ORIGINAL RESEARCH

Is There an Association Between Risk Perception and Disaster Preparedness in Rural US Hospitals?

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Abbreviations:
AHM = all-hazards measure
AHRQ = Agency for Healthcare Research and Quality
AP = administration and planning
BT = biological threat
CEO = chief executive officer
CT = chemical threat
ET = explosive threat
ICU = intensive care unit
ID = isolation and decontamination
MD = humanmade disaster
NT = nuclear threat
OPM = overall preparedness measure
RT = radiological threat
SC = surge capacity
SP = supplies, pharmaceuticals, and laboratory support
SS = staffing and support

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Abstract

Introduction: This study examined disaster preparedness, risk perception, and their association in rural hospitals in the United States. The focus of disaster preparedness largely has been centered on urban areas, in part because of the perception that more concentrated areas have an increased risk of a disastrous event. Therefore, it was hypothesized that risk perception may be a contributing factor for adequate preparedness in rural areas. This research was a component of a larger study of rural hospital preparedness. The objective of this study was to describe the perceived risk of disaster events and the status of disaster preparedness in rural hospitals. It was hypothesized that there is a positive association between risk perception and preparedness.

Methods: Secondary data analysis was conducted using the National Study of Rural Hospitals (2006–2007) from Johns Hopkins University. The study, based on a regionally stratified, random sample of rural hospitals, consisted of a mailed questionnaire and a follow-up telephone interview with each hospital's Chief Executive Officer (n = 134). A model of disaster preparedness was utilized to examine seven elements of preparedness. Risk perception was examined through seven perceived risk threats.

Results: The results indicated that rural hospitals were moderately prepared, overall, (78% prepared on average), with higher 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 lower preparedness in surge capacity (64%).

The respondents reported greater perceived risk from disasters due to natural hazards (79% reported moderate to high risk) and vehicular accidents (77%) than from humanmade disasters (23%). 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 = 0.61; 95% CI = 0.26–1.44). Positive associations were identified only between higher perceived risk overall and the subcategory of education/training preparedness (OR = 1.24; 95% CI = 1.05–1.27).

Conclusions: Rural hospitals reported being moderately prepared in the event of a disaster with a low perception of risk for human-made disasters. 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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Introduction

This research explored the issue of disaster preparedness among rural hospitals in the United States. While disasters can occur in urban and rural areas, a recent analysis found that, within the US, the rural healthcare infrastructure was ill-prepared for a large-scale disaster compared to urban areas because of limited capabilities.[1] The Office of Rural Health Policy also found that rural hospitals

tend to have less capacity and resources than their urban and suburban counterparts,[2] and therefore, may be more vulnerable to terrorism and other serious public health threats.[3]

The focus of disaster preparedness has been largely centered in urban areas, in part because of the perception that more concentrated population areas are likely to have an increased risk of a disastrous event.[4] Risk perceptions 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, the proximity to international borders, and the availability of food and water supplies in rural America.[1,5] Since rural areas also can be targets of disasters and may not all have considered the likelihood of that occurrence, risk perception was hypothesized to be a contributing factor for adequate preparedness.

The purpose of this research was to examine the current state of disaster preparedness in rural hospitals in the US and to explore the perceived risk of a disaster event. This study also sought to determine the relationship between preparedness and perception of risk in rural hospitals.

Methods

This research was based on a secondary analysis of survey data from the Preparedness Module of the National Study of Rural Hospitals, conducted by the Johns Hopkins Bloomberg School of Public Health from 2006–2007. A survey questionnaire was utilized in this research to gather information directly from the Chief Executive Officers (CEOs) in rural acute care hospitals in the US in an effort to describe and explore issues related to preparedness. A non-experimental, cross-sectional research design was used that consisted of a mail survey and follow-up telephone interview to explore the current status of disaster risk perceptions and disaster preparedness in rural hospitals.

