hospitals in the U.S., what is the perceived risk of disaster events, including natural disasters; mass casualty incidents; manmade disasters including chemical threats, biological threats, radiological threats, nuclear threats, explosive threats; and overall all-hazards?

Among rural acute care hospitals in the U.S., the perceived risk of disaster events varied according to the type of disaster (see Figure 7). Natural disasters had the highest perceived risk with 21% reporting high risk, followed closely by vehicular accidents with 20% high risk. However, the margin of error of ± 9.0% indicated no statistically significant difference in perception of risk between vehicular accidents and natural disasters. Only 2% of the respondents identified manmade disasters as high risk. Overall, the perceived risk of manmade events was reported as the lowest risk with 77% of the hospitals reporting a low perception of risk from manmade disasters, followed by 23% low risk for vehicular accidents and 21% for natural disasters.

Manmade disasters were viewed collectively as the combination of chemical threats, biological threats, radiological threats, nuclear threats, and explosive threats. Of these five identified manmade threats, chemical threats were perceived as the highest risk with 6% identified as high risk, whereas radiological threats had no reported high risk. However, with the margin of error of ± 9.0%, this may indicate no statistically significant difference in perception of high risk between the manmade disasters. Radiological threats
Figure 7. Perceived Risk by Type of Disaster

were found to be the lowest threat among the five manmade disasters with 87% of the rural hospital CEOs reporting low perception of radiological threats (see Figure 8).

* All-Hazards Disasters

All-hazards disasters are a combination of natural disasters, vehicular accidents and all manmade disasters (formula described in Chapter III). The All Hazards Measure (AHM) was calculated as:

\[ 5(ND) + 5(VA) + 1(CT + BT + RT + NT + ET) = AHM \]
Figure 8. Perceived Risk by Type of Manmade Disaster

In this study, according to the self-reports of the CEOs, there was an overall high perception of risk in 14% of the hospitals, compared to an overall low perception in 41% and a moderate perception of risk in 45% of the hospitals, with a margin of error of ±9.0% (see Figure 9). Based on this study, the average AHM was:

\[ 5(2) + 5(1.97) + 1(1.50 + 1.19 + 1.13 + 1.22 + 1.23) = 26.12 \]

The AHM of 26.12 was low within the scale of 26 to 35 for moderate risk perception.

Risk perception was also examined by geographic regions. Risk perception of natural disasters was found to be highest in the Midwest (33% high risk), compared to the
Figure 9. Perceived Risk for All-Hazards Disasters

South (18%), West (14%), or the Northeast (6%) (Pearson chi-square, 21.84, $p = 0.00$).

No differences by region were found for vehicular accidents (Pearson chi-square, 3.45, $p = 0.75$), manmade disasters (31.24, $p = 0.07$), or the AHM (6.31, $p = 0.39$).

Also examined was risk perception by system affiliation and Joint Commission accreditation. No differences by system affiliation were found for natural disasters (Pearson chi-square, 1.59, $p = 0.45$), vehicular accidents (1.33, $p = 0.54$), manmade disasters (2.89, $p = 0.89$), or the AHM (4.21, $p = 0.12$). Differences were also not found by Joint Commission accreditation for natural disasters (Pearson chi-square, 4.43, $p = 0.11$), vehicular accidents (1.67, $p = 0.43$), manmade disasters (2.78, $p = 0.84$), or the AHM (1.68, $p = 0.43$).

* Margin of error: ± 9.0%
Summary of Results for Research Question 1

Natural and vehicular disasters were perceived to pose a far greater risk to rural hospitals than the manmade disasters, with natural and vehicular disasters reported as moderate or high risk in 79% and 77%, respectively, of the hospitals compared to 23% for manmade disasters. In examining the five types of disasters within the manmade category, chemical disasters were perceived to pose a moderate or high risk in 48% of the hospitals; conversely, radiological disasters posed a moderate or high threat at only 13% of the hospitals. Overall, a high or moderate perception of risk was reported in 59% of the hospitals. The Midwest had the highest perception of natural disaster risk and the Northeast had the lowest.

Descriptive Research Question 2

Among rural acute care hospitals in the U.S., what is the amount of funding received from HRSA for preparedness activities?

Among rural acute care hospitals in the U.S., the amount of funding received from HRSA for preparedness activities varied widely. Of the 134 respondent hospitals, 119 (89%) received some HRSA funding, while the remaining 11% received no funding from HRSA. Funding received ranged from $0 to $526,555 with a mean of $77,670 and a median of $50,000 (see Figure 10). HRSA funding for the 134 hospitals was also calculated as a categorical variable as discussed in Chapter III as low HRSA funding (< $77,670) and high HRSA funding (≥ $77,670).
HRSA funding was also examined by geographic regions, system affiliation and Joint Commission accreditation (see Table 3). HRSA funding was found to be highest in the Northeast (87.5%), compared to the Midwest (31%), South (32%), or West (36%) (Pearson chi-square, \( p = 0.00 \)). HRSA funding was found to be higher in system affiliated hospitals (51%; \( p = .04 \)) and in Joint Commission accredited hospitals (44%; \( p = .02 \)).

**Summary of Results for Research Question 2**

Eighty-nine percent of the hospitals received some HRSA funding for preparedness activities. The mean funding received was $77,670. The Northeast received the highest percent of high HRSA funding compared to the other three geographic regions. HRSA funding was also greater in system affiliated hospitals and Joint
Table 3

Percent of Low and High HRSA Funding by Geographic Regions, System Affiliation and Joint Commission Accreditation

| HRSA Funding |  
|--------------|--------------------------------------------------|
|              | Low Number (%) | High Number (%) | p*   |
| Regions      |               |                 |      |
| Northeast    | 2 (12.5%)     | 14 (87.5%)      | .00  |
| Midwest      | 29 (69%)      | 13 (31%)        |      |
| South        | 42 (68%)      | 20 (32%)        |      |
| West         | 9 (64%)       | 5 (36%)         |      |
| System Affiliation |       |                 | .04  |
| No           | 61 (68%)      | 29 (32%)        |      |
| Yes          | 21 (49%)      | 22 (51%)        |      |
| Joint Commission Accreditation | | | .02 |
| No           | 26 (79%)      | 7 (21%)         |      |
| Yes          | 55 (56%)      | 43 (44%)        |      |

* Pearson chi-square p-value

Commission accredited hospitals than hospitals without system affiliation or Joint Commission accreditation.

Descriptive Research Question 3

Among rural acute care hospitals in the U.S., what is the status of disaster preparedness in the areas of administration and planning; patient capacity; education
Seven subcategories of preparedness, in addition to overall preparedness, were examined across respondent rural acute care hospitals in the U.S. In this section, the results will be reported for each subcategory before discussing overall preparedness and the summary. As discussed in Chapter III, the possible response for each indicator within a subcategory could only be 0 (not present or not prepared) or 1 (present or prepared). The results were reported by the number of hospitals and percent that were prepared for each specific indicator.

**Administration and Planning**

There were 20 indicators within the administration and planning subcategory of preparedness (see Table 4). The presence of a coordinator/group/committee responsible for overseeing all hazards preparedness efforts was in place at all respondent hospitals. The lowest probability (50%) related to administration and planning preparedness was in the indicator related to a plan to activate decommissioned clinical space. The other 18 indicators had results that ranged from 54% prepared (hospitals have a plan for stockpiling antibiotics) to 98% (hospitals have alternative emergency electrical supply). The overall percent prepared for administration and planning was 80% based on a score of 16.08 out of a possible 20. As identified in Chapter III, a response of 80% indicated moderate preparedness in the subcategory of administration and planning.
### Table 4

**Hospital Preparedness With Indicators of Administration and Planning**

<table>
<thead>
<tr>
<th>Indicator (module question #)</th>
<th># (%) of hospitals</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coordinator/group/committee oversees preparedness (f5)</td>
<td>134 (100%)</td>
<td>95-100%</td>
</tr>
<tr>
<td>Have alternative emergency electric supply (f8)</td>
<td>131 (98%)</td>
<td>95-100%</td>
</tr>
<tr>
<td>Have at least one negative pressure isolation room</td>
<td>129 (96%)</td>
<td>93-99%</td>
</tr>
<tr>
<td>Plan for coordination with local public health officials (f6k)</td>
<td>128 (96%)</td>
<td>92-99%</td>
</tr>
<tr>
<td>Plan for integration in community-wide plan (f6a)</td>
<td>121 (90%)</td>
<td>85-95%</td>
</tr>
<tr>
<td>Cooperative planning with other health care facilities (f6b)</td>
<td>121 (90%)</td>
<td>85-95%</td>
</tr>
<tr>
<td>Plan for evacuation if facility is at risk (f6n)</td>
<td>120 (90%)</td>
<td>84-95%</td>
</tr>
<tr>
<td>Plan for coordination with state public health officials (f6l)</td>
<td>118 (88%)</td>
<td>82-94%</td>
</tr>
<tr>
<td>Plan for cancellation of elective surgeries/admissions (f6e)</td>
<td>118 (88%)</td>
<td>82-94%</td>
</tr>
<tr>
<td>If have alternative electric supply, protected from flooding (f8a)</td>
<td>113 (84%)</td>
<td>78-91%</td>
</tr>
<tr>
<td>Plan for media/PR protocols during all hazards events (f6m)</td>
<td>113 (84%)</td>
<td>77-90%</td>
</tr>
<tr>
<td>Have a formal Incident Command System (ICS) (f7)</td>
<td>113 (84%)</td>
<td>78-90%</td>
</tr>
<tr>
<td>Plan for establishment of alternative care sites (f6d)</td>
<td>105 (78%)</td>
<td>71-85%</td>
</tr>
<tr>
<td>Plan for clinical utilization of non-clinical space (f6h)</td>
<td>103 (77%)</td>
<td>70-84%</td>
</tr>
<tr>
<td>MOU with other hospitals to accept inpatients (f6c)</td>
<td>102 (76%)</td>
<td>69-83%</td>
</tr>
<tr>
<td>Plan for coordinated supply chain management (f6j)</td>
<td>101 (75%)</td>
<td>68-83%</td>
</tr>
<tr>
<td>If have formal ICS, hospital staff trained (f7a)</td>
<td>62 (55%)</td>
<td>38-58%</td>
</tr>
<tr>
<td>Plan for conversion of PACU to augment ICU capacity (f6f)</td>
<td>74 (55%)</td>
<td>47-64%</td>
</tr>
<tr>
<td>Plan for stockpiling antibiotics (f6i)</td>
<td>73 (54%)</td>
<td>46-63%</td>
</tr>
<tr>
<td>Plan for activation of decommissioned clinical space (f6g)</td>
<td>67 (50%)</td>
<td>41-59%</td>
</tr>
<tr>
<td>TOTAL (16.08 of 20 indicators)</td>
<td>(80%)</td>
<td>77-83%</td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals
**Patient/Surge Capacity**

There were three indicators within the subcategory of patient/surge capacity (see Table 5). Of the 134 hospitals, 87 hospitals (65%) reported the ability to increase their general patient capacity by at least 20% within 24 hours. Sixty-six of the 134 hospitals (49%) had ICUs that could increase their capacity by at least 20% in 24 hours. Surge capacity also included an indicator about the hospital’s participation in a regional system to monitor inpatient bed availability and 103 of the 134 hospitals (77%) reported participation. The overall response for surge capacity was 64%, based on a score of 1.91 out of a possible score of 3.0. As identified in Chapter III, a response of 64% represented low preparedness in the subcategory of surge capacity.

Table 5

*Hospital Preparedness With Indicators of Patient/Surge Capacity*

<table>
<thead>
<tr>
<th>Indicator (module question #)</th>
<th># (% of hospitals)</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participate in regional system to monitor bed availability (f15)</td>
<td>103 (77%)</td>
<td>70-84%</td>
</tr>
<tr>
<td>Surge capacity in general acute care (f13b)</td>
<td>87 (65%)</td>
<td>57-73%</td>
</tr>
<tr>
<td>Surge capacity in ICU (f13a)</td>
<td>66 (49%)</td>
<td>41-58%</td>
</tr>
<tr>
<td>TOTAL (1.91 of 3 indicators)</td>
<td>(64%)</td>
<td>58-69%</td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals*
Education and Training

There were two indicators in the subcategory of education and training (see Table 6). According to the respondent hospitals, 122 of 134 hospitals (91%) reported that staff members participated in hospital-wide all-hazards exercises and drills and 118 of 134 rural acute care hospitals (88%) had hospital staffs that were educated on the all-hazards plan. The overall response for education and training was 89%, based on a score of 1.79 out of a possible score of 2.0. As discussed in Chapter III, 89% represented high preparedness for the subcategory of education and training.

