RESEARCH

Factors Affecting Hospital-based Nurses' Willingness to Respond to a Radiation Emergency

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ABSTRACT

Background: Despite increased government and public awareness of the threat of a radiological emergency resulting from a terrorist attack or industrial accident, limited emphasis has been placed on preparing the US health care workforce for such an event. The purpose of this study was to develop and apply a rapid survey to evaluate hospital-based nurses' baseline knowledge, self-assessed clinical competence, perception of personal safety, and willingness to respond in the event of a radiological emergency.

Methods: The study was conducted in 2 phases, the first targeting nursing units likely to respond in the event of a radiological emergency and the second focusing more generally on members of the New York State Emergency Nurses Association currently employed as hospital-based nurses.

Results: Among the 668 nurses surveyed, baseline knowledge was found to be inadequate. Although baseline knowledge, clinical competence, and perception of personal safety were all positively associated with willingness to respond, perception of safety appeared to be the primary determinant. Furthermore, baseline knowledge did not appear to be strongly associated with perception of personal safety.

Conclusions: Based on these results, the investigators recommend further clinical training to enhance preparedness and a more detailed exploration of the determinants of perceived personal safety. (*Disaster Med Public Health Preparedness.* 2008;2:224–229)

Key Words: nursing, radiation emergency, radiological terrorism, perceived safety, willingness to report

In the decades since the end of the Cold War, the threat of a major radiation emergency, intentional or otherwise, remains an unfortunate reality.[1] Radiological incidents have resulted in large-scale evacuations, hospitalizations, death due to radiation sickness, and long-term health effects.[1,2] Such a scenario would have devastating consequences on a region's health care system and workforce, including nurses.[2,3] Concern regarding the use of radiological weapons within the United States is of paramount importance to the Department of Homeland Security and media reports document the government's heightened concern regarding the potential use of radioactive dispersal devices ("dirty bombs") by terrorists.[4,5] Although the United States has made preparation for natural disasters as well as biological and chemical terrorism-related incidents a priority for government and military agencies,[6] response to radiological threats remains one of the least emphasized aspects of current terrorism preparedness efforts. Unintentional radiation exposures from industrial accidents and nuclear power plant failures such as those that occurred at Three Mile Island (1979) or Chernobyl (1986) also present unique challenges to health care workers.[1,7,8]

It is important to recognize that there is minimal health risk to nursing or emergency personnel from working with patients exposed to high levels of radiation. Patients contaminated, even at high levels, pose little to no threat; radiation exposure and contamination are not likely to be significant hazards to staff.[9] Staff can protect themselves from radioactive contamination by using universal precautions while treating these patients. As opposed to chemical or biological agents that arrive with contaminated patients, radioactive contamination is easy to detect.[10]

Nurses comprise the largest segment of the health care workforce and, in the event of an emergency, would constitute the front line in patient care. Despite the minimal risk associated with caring for exposed individuals,[9–11] many nurses have significant anxiety related to treating patients exposed to radiation.[12] This anxiety is generally exacerbated by insufficient knowledge regarding the true effects of radiation, inability to recognize radiation injuries, or lack of appropriate clinical experience with patients involved in radiological incidents.[7] Inadequate knowledge on the part of health care providers has historically resulted in the delay or denial of treatment to mildly contaminated patients, underestimation of to-

tal radiation exposure, and failure to recognize acute radiation injury.[7,8] In addition, anxiety related to personal and family safety has been shown to be a strong consideration in nurses' willingness to report to work.[13,14]

Patients exposed to radiation require decontamination, close monitoring, and follow-up. Nurses must ensure that their patients are hemodynamically stable before initiating definitive radiation measures of decontamination and other radiation-related therapies. It is essential that nurses are able to recognize radiation injury and provide appropriate treatment whenever possible.[9,10] This study offers insight into nurses' knowledge of radiation and willingness to participate in the event of a disaster, and will aid in the development of educational programs to prepare nurses to safely and effectively deal with the public health consequences of radiation emergencies.