The unit of study for this research was rural acute care, non-critical access, and hospitals. Because there is no universally preferred definition of "rural" that serves all policy purposes,[6] the US Office of Management and Budget's definition of rural as a non-metropolitan statistical area with micropolitan areas and non-core counties was adopted for this study.[7]

Independent Variable: Risk Perception

In this study, risk perception referred to the perceived probability of a specified type of accident happening according to the self-assessment of hospital CEOs in rural acute care hospitals in the US. Seven disaster events were included in this study: disasters due to natural hazards (ND); mass-casualty incidents or vehicular accidents (VA); and the five subcategories of humanmade disasters (MD) including chemical threats (CT), biological threats (BT), radiological threats (RT), nuclear threats (NT), and explosive threats (ET). Each event was self-reported by the hospital CEOs 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):

$$AHM = 5(ND) + 5(VA) + 1(CT + BT + RT + NT + ET).$$

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. The remaining events were left independent. This formula, in effect, weights disasters due to natural hazards, humanmade disasters, and vehicular accidents equally. 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. A dichotomous measure also was created, low AHM (<30) and high AHM (≥30), based on the midpoint of possible responses for perception of risk.

Dependent Variable: Preparedness

Preparedness was examined by using a model adapted from a data collection tool made widely available by the Agency for Healthcare Research and Quality (AHRQ) to assess the capacity of hospitals and health systems to respond to a disaster.[8–10] The data collection tool and model criteria included eight key elements of hospital preparedness regardless of the type of disaster: (1) administration and planning; (2) surge capacity; (3) education and training; (4) communication and notification; (5) staffing and support; (6) isolation and decontamination; (7) supplies, pharmaceuticals, and laboratory support; and (8) surveillance. The secondary data utilized for this study had no questions specific to surveillance; thus, there were only seven subcategories of preparedness for this study. There were 37 indicators within the seven subcategories of preparedness. 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."

The responses to each indicator were added to establish a total sub-score for each subcategory; the possible range of responses for each were: (1) administration and planning (AP), 0–20; (2) surge capacity (SC), 0–3; (3) education and training (ET), 0–2; (4) communication and notification (CN), 0–4; (5) staffing and support (SS), 0–1; (6) isolation and decontamination (ID), 0 to 3; and (7) supplies, pharmaceuticals, and laboratory support (SP), 0–4.

For each hospital the total for each subcategory was then divided by 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) is shown in Figure 1.

Using the seven preparedness subcategories and assuming they should be weighted equally, an Overall Preparedness Measure (OPM) was formulated:

$$OPM = (AP + SC + ET + CN + SS + ID + SP)/7.$$

The range of responses for the preparedness measures was from 0.0 (not prepared) to 1.0 (optimally prepared) with

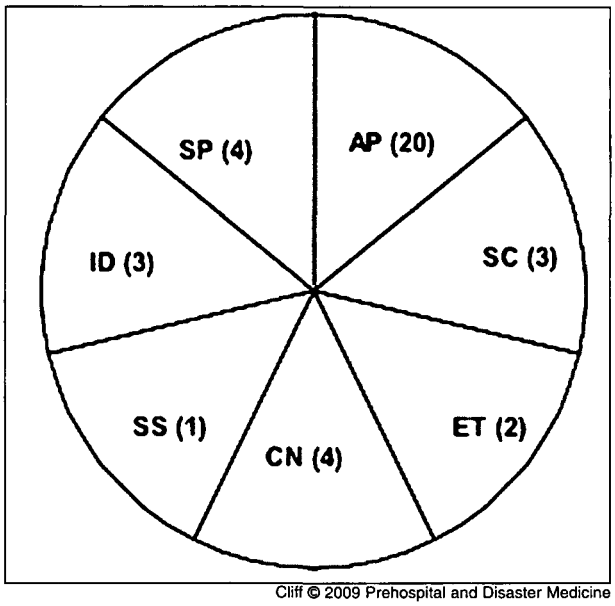

Figure 1—Model of Disaster Preparedness Subcategories: AP = Administration and Planning; SS = Staffing and Support; SC = Surge Capacity; ID = Isolation and Decontamination; ET = Education and Training; CN = Communication and Notification; SP = Supplies, Pharmaceuticals, and Laboratory Support