Table 6

*Hospital Preparedness With Indicators of Education and Training*

<table>
<thead>
<tr>
<th>Indicator (module question #)</th>
<th># (%) of hospitals</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff members participate in exercises and drills (fl8)</td>
<td>122 (91%)</td>
<td>86-96%</td>
</tr>
<tr>
<td>Hospital staffs are educated on all-hazards plan (fl7)</td>
<td>118 (88%)</td>
<td>82-94%</td>
</tr>
<tr>
<td>TOTAL (1.79 of 2 indicators)</td>
<td>(89%)</td>
<td>85-94%</td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals

Communication and Notification

There were four indicators within the subcategory of communication and notification (see Table 7). In the event that telephones, cell phones, and radios are overloaded, 126 of the 134 hospitals (94%) had backup communications capability. According to the literature review, ham radios are the most effective backup communication medium and 64 of the 126 hospitals (51%) that had backup
communications capability utilized ham radios. The majority (96%) of the respondent rural hospitals had Internet access in the ED and of these 128, 119 of them (92%) had high speed connections. The overall response for communication and notification was 83%, based on a score of 3.3 out of a possible score of 4.0. This represented moderate preparedness in this subcategory.

Table 7

Hospital Preparedness With Indicators of Communication and Notification

<table>
<thead>
<tr>
<th>Indicator (module question #)</th>
<th># (%) of hospitals</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internet access in the ED (f21)</td>
<td>128 (96%)</td>
<td>92-99%</td>
</tr>
<tr>
<td>Backup communications capability (f20)</td>
<td>126 (94%)</td>
<td>90-98%</td>
</tr>
<tr>
<td>Internet access in the ED is high speed (f21a)</td>
<td>119 (92%)</td>
<td>88-97%</td>
</tr>
<tr>
<td>Utilize ham radios for backup communications (f20a)</td>
<td>64 (51%)</td>
<td>42-59%</td>
</tr>
<tr>
<td>TOTAL (3.34 of 4 indicators)</td>
<td>(83%)</td>
<td>78-85%</td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals

**Staffing and Support**

There was only one indicator in the subcategory of staffing and support. It pertained to the availability of policies for advanced registration and credentialing of clinicians needed in the event of a disaster. Eighty-eight of the 134 hospitals (66%) had such policies (see Table 8). The overall response for staffing and support was 66%, based on a score of 0.66 out of a possible 1.0, representing moderate preparedness for this subcategory.
Table 8

Hospital Preparedness With Indicator of Staffing and Support

<table>
<thead>
<tr>
<th>Indicator (module question #)</th>
<th># (%) of hospitals</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced registration and credentialing (f22)</td>
<td>88 (66%)</td>
<td>58-74%</td>
</tr>
<tr>
<td>TOTAL (0.66 of 1 indicator)</td>
<td>88 (66%)</td>
<td>58-74%</td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals

Isolation and Decontamination

There were three indicators within the subcategory of isolation and decontamination (see Table 9). Decontamination was addressed at 119 of 134 hospitals (89%) and 128 of 134 hospitals (96%) had access to decontamination showers. One hundred and seventeen hospitals (87%) reported that they have written respiratory protection programs in compliance with the Occupational Safety and Health Administration (OSHA) standards. The overall response for this subcategory was 91%, based on a score of 2.7 out of a possible 3.0. This represented high preparedness for isolation and decontamination.

Supplies, Pharmaceuticals and Laboratory Support

There were four indicators within this subcategory that pertained to pharmaceuticals and laboratory support but did not address supplies (see Table 10). For laboratory support, 106 of the respondent hospitals (79%) had alternative laboratories identified in the event current laboratories were contaminated or inundated and 78 hospitals (58%) had a specific laboratory support plan for use in a disaster. For pharmacy
Table 9

*Hospital Preparedness With Indicators of Isolation and Decontamination*

<table>
<thead>
<tr>
<th>Indicator (module question #)</th>
<th># (% of hospitals)</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to decontamination showers (f24)</td>
<td>128 (96%)</td>
<td>92-99%</td>
</tr>
<tr>
<td>Decontamination is addressed (f23)</td>
<td>119 (89%)</td>
<td>83-94%</td>
</tr>
<tr>
<td>Respiratory protection program compliant with OSHA (f25)</td>
<td>117 (87%)</td>
<td>81-92%</td>
</tr>
<tr>
<td>TOTAL (2.7 of 3 indicators)</td>
<td>(91%)</td>
<td>86-94%</td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals

Table 10

*Hospital Preparedness With Indicators of Supplies, Pharmaceuticals, and Laboratory Support*

<table>
<thead>
<tr>
<th>Indicator (module question #)</th>
<th># (% of hospitals)</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agreements to access additional pharmaceuticals (f30)</td>
<td>113 (84%)</td>
<td>78-91%</td>
</tr>
<tr>
<td>Alternative laboratories identified (f28)</td>
<td>106 (79%)</td>
<td>72-86%</td>
</tr>
<tr>
<td>Laboratory support plan for use in a disaster (f29)</td>
<td>78 (58%)</td>
<td>50-67%</td>
</tr>
<tr>
<td>Agreements for regional pharmaceutical stockpiles (f30e)</td>
<td>78 (58%)</td>
<td>50-67%</td>
</tr>
<tr>
<td>TOTAL (2.9 of 4 indicators)</td>
<td>(70%)</td>
<td>65-75%</td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals

support, 113 hospitals (84%) had agreements in place for accessing additional supplies of medication from outside resources during a disaster, and 78 hospitals (58%) had agreements that include regional pharmaceutical stockpiles. The overall response for this subcategory was 70%, based on a score of 2.9 out of a possible 4.0. This represented moderate preparedness for supplies, pharmaceuticals and laboratory support.
Overall Preparedness

Overall preparedness is a combination of all seven subcategories of preparedness (formula described in Chapter III) The Overall Preparedness Measure (OPM) was calculated as:

$$\frac{(AP + SC + ET + CN + SS + ID + SP)}{7} = OPM$$

Based on this study, the OPM was:

$$\frac{(0.80 + 0.64 + 0.89 + 0.83 + 0.66 + 0.91 + 0.70)}{7} = 0.78$$

As discussed in Chapter III, the range of responses for the preparedness measures was from 0 (not prepared) to 1 (optimally prepared) with ≤ 65% representing low preparedness, 66 to 85% as moderate preparedness, and > 85% as high preparedness. The OPM of 78% is within the scale of moderate preparedness.

In this study, according to the self-reports of the rural hospital CEOs, there was overall high preparedness level in 47 (35%) of the hospitals, compared to overall low preparedness level in 25 (19%) and a moderate preparedness in 62 (46%) of the hospitals (see Figure 11).

Preparedness was also examined by geographic regions, system affiliation, and Joint Commission accreditation (see Table 11). No differences by region were found in any element of preparedness. When examining preparedness by system affiliation, it was found that two subcategories showed a statistically significant positive relationship: staffing and support (Pearson chi-square, 8.75, \( p = .00 \)) and supplies, pharmaceuticals, and laboratory support (8.42, \( p = .00 \)). Also examined was preparedness by Joint Commission accreditation. Three subcategories were found to have statistically
significant positive associations: administration and planning (Pearson chi-square, 13.85, \( p = .00 \)), education and training (15.18, \( p = .00 \)), and supplies, pharmaceuticals, and laboratory support (8.33, \( p = .00 \)).

* Summary of Results for Research Question 3 *

Seven elements of preparedness, in addition to overall preparedness, were examined across respondent rural acute care hospitals in the U.S. Overall preparedness was found to be moderate, with a range of the seven subcategories from low preparedness of .64 (surge capacity) to high preparedness of .91 (isolation and decontamination) (see
Table 11

Hospital Preparedness in Each Subcategory by Geographic Regions, System Affiliation, and Joint Commission Accreditation

<table>
<thead>
<tr>
<th></th>
<th>SC</th>
<th>ET</th>
<th>CN</th>
<th>AP</th>
<th>SC</th>
<th>ET</th>
<th>CN</th>
<th>AP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No(%)</td>
<td>Yes(%)</td>
<td>No(%)</td>
<td>Yes(%)</td>
<td>No(%)</td>
<td>Yes(%)</td>
<td>No(%)</td>
<td>Yes(%)</td>
</tr>
<tr>
<td>Regions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Northeast</td>
<td>1(6)</td>
<td>15(94)</td>
<td>10(62)</td>
<td>6(38)</td>
<td>0(0)</td>
<td>16(100)</td>
<td>3(19)</td>
<td>13(81)</td>
</tr>
<tr>
<td>Midwest</td>
<td>13(31)</td>
<td>29(69)</td>
<td>29(69)</td>
<td>13(31)</td>
<td>6(14)</td>
<td>36(86)</td>
<td>3(7)</td>
<td>39(93)</td>
</tr>
<tr>
<td>South</td>
<td>17(27)</td>
<td>45(73)</td>
<td>43(69)</td>
<td>19(31)</td>
<td>13(21)</td>
<td>49(79)</td>
<td>8(13)</td>
<td>54(87)</td>
</tr>
<tr>
<td>West</td>
<td>5(36)</td>
<td>9(64)</td>
<td>10(71)</td>
<td>4(29)</td>
<td>2(14)</td>
<td>12(86)</td>
<td>3(21)</td>
<td>11(79)</td>
</tr>
<tr>
<td></td>
<td>.22</td>
<td>.95</td>
<td>.22</td>
<td>.44</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>System Affiliation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>27(30)</td>
<td>63(70)</td>
<td>65(72)</td>
<td>25(28)</td>
<td>15(17)</td>
<td>75(83)</td>
<td>12(13)</td>
<td>78(87)</td>
</tr>
<tr>
<td>Yes</td>
<td>8(19)</td>
<td>35(81)</td>
<td>26(61)</td>
<td>17(39)</td>
<td>5(12)</td>
<td>38(88)</td>
<td>4(9)</td>
<td>39(91)</td>
</tr>
<tr>
<td></td>
<td>.16</td>
<td>.17</td>
<td>.45</td>
<td>.50</td>
<td></td>
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</tr>
<tr>
<td>Joint Commission Accreditation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>17(52)</td>
<td>16(48)</td>
<td>25(76)</td>
<td>8(24)</td>
<td>12(36)</td>
<td>21(64)</td>
<td>6(18)</td>
<td>27(82)</td>
</tr>
<tr>
<td>Yes</td>
<td>18(18)</td>
<td>80(82)</td>
<td>64(65)</td>
<td>34(35)</td>
<td>8(8)</td>
<td>90(92)</td>
<td>10(10)</td>
<td>88(90)</td>
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<td></td>
<td>.00</td>
<td>.27</td>
<td>.00</td>
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</tr>
</tbody>
</table>

* Pearson chi-square p-value
Figure 12. Of the seven subcategories, one was found to be low preparedness (surge capacity); four were found to be moderately prepared (administration and planning; communication and notification; staffing and support; and supplies, pharmaceuticals, and laboratory support); and two were found to be high preparedness (education and training; isolation and decontamination).

![Graph showing subcategories of preparedness]

**Figure 12. Summary of Preparedness**

Preparedness was also examined by geographic regions, system affiliation, and Joint Commission accreditation. No significant associations were found with geographic regions, whereas preparedness was positively associated with system affiliation in the elements of staffing and support, and supplies, pharmaceuticals, and laboratory supplies.
Preparedness was also positively associated with Joint Commission accreditation in the subcategories of administration and planning; education and training; staffing and support; and supplies, pharmaceuticals, and laboratory support.

Inferential Research Questions

Inferential Research Questions 1 and 2

Data collected in this study were analyzed using the dependent variable of preparedness, to include the subcategories of administration and planning; surge capacity; education and training; communication and notification; staffing and support; isolation and decontamination; supplies, pharmaceuticals, and laboratory support; and overall preparedness and the independent variables of all-hazards risk perception and HRSA funding. System affiliation and Joint Commission accreditation were also included in the model. The results of the model for Inferential Research Question 1, pertaining to the association between preparedness and risk perception, and Inferential Research Question 2, regarding the association between preparedness and HRSA funding, are displayed together. The summary and analysis will then be reported by the respective research question.