The aims of this study were to assess hospital-based nurses' baseline knowledge for identifying and treating radiation injuries and their willingness to come to work during a major radiation event (ie, willingness to respond). The investigators were specifically interested in evaluating associations between willingness to respond and baseline knowledge, perception of personal safety during a radiological emergency, and self-assessed clinical competence relating to radiation emergencies.

METHODS

This study was a cross-sectional survey using a purposive sample of hospital-based nurses in New York state. Participation was voluntary, responses were anonymous, and all of the surveys were accompanied by an information sheet detailing the purpose of the project. This study and the supporting survey instrument were approved by the New York State Emergency Nurses Association (NYSENA) and the institutional review boards of each participating institution.

Survey Development

The Radiation Survey (RS) is a rapid, self-administered questionnaire developed to assess hospital-based nurses' knowledge, attitudes, and behavior with regard to radiation emergencies. The survey's 38 multiple-choice questions were conceptualized to encompass 4 specific domains: baseline knowledge for identifying and treating radiation injuries, perception of personal safety during a radiological emergency, self-assessed clinical competence relating to radiation emergencies, and willingness to report to work in the event of a radiological emergency (Table 1). Although no uniquely identifiable information was collected, the survey included a series of 10 demographic questions to describe and classify the respondents.

Due to the novel nature of this assessment and the limited available literature, the researchers used a standard, multistage process for developing and refining the RS.[15,16] Conceptual domains were identified and operationalized through a review of the existing literature and refined in a series of focus groups among hospital-based nurses.

Baseline knowledge questions were derived from a previously published survey called Radiologic Incidents and Emergen-

TABLE 1

Sample Questions by Radiation Survey Conceptual Domain

Conceptual Domain	Sample Question
Baseline knowledge (16 questions)	Q.13 The most immediate concern regarding a person with radioactive-contaminated clothing is: Stroke Tissue necrosis Internal contamination Development of a local radiation injury
Perception of clinical competence (3 questions)	Q.17 I am clinically competent to care for patients exposed to radiation: Yes No Unsure
Perception of personal safety (3 questions)	Q.21 My health care organization has mechanisms in place to ensure my personal safety with regard to radiation: Yes No Unsure
Willingness to respond (6 scenario questions)	Q.25 A large sporting event is taking place in your community today with an estimated crowd of 10,000 spectators. Toward the end of the event, a large explosion of unknown origin occurs in the lower level seating section. Injury and death count estimates are high and your hospital declares an external disaster. Extra staff is needed to care for the arriving wounded, as well as patients already present in the Emergency Department. You have been called and asked to come in to work. Will you come in? Yes No Unsure
Demographics (10 questions)	Age, sex, years in clinical practice, home ZIP code, etc

https://doi.org/10.1097/DMP.0b013e3181a2b7a5 Published online by Cambridge University Press

cies[17] and from an existing national examination of radiation knowledge from the Radiation Emergency Assistance Center/Training Site.[18] Knowledge items were selected to cover a broad range of basic clinical knowledge relating to radiation injuries and emergencies.

Nurses' willingness to respond (ie, willingness to report to work during a radiological emergency) was assessed using a series of questions relating to 2 hypothetical radiation events: a nuclear power plant emergency and an explosion at a sporting event. Each scenario comprised 3 questions of increasing intensity/severity to challenge nurses' willingness to respond. The scenarios were created by the investigators, and reviewed for face and content validity by 3 radiation biology and safety experts.

To assess the influence and respondents' awareness of their proximity to a nuclear facility, nurses were asked to provide their home ZIP code. These were compared with a list of ZIP codes known to fall within the 10-mile Emergency Planning Zone (EPZ) surrounding each of New York's 3 operating nuclear facilities: James A Fitzpatrick/Nine Mile Point, RE Ginna, and Indian Point.

Once assembled, the survey instrument was again reviewed for validity by the study's subject matter experts. The final version of the RS was pretested in a series of doctoral students and pilot-tested by a group of 16 master's degree–level nurses. Although the final survey device was anonymous and did not include any unique identifiers, color coding was used to differentiate responses in the second phase of the study.