≤0.65 representing low preparedness, 0.66 to 0.85 as moderate preparedness, and >0.85 as high preparedness, based on the creation of tertiles of responses for overall preparedness. The categorical measure was based on low OPM (<0.75) and high OPM (≥0.75) and was selected based on the midpoint of responses for overall preparedness.

Data Processing

The Statistical Package for the Social Sciences (SPSS, Inc., version 15.0, Chicago, IL) was used for all statistical analyses. Bivariate descriptive statistics were calculated on the research questions pertaining to the current state of preparedness and risk perception. Multivariable binary logistic regression, using the forced entry method, was used to test the association between preparedness and risk perception.

Results

Of the 403 hospitals eligible 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 (ICU) 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 (n = 21). The respondents were also from hospitals from all nine census divisions and all four census regions of the US, with the greatest number from the West South Central Division (n = 31) and the South Region (n = 62).

Among rural acute care hospitals in the US, the perceived risk of disaster events varied according to the type of disaster. Disasters due to natural hazards had the highest perceived risk with 21% reporting high risk, followed closely by vehicular accidents, with 20% reporting high risk; this difference was not statistically significant with a 9% margin of error. Only 2% of the respondents identified humanmade 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 humanmade disasters, followed by 23% low risk for vehicular accidents, and 21% for disasters due to natural hazards.

Humanmade 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 no hospitals reported high perceived risk of radiological threats. However, these differences were not statistically significant. Radiological threats were found to be perceived as the lowest threat among the five humanmade disasters, with 87% of the rural hospitals reporting low perception of radiological threats.

The all-hazards measure (AHM) is a combination of disasters due to natural hazards, vehicular accidents, and all humanmade disasters. In this study, 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%. Based on this study, the average AHM was 26.12; the low end of the moderate risk perception category (range: 26–35).

Risk perception also was examined in relation to geographic regions. Risk perception of disasters due to natural hazards was found to be highest in the Midwest (33% perceived high risk), compared to the South (18%), West (14%), or the Northeast (6%) (Pearson chi-square, 21.84, p <0.005). No differences by region were found for vehicular accidents (Pearson chi-square, 3.45, p = 0.75), humanmade disasters (31.24, p = 0.07), or the AHM (6.31, p = 0.39).

Seven subcategories of preparedness were examined across respondent rural acute care hospitals in the US. Of these seven subcategories, surge capacity was found to have low preparedness (0.64; 95% CI = 0.58–0.69). Four subcategories had moderate preparedness, including administration and planning (0.80; 95% CI = 0.77–0.83); communication and notification (0.83; 95% CI = 0.78–0.85); staffing and support (0.66; 95% CI = 0.58–0.74); and supplies, pharmaceuticals, and laboratory support (0.70; 95% CI = 0.65–0.75). Two subcategories were found to have high preparedness: education and training (0.89; 95% CI = 0.85–0.94) and isolation and decontamination (0.91; 95% CI = 0.86–0.94) (Figure 2).