A Pearson chi-square test was conducted to determine whether any statistically significant difference in the percent prepared existed by all-hazards risk perception (low/high), HRSA funding (low/high), system affiliation (no/yes), or Joint Commission accreditation (no/yes) (see Table 12). Positive associations were found in administration and planning by Joint Commission accreditation (Pearson chi-square, $p = .00$); education
Table 12

Hospital Preparedness in Each Subcategory by Risk Perception, HRSA Funding, System Affiliation, and Joint Commission Accreditation

<table>
<thead>
<tr>
<th></th>
<th>AP</th>
<th>SC</th>
<th>ET</th>
<th>CN</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No(%)</td>
<td>Yes(%)</td>
<td>No(%)</td>
<td>Yes(%)</td>
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<tr>
<td>All-Hazards Risk Perception</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Low</td>
<td>26(27)</td>
<td>69(73)</td>
<td>65(68)</td>
<td>30(32)</td>
</tr>
<tr>
<td>High</td>
<td>10(26)</td>
<td>29(74)</td>
<td>27(69)</td>
<td>12(31)</td>
</tr>
<tr>
<td>p-value*</td>
<td>.84</td>
<td>.93</td>
<td>.03</td>
<td>.09</td>
</tr>
<tr>
<td>HRSA Funding</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Low</td>
<td>24(29)</td>
<td>58(71)</td>
<td>60(73)</td>
<td>22(27)</td>
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<tr>
<td>High</td>
<td>12(23)</td>
<td>40(77)</td>
<td>32(62)</td>
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<td>p-value*</td>
<td>.43</td>
<td>.16</td>
<td>.94</td>
<td>.46</td>
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<td>System Affiliation</td>
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<td>No</td>
<td>27(30)</td>
<td>63(70)</td>
<td>65(72)</td>
<td>25(28)</td>
</tr>
<tr>
<td>Yes</td>
<td>8(19)</td>
<td>35(81)</td>
<td>26(61)</td>
<td>17(39)</td>
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<td>p-value*</td>
<td>.16</td>
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<td>.50</td>
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<tr>
<td>Joint Commission Accreditation</td>
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<td>No</td>
<td>17(52)</td>
<td>16(48)</td>
<td>25(76)</td>
<td>8(24)</td>
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<tr>
<td>Yes</td>
<td>18(18)</td>
<td>80(82)</td>
<td>64(65)</td>
<td>34(35)</td>
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<tr>
<td>p-value*</td>
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<td>.00</td>
<td>.23</td>
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<td>No(%)</td>
<td>Yes(%)</td>
<td>No(%)</td>
<td>Yes(%)</td>
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<tr>
<td>All-Hazards Risk Perception</td>
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<tr>
<td>Low</td>
<td>30(32)</td>
<td>65(68)</td>
<td>20(21)</td>
<td>75(79)</td>
</tr>
<tr>
<td>High</td>
<td>16(41)</td>
<td>23(59)</td>
<td>6(15)</td>
<td>33(85)</td>
</tr>
<tr>
<td>p-value*</td>
<td>.29</td>
<td>.45</td>
<td>.37</td>
<td>.54</td>
</tr>
<tr>
<td>HRSA Funding</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>32(39)</td>
<td>50(61)</td>
<td>21(26)</td>
<td>61(74)</td>
</tr>
<tr>
<td>High</td>
<td>14(27)</td>
<td>38(73)</td>
<td>5(10)</td>
<td>47(90)</td>
</tr>
<tr>
<td>p-value*</td>
<td>.15</td>
<td>.02</td>
<td>.27</td>
<td>.62</td>
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<tr>
<td>System Affiliation</td>
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<td></td>
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</tr>
<tr>
<td>No</td>
<td>38(42)</td>
<td>52(58)</td>
<td>18(20)</td>
<td>72(80)</td>
</tr>
<tr>
<td>Yes</td>
<td>7(16)</td>
<td>36(84)</td>
<td>7(16)</td>
<td>36(84)</td>
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<tr>
<td>p-value*</td>
<td>.00</td>
<td>.61</td>
<td>.00</td>
<td>.22</td>
</tr>
<tr>
<td>Joint Commission Accreditation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>15(46)</td>
<td>18(54)</td>
<td>9(27)</td>
<td>24(73)</td>
</tr>
<tr>
<td>Yes</td>
<td>29(30)</td>
<td>69(70)</td>
<td>16(16)</td>
<td>82(84)</td>
</tr>
<tr>
<td>p-value*</td>
<td>.09</td>
<td>.17</td>
<td>.00</td>
<td>.12</td>
</tr>
</tbody>
</table>

* Pearson chi-square p-value

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and training by risk perception ($p = .03$) and accreditation ($p = .00$); staffing and support by system affiliation ($p = .00$); isolation and decontamination by HRSA funding ($p = .02$); supplies, pharmaceuticals, and laboratory support by system affiliation ($p = .00$) and accreditation ($p = .00$). No differences were found in the subcategories of surge capacity, communication and notification, or overall preparedness.

Eight logistic regression models were run to determine the predictors of the subcategories of preparedness, and overall preparedness, from the independent variables. They will be discussed according to subcategories with one model to follow on the overall preparedness measure.

*Administration and Planning*  

A logistic regression model was run to determine if the independent variables of risk perception, HRSA funding, system affiliation, and Joint Commission accreditation could predict preparedness in the subcategory of administration and planning. All 134 cases were included and “yes” was selected as the predicted outcome. The test of this subcategory with all four predictors against a constant only model was statistically significant, $\chi^2 (4, N = 134) = 73.3, p < .001$, indicating that the predictions as a set could reliably distinguish between low preparedness and high preparedness.

The Omnibus Tests of Model Coefficients indicated that the overall model was significant in predicting the preparedness subcategory of administration and planning (chi-square, 13.48; $p = .01$). The Cox and Snell $R$-Square (.098) and Nagelkerke $R$-Square (.142) indicated that between 9.8% and 14.2% of the variation in the outcome
variable (prepared in administration and planning) was explained by this logistic model.

Table 13 shows the estimates of the regression model.

Table 13

*Estimates of the Logistic Regression Model for Administration and Planning*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>p</th>
<th>Exp(B)</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Perception</td>
<td>.185</td>
<td>.469</td>
<td>.156</td>
<td>.693</td>
<td>1.204</td>
<td>.480-3.019</td>
</tr>
<tr>
<td>HRSA funding</td>
<td>-.052</td>
<td>.455</td>
<td>.013</td>
<td>.910</td>
<td>.950</td>
<td>.389-2.317</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>-.327</td>
<td>.491</td>
<td>.445</td>
<td>.505</td>
<td>.721</td>
<td>.275-1.887</td>
</tr>
<tr>
<td>Accreditation</td>
<td>1.497</td>
<td>.456</td>
<td>10.767</td>
<td>.001</td>
<td>1.224</td>
<td>1.092-1.547</td>
</tr>
<tr>
<td>Constant</td>
<td>1.609</td>
<td>.556</td>
<td>8.366</td>
<td>.004</td>
<td>4.996</td>
<td></td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals

Joint Commission accreditation was found to be the most important contribution to the model (Wald = 10.767) and was also found to be a statistically significant predictor of preparedness in the subcategory of administration and planning ($p = .001$).

As discussed in Chapter III, multicollinearity was examined by inspecting the magnitude of the standard error (SE) of each variable (except the constant) to omit those with SE greater than 5.0. As identified in Table 13, the SEs were each less than 5.0 and, thus, no adjustments for multicollinearity were conducted.

In Table 13, the Exp(B) gives the odds ratios. As discussed in Chapter III, the reference groups were set at the lowest coded category of low risk perception, low HRSA funding, no system affiliation, and no Joint Commission accreditation. The results indicated that JCAHO accredited hospitals had an odds of 1.2 (95% CI, 1.09 to 1.55)
times greater than non-JCAHO accredited hospitals of being prepared in administration and planning. The correlation values among risk perception, HRSA funding, system affiliation, and Joint Commission accreditation were low (see Table 14).

Table 14

*Correlation Matrix for Administration and Planning*

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>Risk Perception</th>
<th>HRSA Funding</th>
<th>System Affiliation</th>
<th>Joint Comm. Accreditation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.000</td>
<td>-.524</td>
<td>.454</td>
<td>-.460</td>
<td>-.017</td>
</tr>
<tr>
<td>Risk Perception</td>
<td>-.524</td>
<td>1.000</td>
<td>.098</td>
<td>-.131</td>
<td>-.130</td>
</tr>
<tr>
<td>HRSA Funding</td>
<td>-.454</td>
<td>.098</td>
<td>1.000</td>
<td>-.126</td>
<td>-.197</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>-.460</td>
<td>-.131</td>
<td>-.126</td>
<td>1.000</td>
<td>-.147</td>
</tr>
<tr>
<td>Joint Comm. Accreditation</td>
<td>-.017</td>
<td>-.130</td>
<td>-.197</td>
<td>-.147</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Surge Capacity*

A logistic regression model was run to determine if the independent variables of risk perception, HRSA funding, system affiliation, and Joint Commission accreditation could predict preparedness in the subcategory of surge capacity. All 134 cases were included and “yes” was selected as the predicted outcome. The test of this subcategory with all four predictors against a constant only model was statistically significant,
$X^2(4, N = 134) = 67.9, p < .001$, indicating that the predictions as a set could reliably distinguish between low preparedness and high preparedness.

The Omnibus Tests of Model Coefficients indicated that the overall model was not significant in predicting the preparedness of surge capacity (chi-square, 4.14; $p = .39$). The Cox and Snell $R^2$-Square (.031) and Nagelkerke $R^2$-Square (.044) indicated that between 3.1% and 4.4% of the variation in the outcome variable (prepared in surge capacity) was explained by this logistic model. Table 15 shows the estimates of the regression model.

Table 15

*Estimates of the Logistic Regression Model for Surge Capacity*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>p</th>
<th>Exp(B)</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Perception</td>
<td>.081</td>
<td>.425</td>
<td>.036</td>
<td>.849</td>
<td>.849</td>
<td>.472–2.493</td>
</tr>
<tr>
<td>HRSA funding</td>
<td>-.460</td>
<td>.395</td>
<td>1.353</td>
<td>.245</td>
<td>.245</td>
<td>.291–1.370</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>-.431</td>
<td>.409</td>
<td>1.107</td>
<td>.293</td>
<td>.293</td>
<td>.291–1.450</td>
</tr>
<tr>
<td>Accreditation</td>
<td>-.311</td>
<td>.479</td>
<td>.422</td>
<td>.516</td>
<td>.516</td>
<td>.286–1.874</td>
</tr>
<tr>
<td>Constant</td>
<td>-.178</td>
<td>.465</td>
<td>.147</td>
<td>.702</td>
<td>.702</td>
<td></td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals*

As indicated by the Wald estimate, none of these variables make a significant contribution to the model and the $p$-value indicated that none of these variables could predict surge capacity. Table 15 also provides the Exp(B) value, indicating the odds ratios. All values were below 1.0, indicating decreased odds. No multicollinearity was found.
The correlation values among risk perception, HRSA funding, system affiliation, and Joint Commission accreditation were low (see Table 16).

Table 16

*Correlation Matrix for Surge Capacity*

<table>
<thead>
<tr>
<th>Constant</th>
<th>Risk Perception</th>
<th>HRSA Funding</th>
<th>System Affiliation</th>
<th>Joint Comm. Accreditation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant 1.000</td>
<td>-.613</td>
<td>-.430</td>
<td>-.402</td>
<td>.005</td>
</tr>
<tr>
<td>Risk Perception -.613</td>
<td>1.000</td>
<td>.076</td>
<td>-.100</td>
<td>-.078</td>
</tr>
<tr>
<td>HRSA Funding .430</td>
<td>.076</td>
<td>1.000</td>
<td>-.119</td>
<td>-.169</td>
</tr>
<tr>
<td>System Affiliation -.402</td>
<td>-.100</td>
<td>-.119</td>
<td>1.000</td>
<td>-.170</td>
</tr>
<tr>
<td>Joint Comm. Accreditation .005</td>
<td>-.078</td>
<td>-.169</td>
<td>-.170</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Education and Training*

A logistic regression model was run to determine if the independent variables of risk perception, HRSA funding, system affiliation, and Joint Commission accreditation could predict preparedness in the subcategory of education and training. All 134 cases were included and “yes” was selected as the predicted outcome. The test of this subcategory with all four predictors against a constant only model was statistically significant, \(X^2 (4, N = 134) = 84.7, p < .001\), indicating that the predictions as a set could reliably distinguish between low preparedness and high preparedness.
The Omnibus Tests of Model Coefficients indicated that the overall model was significant in predicting the preparedness in education and training (chi-square, 17.403; \( p = .002 \)). The Cox and Snell \( R^2 \) (.124) and Nagelkerke \( R^2 \) (.217) indicated that between 12.4% and 21.7% of the variation in the outcome variable (prepared in education and training) was explained by this logistic model. Table 17 shows the estimates of the regression model.