Survey Deployment/Study Design

Deployment of the RS was conducted in 2 phases, the first targeting nursing units most likely to be involved in a radiation emergency and the second focusing more broadly on members of the NYSENA. Nursing units included in the first phase of the study were preselected from 2 hospitals in a midsized city in western New York state: a major tertiary medical center and a large urban hospital. Units were selected based on their likelihood of responding to a major radiation emergency or demonstrated proficiency in caring for burn patients. The final sample included adult and pediatric emergency departments, burn and intensive care units, a surgical intensive care unit, and a trauma intensive care unit. The survey was distributed by nurse managers on the selected units and returned, in the blank envelope provided, to a locked drop box placed at each of the units. To prevent duplication, NYSENA members were asked not to complete the survey in the study's first phase.

In the study's second phase, surveys were mailed to NYSENA members currently employed as hospital-based nurses. The NYSENA gave a priori approval for the study and provided mailing addresses for its membership. A letter of introduction and endorsement from the NYSENA director was sent to each member the week before the survey was initially mailed. Surveys were sent via regular post and returned by prepaid mailer. To maximize response rate, each NYSENA member received the survey mailing up to a total of 3 times. Color coding was used to prevent duplication across mailings.

Data Analysis

All of the data management and analyses were performed using SPSS version 12.0 for Windows (SPSS, Chicago, IL). Univariate descriptive statistics were used to summarize respondent demographic data and survey results. Internal consistency and reliability of the conceptual domain subscale items were assessed using Cronbach α and split-half correlation. Relations among the survey's conceptual domains were evaluated using Pearson correlation. Interactions between conceptual domains were tested using hierarchical multiple regression and interpreted according to the mediator–moderator framework described by Baron and Kenny[19] and Bennett.[20] Unless otherwise specified, all of the analyses were 2-tailed and considered statistically significant at an α level of .05.

RESULTS

The response rates for phases 1 and 2 of the study were 59% (189 nurses) and 41% (479 nurses), respectively, with an overall response rate of 45%. Based on their comparable demographic profiles, the 2 samples were combined to increase the overall power of the study. The final combined sample comprised a total of 668 hospital-based nurses. The nurses in the combined sample were found to be predominantly female (82.8%) and married (63.3%), and to have fewer than 2 dependents at home. Most respondents (67.2%) had completed at least a bachelor's degree and stated that their highest level of licensure was as a registered nurse (89.4%; Table 2).

A majority of respondents believed that they neither worked (57.9%) nor lived (63.9%) within the 10-mi EPZ surrounding a nuclear facility. Nurses seemed generally less confident when assessing the proximity of their workplace (Table 2). These findings were validated for true proximity by comparing the nurses' home ZIP codes with a list of EPZ ZIP codes provided by county emergency planning departments. Among those providing ZIP code information (n = 617), a majority correctly classified their home's proximity to a nuclear facility (72.4%). False positives were considerably more common than false negatives, suggesting that individuals are inclined to overestimate their risk for living within an EPZ.

Internal consistency and reliability of the conceptual domain subscales was found to be generally good for willingness to respond (.93), sense of competence (.82), and personal safety (.69) during a radiological emergency. Despite significant spilt-half correlations for its constituent questions, subscale concordance for baseline knowledge was found to be low (Table 3).

Out of a possible 16 points in the RS assessment of baseline knowledge identifying and treating radiation injuries, the

TABLE 2

Characteristics of Emergency Nurses Responding to the Radiation Survey (N = 668)

Characteristic	Mean (SD)
Age, y	44.1 (9.7)
No. of dependents at home	1.43 (1.41)
Years in active clinical practice	18.4 (10.2)
	n (%)*
Sex	
Male	102 (15.3)
Female	553 (82.8)
Marital status	
Single	130 (19.5)
Married	423 (63.3)
Living with partner, not married	31 (4.6)
Divorced	67 (10.0)
Widowed	7 (1.0)
Licensure	
Licensed practical nurse	12 (1.8)
RN	597 (89.4)
Nurse practitioner	45 (6.7)
RN/physicians' assistant	1 (.1)
Highest level of education	
Diploma	51 (7.6)
Associate	159 (23.8)
Bachelor's	305 (45.7)
Master's	139 (20.8)
MD, doctorate	5 (.7)
Live within 10 mi of a nuclear facility	
Yes	116 (17.4)
No	427 (63.9)
Don't know	117 (17.5)
Work within 10 mi of a nuclear facility	
Yes	117 (17.5)
No	387 (57.9)
Don't know	156 (23.4)

RN, registered nurse.