The overall preparedness measure (OPM) is a combination of all seven subcategories of preparedness. Based on this study, the average OPM was 0.78, which is within the scale of moderate preparedness. In this study, there was an overall higher preparedness level in 47 (35%) of the hospitals, compared to an overall lower preparedness level in 25 (19%) and a moderate preparedness level in 62 (46%) of the hospitals. Preparedness also was examined in relation to geographic region and no statistically significant differences by region were found in any element of preparedness. A Pearson chi-square test was conducted to determine

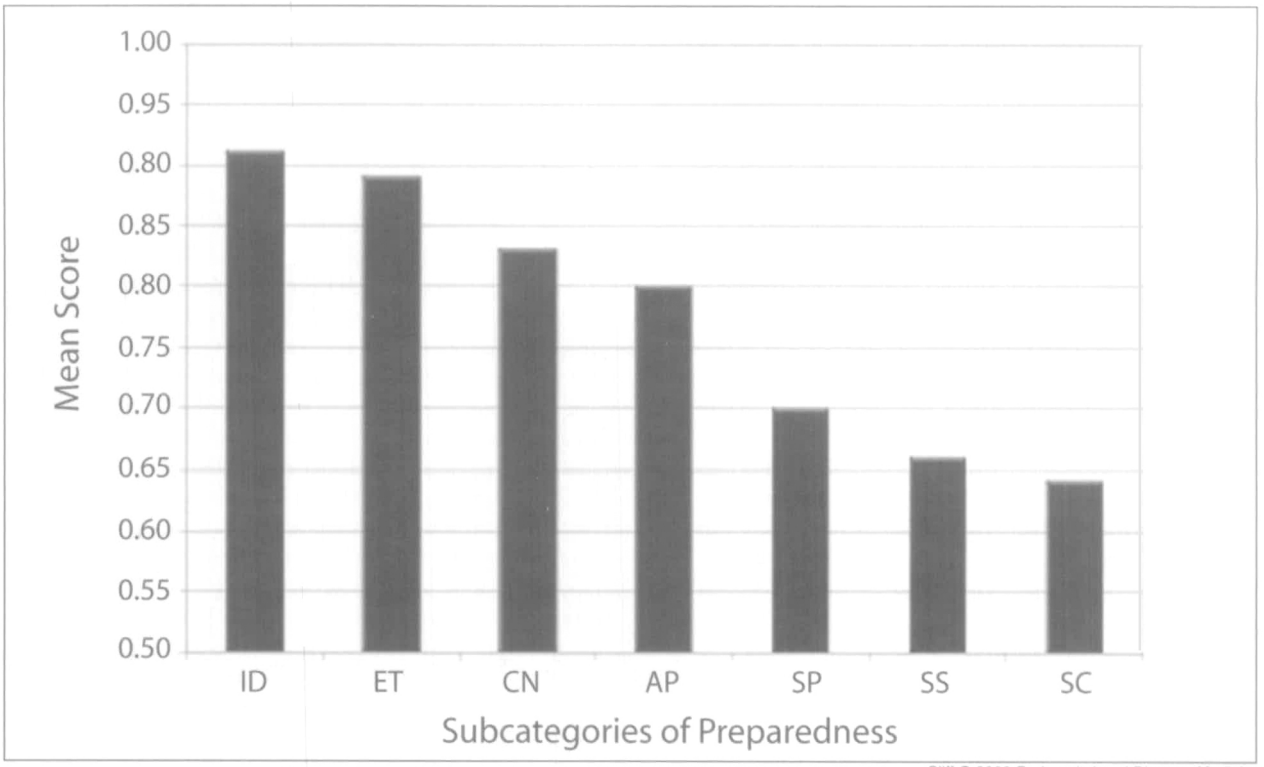

Figure 2—Summary of Preparedness
Subcategories: AP = Administration and Planning; SS = Staffing and Support; SC = Surge Capacity; ID = Isolation and Decontamination; ET = Education and Training; CN = Communication and Notification; SP =Supplies, Pharmaceuticals, and Laboratory Support

	Odds Ratio	95% CI*
Administration and Planning	1.20	0.48–3.02
Surge Capacity	0.85	0.47–2.49
Education and Training	1.25	1.05–1.27
Communication and Notification	0.35	0.07–1.65
Staffing and Support	1.75	0.75–4.07
Isolation and Decontamination	0.70	0.25–1.98
Supplies, Pharmaceuticals, and Laboratory Support	0.87	0.37–2.04
Overall Preparedness	0.61	0.26–1.45