Table 17

*Estimates of the Logistic Regression Model for Education and Training*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>p</th>
<th>Exp(B)</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Perception</td>
<td>1.406</td>
<td>.813</td>
<td>2.990</td>
<td>.034</td>
<td>1.245</td>
<td>1.050–1.266</td>
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<tr>
<td>HRSA funding</td>
<td>.212</td>
<td>.572</td>
<td>.138</td>
<td>.710</td>
<td>1.237</td>
<td>.403–3.793</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>.267</td>
<td>.632</td>
<td>.179</td>
<td>.673</td>
<td>1.306</td>
<td>.378–4.511</td>
</tr>
<tr>
<td>Accreditation</td>
<td>1.938</td>
<td>.578</td>
<td>11.232</td>
<td>.001</td>
<td>1.144</td>
<td>1.046–1.447</td>
</tr>
<tr>
<td>Constant</td>
<td>3.265</td>
<td>.882</td>
<td>13.698</td>
<td>.000</td>
<td>26.173</td>
<td></td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals*

Joint Commission accreditation was found to be the most important contribution to the model (Wald = 11.232) and was also found to be a statistically significant predictor of preparedness in the subcategory of education and training (\( p = .001 \)). Risk perception was also found to be statistically significantly associated with this subcategory (\( p = .034 \)).

In Table 17, the Exp(B) gives the odds ratios. The results showed that with high risk perception, the odds were 1.2 (95% CI, 1.05 to 1.27) times greater of being prepared in education and training than when low risk perception and with Joint Commission
accreditation, the odds were 1.1 (CI 95%, 1.05 to 1.45) compared to those without Joint Commission accreditation. No multicollinearity was found.

The correlation values among risk perception, HRSA funding, system affiliation, and Joint Commission accreditation were low (see Table 18).

Table 18

*Correlation Matrix for Education and Training*

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>Risk Perception</th>
<th>HRSA Funding</th>
<th>System Affiliation</th>
<th>Joint Comm. Accreditation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
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<td>-.338</td>
<td>-.240</td>
<td>-.115</td>
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<tr>
<td>Risk Perception</td>
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<td>1.000</td>
<td>.051</td>
<td>-.182</td>
<td>.063</td>
</tr>
<tr>
<td>HRSA Funding</td>
<td>-.338</td>
<td>.051</td>
<td>1.000</td>
<td>-.063</td>
<td>-.250</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>-.240</td>
<td>-.182</td>
<td>-.063</td>
<td>1.000</td>
<td>-.314</td>
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<tr>
<td>Joint Comm. Accreditation</td>
<td>-.115</td>
<td>.063</td>
<td>-.250</td>
<td>-.314</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Communication and Notification*

A logistic regression model was run to determine if the independent variables of risk perception, HRSA funding, system affiliation, and Joint Commission accreditation could predict preparedness in the subcategory of communication and notification. All 134 cases were included and “yes” was selected as the predicted outcome. The test of this subcategory with all four predictors against a constant only model was statistically
significant, $X^2 (4, N = 134) = 87.8, p < .001$, indicating that the predictions as a set could reliably distinguish between low preparedness and high preparedness.

The Omnibus Tests of Model Coefficients indicated that the overall model was not significant in predicting the preparedness subcategory of communication and notification (chi-square, 4.345; $p = .36$). The Cox and Snell R-Square (.033) and Nagelkerke R-Square (.062) indicated that only between 3.3% and 6.2% of the variation in the outcome variable (prepared in communication and notification) was explained by this logistic model. Table 19 shows the estimates of the regression model.

Table 19

*Estimates of the Logistic Regression Model for Communication and Notification*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>p</th>
<th>Exp(B)</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Perception</td>
<td>-1.050</td>
<td>.792</td>
<td>1.758</td>
<td>.185</td>
<td>.350</td>
<td>.074-1.652</td>
</tr>
<tr>
<td>HRSA funding</td>
<td>.389</td>
<td>.569</td>
<td>.467</td>
<td>.495</td>
<td>1.475</td>
<td>.484-4.499</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>-.202</td>
<td>.646</td>
<td>.098</td>
<td>.754</td>
<td>.817</td>
<td>.230-2.898</td>
</tr>
<tr>
<td>Accreditation</td>
<td>-.636</td>
<td>.606</td>
<td>1.102</td>
<td>.294</td>
<td>.529</td>
<td>.162-1.735</td>
</tr>
<tr>
<td>Constant</td>
<td>2.908</td>
<td>.871</td>
<td>11.151</td>
<td>.001</td>
<td>18.321</td>
<td></td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals*

As indicated by the Wald estimate, none of these variables make a significant contribution to the model and the $p$-value indicates that none of these variables could predict communication and notification. Table 19 also shows the Exp(B) value, indicating the odds ratios. Risk perception, system affiliation, and accreditation are below 1.0, indicating decreased odds. Multicollinearity was checked by inspecting the magnitude of the standard error of each variable (except the constant). As identified in Table 19, the
SEs were each greater than 5.0 and thus, there was no multicollinearity found. The correlation values among risk perception, HRSA funding, system affiliation, and Joint Commission accreditation were low (see Table 20).

Table 20

Correlation Matrix for Communication and Notification

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>Risk Perception</th>
<th>HRSA Funding</th>
<th>System Affiliation</th>
<th>Joint Comm. Accreditation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.000</td>
<td>-.739</td>
<td>-.323</td>
<td>-.380</td>
<td>.015</td>
</tr>
<tr>
<td>Risk Perception</td>
<td>-.739</td>
<td>1.000</td>
<td>.066</td>
<td>-.100</td>
<td>-.060</td>
</tr>
<tr>
<td>HRSA Funding</td>
<td>-.323</td>
<td>.066</td>
<td>1.000</td>
<td>-.087</td>
<td>-.224</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>-.380</td>
<td>-.100</td>
<td>-.087</td>
<td>1.000</td>
<td>-.236</td>
</tr>
<tr>
<td>Joint Comm. Accreditation</td>
<td>.015</td>
<td>-.060</td>
<td>-.224</td>
<td>-.236</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Staffing and Support

A logistic regression model was run to determine if the independent variables of risk perception, HRSA funding, system affiliation, and Joint Commission accreditation could predict preparedness in the subcategory of staffing and support. All 134 cases were included and “yes” was selected as the predicted outcome. The test of this subcategory with all four predictors against a constant only model was statistically significant,
\( \chi^2 (4, N = 134) = 66.4, p < .001 \), indicating that the predictions as a set could reliably distinguish between low preparedness and high preparedness.

The Omnibus Tests of Model Coefficients indicated that the overall model was significant in predicting the staffing and support subcategory (chi-square, 12.15; \( p = .02 \)). The Cox and Snell \( R^2 \)-Square (.089) and Nagelkerke \( R^2 \)-Square (.123) indicated that between 8.9% and 12.3% of the variation in the outcome variable (prepared in staffing and support) was explained by this logistic model. Table 21 shows the estimates of the regression model.

Table 21

*Estimates of the Logistic Regression Model for Staffing and Support*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>p</th>
<th>Exp(B)</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Perception</td>
<td>.559</td>
<td>.430</td>
<td>1.684</td>
<td>.194</td>
<td>1.748</td>
<td>.752–4.065</td>
</tr>
<tr>
<td>HRSA funding</td>
<td>-.299</td>
<td>.420</td>
<td>.506</td>
<td>.477</td>
<td>.742</td>
<td>.326–1.690</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>1.215</td>
<td>.485</td>
<td>6.278</td>
<td>.012</td>
<td>1.297</td>
<td>1.115–1.768</td>
</tr>
<tr>
<td>Accreditation</td>
<td>-.484</td>
<td>.439</td>
<td>1.211</td>
<td>.271</td>
<td>.617</td>
<td>.261–1.459</td>
</tr>
<tr>
<td>Constant</td>
<td>1.504</td>
<td>.540</td>
<td>7.773</td>
<td>.005</td>
<td>4.501</td>
<td></td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals

System affiliation was found to be the most important contribution to the model from among the variables System affiliation was also found to be a statistically significant predictor of preparedness in the subcategory of staffing and support (\( p = .012 \)).

In Table 21, the \( \text{Exp}(B) \) gives the odds ratios. As discussed in Chapter III, the reference groups were set at the lowest coded category of low risk perception, low HRSA funding, no system affiliation and no Joint Commission accreditation. The results indicate
that hospitals who are affiliated with a system have 1.3 (95% CI, 1.11 to 1.77) times greater odds of preparedness in this subcategory compared to those without system affiliation. No multicollinearity was found.

The correlation values among risk perception, HRSA funding, system affiliation, and Joint Commission accreditation were low (see Table 22).

Table 22

*Correlation Matrix for Staffing and Support*

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>Risk Perception</th>
<th>HRSA Funding</th>
<th>System Affiliation</th>
<th>Joint Comm. Accreditation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.000</td>
<td>-.461</td>
<td>.451</td>
<td>-.544</td>
<td>.000</td>
</tr>
<tr>
<td>Risk Perception</td>
<td>-.461</td>
<td>1.000</td>
<td>.098</td>
<td>-.150</td>
<td>-.146</td>
</tr>
<tr>
<td>HRSA Funding</td>
<td>-.451</td>
<td>.098</td>
<td>1.000</td>
<td>-.109</td>
<td>-.173</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>-.544</td>
<td>-.150</td>
<td>-.109</td>
<td>1.000</td>
<td>-.099</td>
</tr>
<tr>
<td>Joint Comm. Accreditation</td>
<td>.000</td>
<td>-.146</td>
<td>-.173</td>
<td>-.099</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Isolation and Decontamination*

A logistic regression model was run to determine if the independent variables of risk perception, HRSA funding, system affiliation, and Joint Commission accreditation could predict preparedness in the subcategory of isolation and decontamination. All 134 cases were included and “yes” was selected as the predicted outcome. The test of this
subcategory with all four predictors against a constant only model was statistically significant, \( X^2 (4, N = 134) = 80.9, p < .001 \), indicating that the predictions as a set could reliably distinguish between low preparedness and high preparedness.

The Omnibus Tests of Model Coefficients indicated that the overall model was not significant in predicting the preparedness of isolation and decontamination (chi-square, 8.33; \( p = .08 \)). The Cox and Snell \( R^2 \)-Square (.062) and Nagelkerke \( R^2 \)-Square (.099) indicated that between 6.2% and 9.9% of the variation in the outcome variable (prepared in isolation and decontamination) was explained by this logistic model. Table 23 shows the estimates of the regression model.

Table 23

*Estimates of the Logistic Regression Model for Isolation and Decontamination*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>p</th>
<th>( \text{Exp(B)} )</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Perception</td>
<td>-.358</td>
<td>.531</td>
<td>.455</td>
<td>.500</td>
<td>.699</td>
<td>.247-1.979</td>
</tr>
<tr>
<td>HRSA funding</td>
<td>1.352</td>
<td>.592</td>
<td>5.204</td>
<td>.023</td>
<td>1.259</td>
<td>1.081-1.827</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>.072</td>
<td>.523</td>
<td>.019</td>
<td>.891</td>
<td>1.074</td>
<td>.386-2.993</td>
</tr>
<tr>
<td>Accreditation</td>
<td>-.401</td>
<td>.505</td>
<td>.629</td>
<td>.428</td>
<td>.670</td>
<td>.249-1.803</td>
</tr>
<tr>
<td>Constant</td>
<td>2.741</td>
<td>.722</td>
<td>14.393</td>
<td>.000</td>
<td>15.503</td>
<td></td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals

HRSA funding was found to be the most important contribution to the model from among the variables and was also found to be a statistically significant predictor of preparedness in the subcategory of isolation and decontamination (\( p = .023 \)). Those hospitals who received high HRSA funding were found to have 1.2 (95% CI, 1.08 to 1.83) times greater odds of preparation in this subcategory compared to those with low
HRSA funding. The correlation values among risk perception, HRSA funding, system affiliation, and Joint Commission accreditation were low (see Table 24). No multicollinearity was found.

Table 24

*Correlation Matrix for Isolation and Decontamination*

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>Risk Perception</th>
<th>HRSA Funding</th>
<th>System Affiliation</th>
<th>Joint Comm. Accreditation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.000</td>
<td>-.546</td>
<td>-.621</td>
<td>-.368</td>
<td>.004</td>
</tr>
<tr>
<td>Risk Perception</td>
<td>-.546</td>
<td>1.000</td>
<td>.079</td>
<td>-.065</td>
<td>-.088</td>
</tr>
<tr>
<td>HRSA Funding</td>
<td>-.621</td>
<td>.079</td>
<td>1.000</td>
<td>-.103</td>
<td>-.132</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>-.368</td>
<td>-.065</td>
<td>-.103</td>
<td>1.000</td>
<td>-.194</td>
</tr>
<tr>
<td>Joint Comm. Accreditation</td>
<td>.004</td>
<td>-.088</td>
<td>-.132</td>
<td>-.194</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Supplies, Pharmaceuticals and Laboratory Support*

A logistic regression model was run to determine if the independent variables of risk perception, HRSA funding, system affiliation, and Joint Commission accreditation could predict preparedness in the subcategory of supplies, pharmaceuticals and laboratory support. All 134 cases were included and "yes" was selected as the predicted outcome. The test of this subcategory with all four predictors against a constant only model was
statistically significant, \( X^2 (4, N = 134) = 63.4, p < .001 \), indicating that the predictions as a set could reliably distinguish between low preparedness and high preparedness.