*Percentages reported as a proportion of the total number of survey respondents.

respondents scored an average of 5.69 points (SD 2.13) with none of the nurses receiving a score higher than 13 (Table 4). The most commonly missed questions related to the correct course of treatment for patients who were in a nuclear power plant during a leak (90.3%), whether it is safe for a pregnant nurse to care for patients exposed to high levels of radiation (90.3%), appropriate contamination control procedures (88.9%), and the initial treatment focus for patients with injuries from a dirty bomb (83.5%). A majority of the respondents were able to correctly define external contamination (82.0%) and thermal injury (72.9%).

TABLE 3

Consistency of Conceptual Domain Subscales From the Radiation Survey (N = 668)

Conceptual Domain	Cronbach α
Baseline knowledge	.40
Perception of personal safety	.69
Perception of clinical competence	.82
Willingness to respond	.93

TABLE 4

Radiation Survey Results Summarized by Conceptual Domain (N = 668)

Conceptual Domain	Scale	Mean (SD)
Baseline knowledge	1–16	5.69 (2.13)
Perception of personal safety	1–3	1.04 (.86)
Perception of clinical competence	1–3	0.30 (.66)
Willingness to respond	1–6	4.17 (2.36)

To determine the nurses' willingness to respond to work in the event of a major radiological event, their responses to 6 scenarios in 2 major radiation events were evaluated. The mean score was 4.18 (SD 2.36) out of a possible total 6 points (Table 4). Although the majority of the nurses said that they were willing to respond at least some of the time, 15.3% (n = 102) were unwilling to respond to work in any of the more severe radiation emergency event scenarios. Willingness to respond decreased as the intensity of the scenario increased.

Willingness to respond in the event of a radiological emergency was found to be weakly but positively correlated with level of baseline knowledge ($r = .16$), perception of personal safety ($r = .32$), and perception of clinical competence ($r = .20$). The association between level of baseline knowledge and perception of personal safety also was found to be weak (Table 5).

Hierarchical regression was used to determine whether the relation between baseline knowledge and willingness to respond is moderated by perception of personal safety. When willingness to respond was regressed onto baseline knowledge, the model was statistically significant and accounted for only 3% of the variance (adjusted r^2) in willingness to respond. When personal safety was added hierarchically to the model, the change in r^2 was found to be statistically significant, with the model now accounting for 12% of the variance in willingness to respond. No interaction was detected between baseline knowledge and perception of personal safety.[19,20] Therefore, although baseline knowledge and perception of personal safety each independently predict willingness to respond, the relation between baseline knowledge and willingness to respond is not moderated by perception of personal safety.

When perception of clinical competence was added into the model, the change in r^2 was statistically significant, with the second model accounting for 5% of the variance in willingness to respond. No significant interaction between predic-

TABLE 5

Correlations Among Baseline Knowledge, Willingness to Respond, Perception of Personal Safety, and Perception of Clinical Competence

Correlated Items	n	*r*	*P*
Nurses' baseline knowledge and willingness to respond to a radiation emergency	668	.16	<.0001
Nurses' baseline knowledge and perception of personal safety	668	.03	.402*
Nurses' baseline knowledge and perception of clinical competence	668	.21	<.0001
Nurses' perception of personal safety and willingness to respond to a radiation emergency	668	.32	<.0001
Nurses' perception of clinical competence and willingness to respond to a radiation emergency	668	.20	<.0001

*Correlation determined to be significant where $P < .01$.

tors was detected. Thus, although baseline knowledge and perception of clinical competence each independently predict willingness to respond, perception of clinical competence does not moderate the relation between baseline knowledge and willingness to respond (Fig. 1).