Table 1—Association between risk perception and preparedness
*Confidence Interval

whether any statistically significant difference in the level of preparedness existed by the all-hazards risk perception (low/high). A positive association was found only for education and training (p = 0.03). No other statistically significant associations were found between risk perceptions and other subcategories of preparedness, including administration and planning (Pearson chi-square; p = 0.84); surge capacity (p = 0.93); communication and notification (p = 0.46); staffing and support (p = 0.29); isolation and decontamination (p = 0.45); supplies, pharmaceuticals, and laboratory support (p = 0.37); and overall preparedness (p = 0.54).

Eight logistic regression models were run to determine if the independent variable of overall risk perception could predict any subcategory of preparedness or overall preparedness (Table 1). The regression models revealed little association between risk perception and preparedness. The only statistically significant association found was that hospitals with high-risk perception had 1.2 (95% CI = 1.05–1.27) times the odds of being prepared in the category of education and training compared to hospitals with low overall risk perception.

Discussion

The results of the study indicate that the majority of rural hospitals in the United States are moderately prepared for a disaster event, with high preparedness in the areas of education and training, and isolation and decontamination. The results of one area—surge capacity—indicate that more work must be done

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to improve preparedness levels. Low preparedness was found in this subcategory (64%). Rural hospitals need to explore alternative mechanisms for surge capacity, such as considering other local facilities; for example, schools and armories.[13]

These results indicate that rural hospitals are 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 disasters due to natural hazards and vehicular accidents than from humanmade disasters. However, 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 the perceived risk of individual disaster events.

Although there are efforts to improve the preparedness of hospitals in the US, 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.

First, there must 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 AHRQ has done.

Second, professional organizations 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 US. There also must be more sharing of best practices. This could be conducted through workshops and internet-based forums on behalf of these professional organizations.

Third, hospital officials must 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.

Fourth, healthcare officials must be encouraged to access available government funding for preparedness in areas of vulnerability, such as surge capacity and staffing. Grants and other funding streams also should be pursued.

Fifth, 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.

Finally, hospital officials must be encouraged to expand education and drills. Education and drills are needed, particularly in the area of surge capacity.

This study served to quantify the levels of preparedness for rural hospitals in the US. Further research should also be conducted to identify the best predictors of preparedness in order to optimize readiness for a disaster event.

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. Furthermore, this study was conducted as a self-report of hospital CEOs. Self-reports raise the issue of validity and accuracy;[11] however, the questionnaires were mailed before the telephone interviews were conducted to allow CEOs to consult with others in the hospital who may have been more knowledgeable about some of the study questions. Additionally, there may have been response bias based on social desirability, in which the CEO presented a favorable image of his or her facility. There also may be a tendency to over exaggerate 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 hospitals may have been 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 telephone interviews improving the rate.[12] Additionally, the respondents were not representative, relative to the target population, in terms of geographic region. 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 the response rates of CEO respondents and non-respondents, geographic region was not associated with preparedness, so it should not have introduced bias. Selection bias also 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.

Conclusions

This research examined risk perceptions and the state of disaster preparedness in rural hospitals in the US, and also explored the relationships between perception of risk and preparedness.

Disasters due to natural hazards and vehicular accidents were perceived to pose a far greater risk to rural hospitals than the humanmade disasters. Disasters due to natural hazards and vehicular accidents reported as moderate or high risk in 79% and 77% of the hospitals, respectively. Humanmade disasters were reported to be moderate or high risk in 23% of hospitals. In examining the five types of disasters within the humanmade 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.

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% of hospitals (isolation and decontamination).

Analyses were conducted between risk perception, the seven subcategories of preparedness, and overall preparedness measure. The results indicated that overall, there was little evidence that risk perception could predict preparedness. However, there was a small, statistically significant positive association between risk perceptions and the education and training subcategory.

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