The Omnibus Tests of Model Coefficients indicated that the overall model was significant in predicting the subcategory of supplies, pharmaceuticals and laboratory support (chi-square, 14.45; \( p = .006 \)). The Cox and Snell \( R^2 \)-Square (.104) and Nagelkerke \( R^2 \)-Square (.143) indicated that between 10.4% and 14.3% of the variation in the outcome variable (prepared in supplies, pharmaceuticals and laboratory support) was explained by this logistic model. Table 25 shows the estimates of the regression model.

Table 25

\textit{Estimates of the Logistic Regression Model for Supplies, Pharmaceuticals, and Laboratory Support}

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>( p )</th>
<th>( \text{Exp}(B) )</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Perception</td>
<td>-.138</td>
<td>.434</td>
<td>.101</td>
<td>.751</td>
<td>.871</td>
<td>.372–2.041</td>
</tr>
<tr>
<td>HRSA funding</td>
<td>-.182</td>
<td>.413</td>
<td>.195</td>
<td>.659</td>
<td>.833</td>
<td>.371–1.872</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>1.043</td>
<td>.462</td>
<td>5.098</td>
<td>.024</td>
<td>1.352</td>
<td>1.142–1.871</td>
</tr>
<tr>
<td>Accreditation</td>
<td>.943</td>
<td>.437</td>
<td>4.660</td>
<td>.031</td>
<td>1.389</td>
<td>1.165–1.917</td>
</tr>
<tr>
<td>Constant</td>
<td>1.773</td>
<td>.546</td>
<td>10.562</td>
<td>.001</td>
<td>5.888</td>
<td></td>
</tr>
</tbody>
</table>

\*CI = Confidence Intervals

System affiliation and Joint Commission accreditation, with Wald estimates of 5.10 and 4.66, respectively, were found to be the most important contributions to the model and were also found to be statistically significant predictors of preparedness in the subcategory of supplies, pharmaceuticals, and laboratory support (\( p = .024 \) and \( .031 \), respectively).
In Table 25, the Exp(B) gives the odds ratios. Hospitals with accreditation were found to have 1.4 (95% CI, 1.16 to 1.92) times greater odds compared to hospitals without accreditation and those with system affiliation was found to have 1.3 (95% CI, 1.14 to 1.87) times greater odds of preparedness in supplies, pharmaceuticals and laboratory support compared to hospitals without system affiliation. No multicollinearity was found. The correlation values among risk perception, HRSA funding, system affiliation, and Joint Commission accreditation were low (see Table 26).

Table 26

*Correlation Matrix for Supplies, Pharmaceuticals, and Laboratory Support*

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>Risk Perception</th>
<th>HRSA Funding</th>
<th>System Affiliation</th>
<th>Joint Comm. Accreditation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.000</td>
<td>-.545</td>
<td>-.446</td>
<td>-.522</td>
<td>-.018</td>
</tr>
<tr>
<td>Risk Perception</td>
<td>-.545</td>
<td>1.000</td>
<td>.109</td>
<td>-.092</td>
<td>-.102</td>
</tr>
<tr>
<td>HRSA Funding</td>
<td>-.446</td>
<td>.109</td>
<td>1.000</td>
<td>-.104</td>
<td>-.176</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>-.522</td>
<td>-.092</td>
<td>-.104</td>
<td>1.000</td>
<td>-.101</td>
</tr>
<tr>
<td>Joint Comm. Accreditation</td>
<td>-.018</td>
<td>-.102</td>
<td>-.176</td>
<td>-.101</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Overall Preparedness*

The final logistic regression model was run to determine if the independent variables of risk perception, HRSA funding, system affiliation, and Joint Commission
accreditation could predict overall preparedness. All 134 cases were included and “yes” was selected as the predicted outcome. The test of this subcategory with all four predictors against a constant only model was statistically significant, $X^2 (4, N = 134) = 67.9, p < .001$, indicating that the predictions as a set could reliably distinguish between low preparedness and high preparedness.

The Omnibus Tests of Model Coefficients indicated that the overall model was not significant in predicting overall preparedness (chi-square, 5.13; $p = .27$). The Cox and Snell $R^2$ (0.038) and Nagelkerke $R^2$ (0.054) indicated that only 3.8% to 5.4% of the variation in overall preparedness was explained by this logistic model. Table 27 shows the estimates of the regression model.

Table 27

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>p</th>
<th>Exp(B)</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk Perception</td>
<td>-.492</td>
<td>.439</td>
<td>1.257</td>
<td>.262</td>
<td>.612</td>
<td>.259–1.445</td>
</tr>
<tr>
<td>HRSA funding</td>
<td>.090</td>
<td>.399</td>
<td>.051</td>
<td>.822</td>
<td>1.094</td>
<td>.500–2.393</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>.473</td>
<td>.411</td>
<td>1.325</td>
<td>.250</td>
<td>1.605</td>
<td>.717–3.593</td>
</tr>
<tr>
<td>Accreditation</td>
<td>.645</td>
<td>.495</td>
<td>1.696</td>
<td>.193</td>
<td>1.906</td>
<td>.722–5.032</td>
</tr>
<tr>
<td>Constant</td>
<td>.595</td>
<td>.481</td>
<td>1.528</td>
<td>.216</td>
<td>1.813</td>
<td></td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals

The Wald estimate indicated that none of the variables contributed to the model and were not predictors of overall preparedness ($p > .05$). The odds ratios indicated a minimal potential of greater odds on overall preparedness. No multicollinearity was...
found. The correlation values among risk perception, HRSA funding, system affiliation, and Joint Commission accreditation were low (see Table 28).

Table 28

Correlation Matrix for Overall Preparedness

<table>
<thead>
<tr>
<th></th>
<th>Constant</th>
<th>Risk Perception</th>
<th>HRSA Funding</th>
<th>System Affiliation</th>
<th>Joint Comm. Accreditation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>1.000</td>
<td>-.632</td>
<td>-.432</td>
<td>-.383</td>
<td>.021</td>
</tr>
<tr>
<td>Risk Perception</td>
<td>-.632</td>
<td>1.000</td>
<td>.065</td>
<td>-.101</td>
<td>-.083</td>
</tr>
<tr>
<td>HRSA Funding</td>
<td>-.432</td>
<td>.065</td>
<td>1.000</td>
<td>-.129</td>
<td>-.165</td>
</tr>
<tr>
<td>System Affiliation</td>
<td>-.383</td>
<td>-.101</td>
<td>-.129</td>
<td>1.000</td>
<td>-.164</td>
</tr>
<tr>
<td>Joint Comm. Accreditation</td>
<td>.021</td>
<td>-.083</td>
<td>-.165</td>
<td>-.164</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Inferential Research Question 1

Among rural acute care hospitals in the U.S., what is the association between risk perception and preparedness?

As shown in Table 12, there was a statistically significant association found between risk perception and the subcategory of education and training (Pearson chi-square; \( p = .03 \)). No other statistically significant associations were found between risk perception and other subcategories of preparedness including administration and planning (Pearson chi-square; \( p = .84 \)); surge capacity (\( p = .93 \)); communication and notification (\( p = .46 \)); staffing and support (\( p = .29 \)); isolation and decontamination (\( p = .45 \));
supplies, pharmaceuticals, and laboratory support \( (p = .37) \); and overall preparedness \( (p = .54) \).

The regression models also revealed little association between risk perception and preparedness. The only positive finding was that hospitals with high risk perception were found to have 1.2 (95% CI, 1.05 to 1.27) times greater odds of being prepared in education and training compared to hospitals with low risk perception.

The following research hypothesis was stated about the relationship between the risk perception and preparedness. Findings are included.

Hypothesis 1. There is a positive association between risk perception and preparedness.

Findings: Risk perception was found to be associated only with the education and training subcategory of preparedness. Hypothesis 1 is rejected for seven of eight associations examined, including overall preparedness.

Inferential Research Question 2

Among rural acute care hospitals in the U.S., what is the association between HRSA funding for preparedness activities and preparedness?

As shown in Table 12, there was a statistically significant association found between HRSA funding and the subcategory of isolation and decontamination (Pearson chi-square; \( p = .02 \)). No other statistically significant associations were found between HRSA funding and other subcategories of preparedness including administration and planning (Pearson chi-square; \( p = .43 \)); surge capacity (\( p = .16 \)); education and training (\( p = .94 \)); communication and notification (\( p = .46 \)); staffing and support (\( p = .15 \));
supplies, pharmaceuticals and laboratory support ($p = .27$); and overall preparedness ($p = .62$).

The regression models also revealed little association between HRSA funding and preparedness. The only positive finding was that hospitals with high HRSA funding were found to have 1.3 (95% CI, 1.08 to 1.83) times greater odds of being prepared in the subcategory of isolation and decontamination compared to hospitals with low HRSA funding.

The following research hypothesis was stated about the relationship between the HRSA funding and preparedness. Findings are included.

_Hypothesis 2._ There is a positive association between HRSA funding and preparedness.

*Findings:* HRSA funding was found to be associated only with the isolation and decontamination subcategory of preparedness. Hypothesis 2 is rejected for seven of eight associations examined, including overall preparedness.

**Inferential Research Question 3**

_Among rural acute care hospitals in the U.S., what is the combined effect of all-hazards risk perception and HRSA funding for preparedness activities and overall preparedness?*

As discussed in Chapter III, a new variable representing a combined risk perception/HRSA funding was created to represent the combined effect of all-hazards risk perception and HRSA funding for preparedness. The four values were low risk
perception/low HRSA funding, low risk perception/high HRSA funding, high risk perception/low HRSA funding, and high risk perception/high HRSA funding.

A two-way contingency table analysis was conducted to evaluate whether overall preparedness was affected by the risk perception/HRSA funding variable (see Table 29). Risk perception/HRSA funding was not found to be significantly related, Pearson $\chi^2 (2, n = 134) = .588, p = .899$. The proportion of preparedness that was represented by low risk perception/low HRSA funding, low risk perception/high HRSA funding, high risk perception/low HRSA funding, and high risk perception/high HRSA funding was .68, .64, .73, and .62, respectively.

Table 29

*Combined Effect of Risk Perception and HRSA Funding and Preparedness*

<table>
<thead>
<tr>
<th>Overall Preparedness</th>
<th>Low (%)</th>
<th>High (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Risk Perception/Low HRSA Funding</td>
<td>18 (32%)</td>
<td>38 (68%)</td>
</tr>
<tr>
<td>Low Risk Perception/High HRSA Funding</td>
<td>14 (36%)</td>
<td>25 (64%)</td>
</tr>
<tr>
<td>High Risk Perception/Low HRSA Funding</td>
<td>7 (27%)</td>
<td>19 (73%)</td>
</tr>
<tr>
<td>High Risk Perception/High HRSA Funding</td>
<td>5 (38%)</td>
<td>8 (62%)</td>
</tr>
</tbody>
</table>

* Pearson chi-square $p = .899$

A logistic regression model was run to determine if the combined independent variable of risk perception and HRSA funding could predict overall preparedness. All 134 cases were included and "low risk perception/low HRSA funding" was selected as the reference group. The test of this variable against a constant only model was statistically
significant, $X^2 (4, N = 134) = 67.9, p < .001$, indicating that the predictions as a set could reliably distinguish between low preparedness and high preparedness.

The Omnibus Tests of Model Coefficients indicated that the overall model was not significant in predicting overall preparedness (chi-square, 0.10; $p = .75$). The Cox and Snell $R$-Square (.001) and Nagelkerke $R$-Square (.001) indicated that only 0.1% of the variation in overall preparedness was explained by this logistic model.

The Wald estimate and odds ratios indicated that none of the variables contributed to the model and were not predictors of overall preparedness. The confidence intervals were wide for each. Because there were only 13 hospitals in the high risk /high HRSA group, a lack of power may have contributed to the lack of significance. No multicollinearity was found. Table 30 shows the estimates of the regression model.

Table 30

*Estimates of the Logistic Regression Model for Risk Perception/HRSA Funding and Overall Preparedness*

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>S.E.</th>
<th>Wald</th>
<th>p</th>
<th>Exp(B)</th>
<th>95% CI*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Risk/Low HRSA</td>
<td>-.586</td>
<td>.900</td>
<td>.586</td>
<td>.900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Risk/High HRSA</td>
<td>-.064</td>
<td>.666</td>
<td>.009</td>
<td>.924</td>
<td>.938</td>
<td>.255-3.458</td>
</tr>
<tr>
<td>High Risk/Low HRSA</td>
<td>-.231</td>
<td>.687</td>
<td>.113</td>
<td>.737</td>
<td>.794</td>
<td>.206-3.053</td>
</tr>
<tr>
<td>High Risk/High HRSA</td>
<td>.188</td>
<td>.746</td>
<td>.063</td>
<td>.801</td>
<td>1.206</td>
<td>.280-5.206</td>
</tr>
<tr>
<td>Constant</td>
<td>.811</td>
<td>.601</td>
<td>1.821</td>
<td>.177</td>
<td>2.25</td>
<td></td>
</tr>
</tbody>
</table>

*CI = Confidence Intervals

The following research hypothesis was stated about the relationship between the variables. Findings are included.
Hypothesis 3. There is a positive combined effect of all-hazards risk perception and HRSA funding for preparedness activities and overall preparedness.