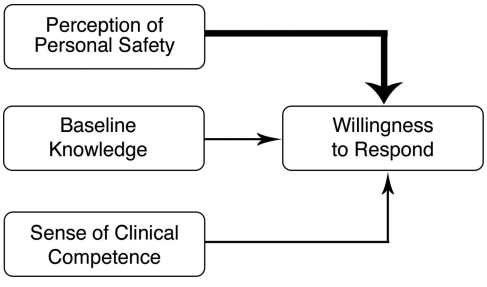
DISCUSSION

Our vulnerability to radiological terrorism persists, and insufficient emphasis has been placed on workforce preparedness and protection from nuclear threats. The detonation of a nuclear weapon would be a frightening reality that would result in massive fatalities, injuries, and health problems caused by the initial explosion and radiation exposure. As health care providers, nurses must possess the knowledge to effectively care for patients with radiation exposure and protect themselves and others from contamination.[9,10]

The results of this study suggest that nurses' knowledge regarding radiation emergencies is somewhat inadequate. Although nurses are familiar with textbook definitions of types of burns, they are unaware of which procedures to follow in scenarios involving a patient with possible radiation exposure. Nurses with a lower level of baseline knowledge regarding radiation emergencies, lower perception of personal safety, and lower perception of clinical competence were less willing to respond during a radiation emergency, suggesting that during an actual radiological incident, there will likely be a shortage of nurses who are able to provide safe, evidence-based nursing care. Most important, the results indicate that perceptions of personal safety account for 3 times the variance in willingness to respond, as compared with baseline knowledge. It would appear that improving baseline knowledge, although clearly critical for ensuring appropriate clinical care, may not significantly affect a nurse's willingness to respond. Given that perception of personal safety, taken alone or in combination with baseline knowledge and perception of clinical competence, accounted for only a limited amount of the overall variation in willingness to respond, further qualitative exploration of this concept is warranted.

FIGURE 1

Theoretical model showing associations between radiation survey conceptual domains



The importance of perception of personal safety in determining willingness to respond has been reported previously in the research literature[21] and studies have reported reductions in health care personnel effectiveness in the presence of concerns about the safety of themselves or loved ones.[13,14,22,23] Health care workers' ability and willingness to respond to such catastrophic events may be affected by multiple factors.[24] Given the proportion of respondents who either indicated they lived near or did not know whether they lived near a nuclear facility, concerns relating to family safety may prove to be an important factor in the event of an actual radiological event. The high false positive rate, however, suggests that increasing knowledge in this area may be a simple means of reducing stress and improving willingness to respond during a crisis.

Sources of Concern

Due to the highly targeted sample used in this study (ie, currently employed hospital-based nurses in New York state) our findings may not be generalizable beyond that group. A larger, more diverse sample is needed to articulate nurses' knowledge and willingness to respond to a radiation emergency on a national level. Given the voluntary nature of the survey, some self-selection is likely, biasing results toward higher levels of baseline knowledge, competence, and experience. The RS was a new survey instrument, and it is possible that the necessarily limited array of survey questions may not have fully measured the conceptualized domains. Specifically, the lower than expected subscale concordance for baseline radiation knowledge (Cronbach $\alpha = .4$) and the weak association between baseline knowledge and willingness to respond may suggest a need for further psychometric testing and refinement of the RS. In light of significant split-half correlation findings among knowledge scale responses, however, these findings may simply indicate the

breadth of the underlying concept (ie, identification and treatment of radiation injuries).[25] Under either interpretation, it seems clear that additional factors, unaddressed by the present model, are at play. Building on the findings of this study, further exploration of the concepts underlying and factors affecting nurses' willingness to respond during radiological and other crises is ongoing.