Finding: Risk perception and HRSA funding combined were not found to be associated with preparedness. Hypothesis 3 is rejected.

Summary of Results for Inferential Questions

Data collected in this study were analyzed using the dependent variable of preparedness, to include the subcategories of administration and planning; surge capacity; education and training; communication and notification; staffing and support; isolation and decontamination; supplies, pharmaceuticals, and laboratory support; and overall preparedness and the independent variables of all-hazards risk perception and HRSA funding. The results indicated that there was no statistically significant difference in the odds of a hospital being prepared overall when comparing high versus low risk perception or high versus low HRSA funding, and no interaction was found between HRSA funding and risk perception on preparedness.

Positive associations were identified between risk perception and the subcategory of education and training, and between HRSA funding and isolation and decontamination. Additionally, positive associations were found between system affiliation and staffing and support, and supplies, pharmaceuticals, and laboratory support; and between Joint Commission accreditation and administration and planning, education and training, and supplies, pharmaceuticals, and laboratory support. A positive combined effect of all-hazards risk perception and HRSA funding and preparedness was also not found.
CHAPTER V

DISCUSSION

This research examined the state of disaster preparedness in rural hospitals in the United States and also explored the relationships between perception of risk and HRSA funding on preparedness. Secondary data analysis was conducted on the Preparedness Module of the National Study of Rural Hospitals from Johns Hopkins Bloomberg School of Public Health. This chapter will summarize the results before comparing the results to those found in similar studies. Strengths and limitations of the study will be identified, as well as the significance of the results. The chapter will close with policy implications and recommendations for future research.

Summary of Research Findings

Of the 403 eligible hospitals for the study, 134 responded for a response rate of 33%. The respondent hospitals had a mean licensed bed capacity of 87 beds with a mean operational bed capacity of 65 beds. The size of the Intensive Care Units also varied with a mean licensed ICU bed capacity of 8.2 beds and a mean operational bed capacity of 7.6 beds. Only five of the hospitals had designated burn or trauma beds. Respondents were from 38 states, with the greatest number from Texas with 21 respondent hospitals. The respondents were also from all nine census divisions and all four census regions of the U.S., with the greatest number from the West South Central Division at 31 hospitals and the South Region at 62 hospitals. Of the respondent hospitals, 32% were affiliated with a
health care system, with the most frequently identified factor for staying independent cited as a lack of strategic reason for affiliation. Seventy-five percent of the respondent hospitals were accredited by the Joint Commission, and those that were not cited cost as the primary reason for not pursuing such accreditation.

Natural disasters and vehicular accidents were perceived to pose a far greater risk to rural hospitals than the manmade disasters, with natural disasters and vehicular accidents reported as moderate or high risk in 79% and 77% of the hospitals, respectively, compared to 23% for manmade disasters. In examining the five types of disasters within the manmade category, chemical disasters were perceived to pose a moderate or high risk in 48% of the hospitals; conversely, radiological disasters posed a moderate or high threat at only 13% of the hospitals. Overall, a high or moderate perception of risk was reported in 59% of the hospitals.

Eighty-nine percent of the hospitals received some HRSA funding for preparedness activities. The mean HRSA funding was $77,670 with a median of $50,000. HRSA funding was examined as a continuous and categorical variable with comparable results. HRSA funding was found to be highest in the Northeast, whereas perception of risk was found to be highest in the Midwest.

Seven elements of preparedness, in addition to overall preparedness, were examined across respondent rural acute care hospitals. Overall preparedness was found to be moderate, with a range of the seven elements from low preparedness at 64% of the hospitals (surge capacity) to high preparedness at 91% (isolation and decontamination).

Preparedness was also examined by geographic regions, system affiliation, and Joint Commission accreditation. No statistically significant associations were found with
geographic regions, whereas preparedness was positively associated with system affiliation in the elements of administration and planning; staffing and support; and supplies, pharmaceuticals, and laboratory supplies. Preparedness was also positively associated with Joint Commission accreditation in overall preparedness, and the elements of administration and planning; education and training; and supplies, pharmaceuticals, and laboratory support.

Analyses were conducted between risk perception and the seven subcategories of preparedness and the overall preparedness measure. A positive association was found between only risk perception and education and training. Binary logistic regression analyses were also conducted to predict the probability that risk perception would contribute to the subcategories of preparedness and overall preparedness. The results indicated that there was little evidence that risk perception could predict preparedness. The only positive findings were that hospitals with high risk perception were found to have slightly greater odds of being prepared in education and training compared to hospitals with low risk perception.

Analyses were also conducted between HRSA funding and the seven subcategories of preparedness and overall preparedness. A positive association was found between only HRSA funding and isolation and decontamination. Logistic regression analyses were also conducted to predict the probability that HRSA funding would contribute to the seven subcategories of preparedness and overall preparedness. The results indicated that there was little evidence that HRSA funding could predict preparedness. However, the findings indicated that hospitals with high HRSA funding were found to have slightly greater odds of being prepared in isolation and
decontamination compared to hospitals with low HRSA funding. A positive combined
effect of all-hazards risk perception and HRSA funding and preparedness was not found.

System affiliation was positively associated with staffing and support and
supplies, pharmaceuticals, and laboratory support, while Joint Commission accreditation
was positively associated with administration and planning; education and training; and
supplies, pharmaceuticals, and laboratory support.

Results Compared to Similar Studies

This study contributed to the body of literature on disaster preparedness. Most
studies conducted immediately following the 2001 terrorist attacks cited that increased
preparedness for disasters may have been due to increased awareness and greater
perceived risk following the event (Braun et al., 2004; Gursky, 2004). This heightened
disaster preparedness for manmade and terrorist events does not appear to hold true in
rural areas where perception of risk was found to be low for manmade events.

This study found that overall there is a moderate perception of risk, with a higher
risk perception for natural disasters and vehicular accidents than manmade disasters.
Williams and Magsumbol (2007) indicate that perception of risk influences preparedness
and that the manmade disaster caused by a chemical threat suggests a higher perception of
risk. It should be noted that Williams and Magsumbol’s study is personal risk perception
and not reflective of a hospital. However, even in their study, manmade risk perception
was found to be low.

One hypothesis in this study was that risk perception would be positively
associated with disaster preparedness. The findings demonstrated an association only
between risk perception and education and training. No other evidence of an association
between risk perception and preparedness was found in this study. In his study on
individual risk perception and disaster preparedness, Kirschenbaum (2005) also
hypothesized the link between the two variables and also rejected his hypothesis. He
found that risk perception was not a significantly significant predictor of actual
preparedness behaviors in his model of individual risk perception. Even though this
examination of rural hospital disaster preparedness is the only one known that explores
risk perception of potential disasters in a rural hospital setting, the findings are
comparable to Kirschenbaum’s results of individual risk perception and disaster
preparedness.

Another hypothesis in this study was that HRSA funding would be positively
associated with disaster preparedness but that hypothesis was rejected in all subcategories
and overall preparedness except isolation and decontamination. No studies have been
identified that measure the effectiveness of HRSA funding, although HRSA (n.d.)
identified improvements in disaster planning, and isolation and decontamination
measures, as a result of the funding. The findings of this study are consistent with
HRSA’s statement that improvements in isolation and decontamination are a result of
funding; however, our study was cross-sectional and causality could not be determined.

The third research hypothesis in this study pertained to the combined effect of
both risk perception and HRSA funding on preparedness, an area that has not been
explored in the literature previously. The researcher hypothesized that a relationship
between risk perception and preparedness would vary by level of HRSA funding (low vs.
high); however, no interaction between risk perception and HRSA funding on preparedness was identified. This hypothesis was also rejected.

In this study, rural hospitals were found to be moderately prepared overall for a disaster event. In 2001, Wetter et al. found that urban hospitals were much better prepared than rural hospitals in plans, training, physical resources, and medication supplies; but Niska and Burt (2003) later reported improvements in hospitals in their study, especially in the areas of administration and planning and education and training. Gursky (2004) also cited a generalized improvement in rural hospital preparedness in planning and training.

Although other studies have been conducted on various elements of preparedness, most have been conducted in urban settings (IOM, 2006b). This dissertation is the most comprehensive study conducted to date in a rural environment by focusing on eight elements of preparedness, in addition to the variables of risk perception and HRSA funding. Certain elements were of particular note for further discussion.

This study identified that the element of administration and planning reflected a moderate level of preparedness. There appears to be an improvement in administration and planning in rural hospitals since 2001 when Treat et al. suggested an overall lack of disaster planning in rural areas. While largely cited in urban hospitals, other studies have also suggested that most hospitals have demonstrated overall improvements in administration and planning since 2001 (Niska & Burt, 2005; Thorne et al., 2006).

Highest preparedness levels were found in education and training, and isolation and decontamination, whereas surge capacity was found to have the lowest level of preparedness in this study. This suggests a concern for rural hospitals and a barrier to
overall preparedness. Manley et al. (2006) also suggested that surge capacity was inadequate in rural hospitals, and Thorne et al. (2006) suggested that most non-urban hospitals had inadequate surge capacity, compared to their urban counterparts. This study was consistent with their findings in the identification of inadequate surge capacity in rural hospitals.

The preparedness data were analyzed using a model of disaster preparedness, adopted from the AHRQ assessment tool. The AHRQ tool was the most comprehensive of all tools and models assessed; it included the major elements of preparedness, specific to hospitals, and it was easily applicable to rural hospitals. This tool should be considered for consistent utilization of ongoing measurement due to its comprehension, ease of use, and ability to apply to any hospital.

Strengths and Limitations

Strengths

The current study built upon the work conducted previously by other researchers with a focus on rural hospitals. The perspective of rural hospital CEOs was a significant strength of the study. The study examined preparedness comprehensively and also examined the role of risk perception and HRSA funding on preparedness in a way that other studies had not examined.

The representative sample survey design also reflected a major strength of the study. Mail surveys allowed for wider geographic coverage and follow-up telephone interviewing further supported the wider geographic coverage.
Limitations

There were several limitations of this study. First, this study was conducted with secondary data, and while there are advantages to the use of secondary data, there are challenges as well. Secondary data limit the analysis to the variables that were predetermined without further clarification or probing in regards to the current research questions being examined. For example, question number 3 asked for the amount of HRSA funding received for preparedness activities but did not indicate a time frame, and question 18a also inquired as to the number of drills but did not indicate the time frame for the drills. Also, additional questions could not be added, such as questions related to surveillance and additional questions in the subcategory of staffing and support.

Furthermore, this study was conducted as a self-report of hospital CEOs. Self-reports raise the issue of validity and accuracy (Polit & Hungler, 1991); however, the mailed questionnaire went out before the interview to allow CEOs to consult with others in the hospital who may have been more knowledgeable about some of the study questions (L. Morlock, personal communication, October 9, 2007). Additionally, there may have been response bias based on social desirability, in which the CEO presents a favorable image of his or her facility. There also may be a tendency to overexaggerate the true readiness of the hospital in an attempt to portray a hospital that is in control and capable of handling such an event; therefore, the moderately prepared hospitals may be even less prepared than reported here.

The response rate of 33% was low, although mail surveys are known to have low response rates of about 20% with follow-up phone interviews improving the rate.
(Bourque & Fielder, 2003b). Additionally, the respondents were not representative, relative to the target population, in terms of geographic region (see Table 31). The Northeast had a response rate of 70% but the results may not be generalizable to the South and West regions that had response rates of 28% and 26%, respectively. Although there were these regional differences between CEO respondents and nonrespondents, geographic region was not associated with preparedness, so it should not have introduced bias. In addition, no statistically significant differences between respondents and nonrespondents were found with respect to either system affiliation or Joint Commission accreditation, two potential confounders.

Table 31

*Target Population and Respondents by Geographic Region*

<table>
<thead>
<tr>
<th>Region</th>
<th>Population</th>
<th>Respondents</th>
<th>% Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>23</td>
<td>16</td>
<td>70%</td>
</tr>
<tr>
<td>Midwest</td>
<td>104</td>
<td>42</td>
<td>40%</td>
</tr>
<tr>
<td>South</td>
<td>222</td>
<td>62</td>
<td>28%</td>
</tr>
<tr>
<td>West</td>
<td>54</td>
<td>14</td>
<td>26%</td>
</tr>
</tbody>
</table>

Response bias may have occurred. For instance, those individuals who did not complete the survey may have been less interested and less prepared than hospitals willing to take time to discuss preparedness issues. However, this is unlikely given that this was only one module of a much larger study.
Significance of Results

The results of the study indicate that the majority of rural hospitals in the United States are, overall, moderately prepared for a disaster event with high preparedness in the areas of education and training, and isolation and decontamination. Both of these subcategories were focus areas for HRSA funding and it should be noted that there was a positive association found in this study between HRSA funding and isolation and decontamination (OR = 1.26, 95% CI, 1.08, 1.83).

The results of one area—surge capacity—indicate that more work to improve preparedness levels needs to be done. Low preparedness was found in this subcategory (64%) and the logistic regression model identified that none of the independent variables made a statistically significant contribution to the model. Rural hospitals need to explore alternative mechanisms for surge capacity, such as considering other local facilities, for example, schools and armories (AHRQ, 2004).

While the low response rate may have skewed the results, rural hospitals were moderately prepared for a disaster event. Moderately prepared is not sufficient in the event of a disaster and concerted efforts must be taken by hospital CEOs to elevate moderate preparedness to high preparedness. The results of this study should be shared with professional organizations, state and national emergency service agencies, and disaster response teams to assist in promoting tools and guidance for disaster preparedness in rural hospitals.

The respondents reported a greater perception of risk from natural disasters and vehicular accidents than from manmade disasters. Overall, 59% of the hospitals reported
a high or moderate perception of risk. With a greater emphasis on all-hazards preparedness and less emphasis on specific threats, risk perception of varying threats may actually be a moot issue. Risk perception of all hazards may be more important than individual disasters events.

However, the results indicated that risk perception may not be a factor in disaster preparedness with the exception of the subcategory of education and training. While further funding may be useful, funding did not represent a significant predictor of disaster preparedness except in the area of isolation and decontamination. Because Joint Commission requires the activation of disaster preparedness standards at its accredited hospitals, accreditation may actually represent the strongest predictor of preparedness.

Policy Implications

Although there are efforts to improve the preparedness of hospitals in the United States, there are still tremendous gaps between these efforts and the preparedness status of rural hospitals as evidenced by the findings in this research. Thus, several recommendations are offered:

1. There needs to be a standardized method to consistently measure preparedness across all hospitals. The AHRQ framework represented an excellent measurement tool and should be considered as a consistent standard. The element of surveillance should be included in the measurement tool as well.
2. Professional organizations, such as the National Rural Health Association, should utilize the findings from this research to create a broader forum for discussion about the critical issues of disaster preparedness facing rural acute
care hospitals in the U.S. There also needs to be more sharing of best practices and this could be conducted through workshops and Internet-based forums on behalf of these professional organizations.

3. Hospital officials need to explore feasible alternatives for surge capacity in the event of a disaster. Community and public health forums should be conducted to involve all entities, not just hospitals.

4. Healthcare officials must be encouraged to access available government funding for preparedness and to utilize the funds in more areas than administration and planning and isolation and decontamination. There was evidence that HRSA funding was associated with isolation and decontamination. Funding should be utilized for other areas of vulnerability as well, such as surge capacity and staffing. Grants and other funding streams should also be pursued.

5. Rural hospital CEOs should build and maintain local and state partnerships in an effort to access crucial resources in the event of a disaster, particularly as related to surge capacity and staffing.

6. Hospital officials must be encouraged to expand education and mock drills. Education and drills are particularly needed in the area of surge capacity.

7. Federal and state policy makers should be more involved in setting minimum expectations for hospital preparedness, especially in those hospitals that are not accredited by Joint Commission.
Future Research

This study served to quantify the levels of preparedness for rural hospitals in the United States. Future research should include additional studies related to risk perception, HRSA funding, and preparedness.

The findings serve as a baseline measurement for rural U.S. hospital preparedness. This study should be repeated with attempts to further increase the response rate. Additional variables should also be added, such as surveillance and further questions on staffing and support. A similar research project should also be considered that focuses intently on only one or two vulnerable areas, such as surge capacity and staffing. Further research should also be conducted to identify the best predictors of preparedness in order to optimize readiness for a disaster event.
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Appendix A
Definitions
## Definitions

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access to Care</td>
<td>Element of the AHA framework; refers to resources for vulnerable populations, such as children, the elderly, homeless, remote populations, chronically ill, those with cultural / language barriers, and the physically and mentally disabled (AHA, 2001b).</td>
</tr>
<tr>
<td>Administration and Planning</td>
<td>Element of AHRQ tool; the overall organizational structure and the disaster planning to include the development of policies, plans, procedures, and strategies (Davis, 2002).</td>
</tr>
<tr>
<td>All Hazards Event</td>
<td>Any, and all, types of disaster events, including simultaneous emergencies (Farmer, 2006); a conceptual and management approach that uses the same set of management arrangements to deal with any and all types of disasters (O'Leary, 2006).</td>
</tr>
<tr>
<td>Biological Disaster</td>
<td>An event that can occur with the release of a pathogen or biotoxin against humans, plants, or animals (National Academy of Engineering, 2004a). This includes bioterrorism agents, such as anthrax, smallpox, botulism, and plague or can include outbreaks of infectious disease with a high risk of transmission and serious health effects, such as severe acute respiratory syndrome (SARS) and the avian flu (IOM, 2006b).</td>
</tr>
<tr>
<td>Business Continuity Plan</td>
<td>Element of the AHA framework; the rapid recovery and timely resumption of critical operations following a wide-scale disruption (O'Leary, 2006).</td>
</tr>
<tr>
<td>Chemical Disaster</td>
<td>A situation in which a hazardous chemical is released and the release has the potential for harming people’s health (National Academy of Engineering, 2004b). Releases can be unintentional as in an industrial accident, or intentional as in a terrorist attack (IOM, 2006b).</td>
</tr>
<tr>
<td>Disaster</td>
<td>A low probability but high impact event that causes a large number of individuals to become ill or injured (IOM, 2006b). An emergency of severity and magnitude resulting in deaths, injuries, illness, and / or property damage that cannot be effectively managed by the application of routine procedures or resources (Landesman, 2001).</td>
</tr>
<tr>
<td>Education and Training</td>
<td>Element of AHRQ tool; knowledge-based learning that hospital associates undergo to gain insights in disaster preparedness (Manley et al., 2006). The primary area of training can be represented by disaster drills as a learning opportunity (IOM, 2006b).</td>
</tr>
<tr>
<td>------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Explosive Disaster</td>
<td>An event characterized by a compound or mixture that causes a rapid chemical reaction (O’Leary, 2006) in which injuries can include blunt force and shock wave induced trauma, as well as burns, hearing loss, and injuries from shrapnel and the secondary collapse of structures (IOM, 2006b).</td>
</tr>
<tr>
<td>Facility Management</td>
<td>Element of the AHA framework; a security plan that addresses limiting access to the facility, crowd control, controlling the media, and augmenting the security force (AHA, 2001b).</td>
</tr>
<tr>
<td>Isolation and Decontamination</td>
<td>Element of AHRQ tool; infection control issues related to negative pressure isolation capacity for airborne diseases and decontamination to individual(s) with potential or actual hazardous agents in or on their body (HRSA, 2004). It also involves procurement of personal protective equipment, including respiratory equipment, garments, and barrier materials used to protect rescuers and medical personnel from exposure to biological, chemical, and radioactive hazards (Farmer, 2006; IOM, 2006b).</td>
</tr>
<tr>
<td>Manmade Disasters</td>
<td>Hazards that have been created by human activities (Sundnes &amp; Birnbaum, 2003) and may be intentional or unintentional (IOM, 2006a); further broken down into five categories: chemical, biological, radiological, nuclear, and explosive, commonly referred to as CBRNE (IOM, 2006b).</td>
</tr>
<tr>
<td>Mass Casualty Incident</td>
<td>Situation in which there are a large number of ill or injured people, and can contribute to a disaster or be the result of a disaster (O’Leary, 2006). Can also, of itself, be considered a disaster as a result of various types of accidents, such as multi-vehicular crashes (IOM, 2006b). In this study, this is also referred to as a vehicular accident.</td>
</tr>
</tbody>
</table>
### Definitions—Continued

| **Materials** | A component of the personnel – materials – methods model; the essential equipment and the apparatus necessary in the chain of medical care according to current medical standards and includes equipment for the basic treatment and monitoring of a victim’s airway, breathing, and circulation (DeBoer, 1997). |
| **Methods** | A component of the personnel – materials – methods model; a fixed way of acting in order to reach a certain goal and includes various plans, procedures and protocols (DeBoer, 1997). |
| **Metropolitan Statistical Area** | A census area that contains one or more central counties with urbanized areas (Coburn et al., 2007). |
| **Mitigation** | First phase of the disaster cycle; alterations that are achieved before an event occurs that lessen or decrease vulnerability (Sundnes & Birnbaum, 2003). |
| **Natural Disasters** | Events that are considered unavoidable (Sundnes & Birnbaum, 2003) and refer to extreme events that may result in deaths and injuries such as earthquakes, extreme heat / extreme cold, winter storms, thunderstorms, floods, hurricanes, tornadoes, tsunamis, volcanoes, and mudslides (IOM, 2006a). |
| **Non-Metropolitan Statistical Area** | A census area that is outside the boundaries of metropolitan areas and can be subdivided into micropolitan areas, representing urban clusters of 10,000 or more people, and non-core counties (Coburn et al., 2007). |
| **Nuclear Disaster** | An event that can result from the use of a device that produces a nuclear explosion (IOM, 2006b) and could cause substantial fatalities, injuries, and infrastructure damage from the heat and blast of the explosion, and significant radiological consequences from both the initial nuclear radiation and the radioactive fallout that settles after the initial event (National Academy of Engineering, 2005). |
| **Outcome** | A component of the structure-process-outcome model; refers to end results, usually specified in terms of health, welfare, and satisfaction (Donabedian, 1969) and includes the maintenance or restoration of affected (or potentially affected) populations' health status (Nelson et al., 2007). |
| **Personnel** | A component of the personnel — materials — methods model; consists of doctors, nurses, paramedics and others who have their duties in the chain of medical care in an organized way (DeBoer, 1997). |
| **Psychiatric Services and Crisis Counseling** | Element of the AHA framework; addresses preparation for the emotional and mental health impacts for staff, patients and families (AHA, 2001b). |
| **Preparedness** | Represents the second phase of the disaster cycle; the process of turning awareness of risks into actions that improve the capability to respond to, and recover from disasters (National Research Council, 1991); also referred to as disaster preparedness or emergency preparedness or hospital preparedness. |
| **Process** | A component of the structure-process-outcome model; those activities and chains of events that produce specific outcomes (Seid et al., 2007) and include those activities executed during an emergency response, such as mass prophylaxis, isolation and quarantine, and public communication (Nelson et al., 2007). |
| **Radiological Disaster** | This refers to the spreading of radioactive material (National Academy of Engineering, 2004c) caused by dirty bombs or by compromising the containment of nuclear power stations or nuclear storage facilities (IOM, 2006b). |
| **Recovery** | The final phase of the disaster cycle; the post-response measures undertaken to restore normalcy (O'Leary, 2006) and to bring all of the components back to their pre-event functional status (Sundnes & Birnbaum, 2003). |
### Definitions—Continued

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Response</strong></td>
<td>The third phase of the disaster cycle; the totality of measures undertaken during and immediately after the disaster impact to address to the situation to the degree possible (O’Leary, 2006).</td>
</tr>
<tr>
<td><strong>Staffing and Support</strong></td>
<td>Element of AHRQ tool; the availability of a system that allows for the advanced registration and credentialing of clinicians needed to augment a hospital’s staffing to meet increased patient/victim needs (HRSA, 2005). It also includes the attempt to assure adequate patient care providers in the event of a disaster (Farmer, 2006).</td>
</tr>
<tr>
<td><strong>Structure</strong></td>
<td>A component of the structure-process-outcome model; the instrumentalities of care and of their organization (Donabedian, 1969) and includes personnel, equipment, training, leadership, planning, and exercises with corrective action (Nelson et al., 2007).</td>
</tr>
<tr>
<td><strong>Supplies, Pharmaceuticals and Laboratory Support</strong></td>
<td>Element of AHRQ tool; refers to the availability of critical supplies, pharmaceuticals, and laboratory support services in the wake of a disaster (HRSA, 2004); can be arranged through optimizing support, stockpiling pharmaceuticals and/or arrangements with an external entity in order to procure the necessary supplies (Farmer, 2006).</td>
</tr>
<tr>
<td><strong>Surge Capacity</strong></td>
<td>A hospital’s ability to expand quickly beyond normal services to meet an increased demand for medical care in the event of a large-scale disaster (AHRQ, 2004; Rodgers, Foushee, Terndrup, &amp; Gaddis, 2006). It encompasses potential patient beds and available space in which patients may be triaged, managed, vaccinated, decontaminated or simply located (JCAHO, 2003). Surge bed capacity for intensive care unit beds, general acute care beds, and burn or trauma beds can indicate whether a hospital can expand to at least 20 percent over capacity within 24 hours (Schultz &amp; Koenig, 2006).</td>
</tr>
<tr>
<td>Definitions—Continued</td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td><strong>Surveillance</strong></td>
<td>The ongoing, systematic collection, analysis, and interpretation of data about a specific health event, or to determine if a health event is occurring (Institute for Crisis, Disaster, and Risk Management, 2007) in order to detect changes in trend or distribution to initiate further investigative or control measures (O’Leary, 2006).</td>
</tr>
<tr>
<td><strong>Vehicular Accident</strong></td>
<td>Situation in which there are a large number of ill or injured people, and can contribute to a disaster or be the result of a disaster (O’Leary, 2006). Can also, of itself, be considered a disaster as a result of various types of accidents, such as multi-vehicular crashes (IOM, 2006b). Also referred to as a mass casualty incident.</td>
</tr>
</tbody>
</table>
Appendix B

Development of Preparedness Module
Development of Preparedness Module

**CITATIONS/LITERATURE**


- Gursky EA. Hometown Hospitals: The Weakest Link? Bioterrorism Readiness in America's Rural Hospital, Report Commissioned by the National Defense University, Center for Technology and National Security Policy, June 2004


**SURVEYS/QUESTIONNAIRE/ANALYSIS**


- Preparedness Questionnaire for Healthcare Facilities. Chemical, Biological, Nuclear and Explosive (All Hazards), AHRQ-HRSA, OMB Number 0935-0123, April 30, 2005.


- Medical Center Hazard and Vulnerability Analysis, Kaiser Foundation Health, Inc., 2001

**CORRESPONDENCE and ADVICE FROM EXPERTS**

- Skidmore, Sue, Project Manager for an AHRQ task called National Hospital CBRNE Response Readiness Assessment, AHRQ Advisory Committee Invitation


- Todd, Jennifer, HRSA, 2005

**MISCELLANEOUS**

- Advisory Committee Review, AHRQ National Hospital Readiness Assessment, June 2005.


L. Engineer, personal communication, December 5, 2006
Appendix C

Cover Letter
National Study of Rural Hospitals
410-955-3121/FAX 410-955-6959

April 28, 2006

ABC
CEO and President
WYZ hospital
123 Street
City, State 100001

Dear Mr. ABC:

The Johns Hopkins University is currently conducting a national study of
the issues and challenges confronting U.S. rural hospitals and rural communities.
Funding for this project has been provided by the U.S. Agency for Healthcare
Research and Quality. As part of this study we have collected publicly available
information on hospital services, finances and service areas. We are also
conducting telephone interviews with the Chief Executive Officers (CEOs) of a
diverse and regionally representative group of rural hospitals in order to
understand in greater depth the effects of changes in Medicare payment policies
and the strategies hospitals are using in their efforts to achieve financial stability
and high quality services. The study is focusing on hospitals that have not
converted to Critical Access Hospitals in order to help highlight for policy makers
and the public the needs and concerns of this very diverse group of rural
hospitals and community settings.

Your hospital has been selected as part of our study sample. We hope
that you will be willing to participate in the project by answering questions during
a one hour telephone interview. The interview will include questions about your
service area, professional staff, available information technology, preparedness
activities and access to capital. As part of this interview we will also ask you to
verify the accuracy of information we have obtained from the American Hospital
Association and the Medicare Cost Reports regarding the services your hospital
has offered during the past ten years and trends in your financial experience.
We are particularly interested in your opinions regarding how changes in
Medicare payment policies have affected your hospital.

We have included with this letter each of the survey modules that will be
covered as part of the interview. A member of our research team will be
contacting your office within the next few days to try to arrange an appointment
for a telephone interview at a time that is most convenient for you. During the
interview we will also seek your consent to contact your Director/Vice President
of Nursing and the individual on your staff who is most knowledgeable regarding
quality of care and patient safety activities.
Your participation in this study is of course completely voluntary. All information that you provide will be treated as strictly confidential. Study results will be reported in the form of statistical summaries without revealing any information that would identify specific individuals, hospitals or communities.

This study will provide critical information regarding the health care challenges currently faced by hospitals in rural America. Results will be widely disseminated to the general public, to rural hospital constituencies and professional groups, to state and federal government agencies and to congressional staff members of the House Rural Health Care Coalition and the Senate Rural Health Caucus. We will also share with you an early summary of the study results for the nation, by region, and for specific types of rural hospitals.

We certainly realize the many demands on rural hospital leaders, but we hope you will be able to make time in your busy schedule to participate in this study. Please do not hesitate to call me at the number above if you have any questions about the project.

With my best wishes,

Laura Morlock, PhD
Professor and Project Director
National Study of Rural Hospitals

LM/mw

Enclosures
Appendix D

Letter Sent Post-Interview
June 12, 2006

ABC
CEO and President
WYZ hospital
123 Street
City, State 100001

Dear Mr. ABC:

I would personally like to thank you for taking the time to participate in our study of U.S. rural hospitals. Our Project Director and project team members would also like to convey their deepest appreciation for your very thoughtful responses to our interview questions.

We would like to emphasize again that the information provided by you will be treated as strictly confidential. Study results will only be reported in the form of statistical summaries. We hope to complete the interview portion of our study by spring next year. We look forward to sharing with you our survey results for the nation, by region, and for specific types of rural hospitals.

As suggested by you during our interview, we have enclosed copies of our Quality and Safety and Nursing modules for your review. We hope to collect this information from the individual on your staff who you feel is the most knowledgeable regarding quality of care and patient safety activities at your hospital and your Director/Vice President of Nursing. We hope that you will forward these modules to the most appropriate individuals and encourage them to participate in our study. The Quality and Safety module is in a mail-in format that should require no more than thirty minutes to complete. We have included a self addressed pre-paid return envelope for this module. For the Nursing module, a Johns Hopkins Nursing faculty member will call to arrange a telephone interview with your Director of Nursing.

Once again, we would like to express our thanks for your cooperation and patience. Your survey responses and additional thoughts will go a long way toward helping us document the great diversity among rural hospitals that have not converted to critical access facilities. The information you have provided will also help promote greater understanding among policy makers regarding the critical issues and challenges rural hospitals are currently confronting as they strive to meet community needs for high quality services while achieving financial stability.

With our best wishes,

Lilly Engineer
Project Coordinator
National Study of Rural Hospitals

Enclosures
Appendix E

Letter From the Human Subjects
Institutional Review Board
Date: October 10, 2006

To: Barbara Cliff, Student investigator for dissertation

From: Amy Naugle, Ph.D., Chair

Re: Approval not needed

This letter will serve as confirmation that your project "Rural Hospital Preparedness" has been reviewed by the Human Subjects Institutional Review Board (HSIRB). Based on that review, the HSIRB has determined that approval is not required for you to conduct this project because you are studying hospital systems and not gathering information about individuals. Thank you for your concerns about protecting the rights and welfare of human subjects.

A copy of your protocol and a copy of this letter will be maintained in the HSIRB files.
Appendix F

Preparedness Variables
## Preparedness Variables

<table>
<thead>
<tr>
<th>Indicator (module question number)</th>
<th>Subcategory</th>
<th>Level</th>
<th>Scale</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Coordinator (5)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>2. Plan for integration of role (6a)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>3. Planning w/ other health care facilities (6b)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>4. Plan for MOU w/ other hospitals (6c)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>5. Plan for establishment of alt care site (6d)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>6. Plan for cx of elective procedures (6e)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>7. Plan for conversion of PACU to augment ICU (6f)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>8. Plan for activation of decommissioned space (6g)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>9. Plan for utilization of non-clinical space (6h)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>10. Plan for stockpiling antibiotics (6i)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>11. Plan for coordinated supply management (6j)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>12. Plan for communication with local PH (6k)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>13. Plan for communication with state PH (6l)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>14. Plan for media &amp; public affairs (6m)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>15. Plan for evacuation of patients (6n)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>16. Have an Incident Command System (7)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>17. Staff trained in ICS (7a)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>18. Alternative emergency electric supply (8)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>19. Power protected from flooding (8a)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>xx. Mechanical Ventilators (9a)</td>
<td>Eliminate; no known standard</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subcategories:
- **AP** = Administration and Planning
- **SC** = Surge Capacity
- **ET** = Education and Training
- **CN** = Communication and Notification
- **SS** = Staffing and Support
- **ID** = Isolation and Decontamination
- **SP** = Supplies, Pharmaceuticals, and Laboratory Support
### Preparedness Variables—Continued

<table>
<thead>
<tr>
<th>Indicator (module question number)</th>
<th>Subcategory</th>
<th>Level</th>
<th>Scale</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>xx. Personal Protective Equipment (9b)</td>
<td></td>
<td></td>
<td></td>
<td>Eliminate; no known standard</td>
</tr>
<tr>
<td>20. Negative Pressure Rooms (9c)</td>
<td>AP</td>
<td>N</td>
<td>Yes/No</td>
<td>At least 1 room (HRSA, 2005)</td>
</tr>
<tr>
<td>xx. Average daily census (10)</td>
<td></td>
<td></td>
<td></td>
<td>Eliminate; N/A</td>
</tr>
<tr>
<td>xx. Times reached operational capacity (11)</td>
<td></td>
<td></td>
<td></td>
<td>Eliminate; no known standard</td>
</tr>
<tr>
<td>xx. Seasonal or cyclical trends (12)</td>
<td></td>
<td></td>
<td></td>
<td>Delete; N/A</td>
</tr>
<tr>
<td>21. Surge bed capacity: ICU (13a)</td>
<td>SC</td>
<td>N</td>
<td>Yes/No</td>
<td>20%/24 hours</td>
</tr>
<tr>
<td>22. Surge bed capacity: Acute Care (13b)</td>
<td>SC</td>
<td>N</td>
<td>Yes/No</td>
<td>20%/24 hours</td>
</tr>
<tr>
<td>23. Surge bed capacity: Burn/Trauma (13c)</td>
<td>SC</td>
<td>N</td>
<td>Yes/No</td>
<td>Deleted from study due to &lt;4% burn units</td>
</tr>
<tr>
<td>24. Plan addresses increasing bed avail (14)</td>
<td>SC</td>
<td>N</td>
<td>Yes/No</td>
<td>Deleted from study due to 10% missing data</td>
</tr>
<tr>
<td>25. Participant in regional system (15)</td>
<td>SC</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>26. Receive patients through NDMS (16)</td>
<td>SC</td>
<td>N</td>
<td>Yes/No</td>
<td>Deleted from study due to 10% missing data</td>
</tr>
<tr>
<td>27. All Hospital staff educated (17)</td>
<td>ET</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>28. Staff participate in exercises/drills (18)</td>
<td>ET</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>29. How many drills (18a)</td>
<td>ET</td>
<td>N</td>
<td>Yes/No</td>
<td>Deleted from study due to 10% missing data</td>
</tr>
<tr>
<td>30. Revise plan as a result of drill (18b)</td>
<td>ET</td>
<td>N</td>
<td>Yes/No</td>
<td>Deleted from study due to 10% missing data</td>
</tr>
<tr>
<td>xx. Do you know..... (19)</td>
<td></td>
<td></td>
<td></td>
<td>Eliminate</td>
</tr>
<tr>
<td>31. Backup communication systems (20)</td>
<td>CN</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>32. Availability of HAM radio (20a)</td>
<td>CN</td>
<td>N</td>
<td>Yes/No</td>
<td>Denominator is Indicator 31 (20)</td>
</tr>
<tr>
<td>33. Internet access in ED (21)</td>
<td>CN</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
</tbody>
</table>

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### Preparedness Variables—Continued

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<tr>
<th>Indicator (module question number)</th>
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<th>Level</th>
<th>Scale</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>34. High speed internet access (21a)</td>
<td>CN</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>35. Advanced registration &amp; credentialing (22)</td>
<td>SS</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>36. Plan addresses decontamination (23)</td>
<td>ID</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>37. Have access to decontamination showers (24)</td>
<td>ID</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>38. Respiratory protection program (25)</td>
<td>ID</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>xx. % lab specimens analyzed in house (26)</td>
<td>Eliminate; N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>xx. % lab specimens analyzed by contract (27)</td>
<td>Eliminate; N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39. Alternative labs identified (28)</td>
<td>SP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>40. Lab support plan (29)</td>
<td>SP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>41. Agreements for additional supplies of meds (30)</td>
<td>SP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
<tr>
<td>42. Agreement in place for regional stockpiles (30e)</td>
<td>SP</td>
<td>N</td>
<td>Yes/No</td>
<td></td>
</tr>
</tbody>
</table>

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