CONCLUSIONS

With the threat of a radiation disaster remaining an unfortunate reality, education is but one critical factor in determining whether hospital-based nurses feel safe, competent, and willing to participate in an emergency. Nurses' knowledge regarding the delivery of effective care in a radiological emergency is inadequate. Nurses need further training with regard to handling exposed patients and measures to be taken to protect themselves and others from contamination. Health care institutions should focus on developing initiatives that will help define and enhance nurses' perception of personal safety when responding to a radiation emergency.

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Received for publication January 17, 2008; accepted August 12, 2008.

Authors' Disclosures

The authors report no conflicts of interest.

Acknowledgments

This study was supported in part by The Center for Nursing Research at the University of Rochester School of Nursing, and was endorsed by the New York State Emergency Nurses Association. The authors wish to acknowledge Andrew Karam, PhD (Radiation Physics, Rochester Institute of Technology), Jackie Williams, PhD (Department of Radiation Biology, University of Rochester), and Tom Morgan, PhD (Radiation Safety Officer, University of Rochester) for their knowledge and expertise in reviewing the survey instrument. The authors also wish to acknowledge Susan Knapp, MS, RN, and Kathy Tyo, MS, RN, former graduate students at the University of Rochester School of Nursing, for their individual contributions to this project. Special thanks to Adam Rains, MSc, for assistance in the preparation of this manuscript.

ISSN: 1935-7893

DOI: 10.1097/DMP.0b013e31818a2b7a

REFERENCES

1. McFee R. Radiation terrorism: the unthinkable possibility, the ignored reality. *JEMS*. 2005;30:78–92.
2. Barnett DJ, Parker CL, Blodgett DW, et al. Understanding radiologic and nuclear terrorism as public health threats: preparedness and response perspectives. *J Nucl Med*. 2006;47:1653–1661.
3. Veenema TG, Toke J. When standards of care change in mass-casualty events. *Am J Nurs*. 2007;107:72A–72F.
4. US Department of Homeland Security Adopted Standards for Radiation and Nuclear Detection Equipment. Department of Homeland Security Web site. *http://www.dhs.gov/xnews/releases/press_release_0360.shtm*. Accessed November 1, 2007.
5. US Department of Homeland Security Adopts Standards for Radiation and Nuclear Detection Equipment. Institute of Electrical and Electronics Engineers Web site. *http://standards.ieee.org/announcements/pr_dhsadoptsNstds.html*. Accessed June 7, 2005.
6. Langan JC. *Preparing Nurses for Disaster Management*. Upper Saddle River, NJ: Pearson Educational; 2005.
7. Veenema TG, Karam PA. Radiation: clinical responses to radiologic incidents and emergencies. *Am J Nurs*. 2003;103:32–40.
8. Shiralkar S, Rennie A, Snow M, et al. Doctors' knowledge of radiation exposure: questionnaire study. *BMJ*. 2003;327:371–372.
9. Karam PA. Radiological incidents and emergencies. In: Veenema TG, ed. *Disaster Nursing and Emergency Preparedness for Chemical, Biological, and Radiological Terrorism and Other Hazards*. New York: Springer; 2007: 521–544.
10. Bushberg JT, Kroger LA, Hartman MB, et al. Nuclear/radiological terrorism: emergency department management of radiation casualties. *J Emerg Med*. 2007;32:71–85.
11. Fong F. Medical management of radiation accidents. In: Hogan D, Burstein J, eds. *Disaster Medicine*. Philadelphia: Lippincott Williams & Wilkins; 2002:237–257.
12. Interim Guidelines for Hospital Response to Mass Casualties From a Radiological Incident. Centers for Disease Control and Prevention Emergency Preparedness and Response Web site. *http://www.bt.cdc.gov/radiation/pdf/masscasualtiesguidelines.pdf*. Accessed November 1, 2007.
13. Chaffee MW. Making the decision to report to work in a disaster: nurses may have conflicting obligations. *Am J Nurs*. 2006;106:54–57.
14. O'Boyle C, Robertson C, Secor-Turner M. Nurses' beliefs about public health emergencies: fear of abandonment. *Am J Infect Control*. 2006;34: 351–357.
15. Converse JM, Presser S. *Survey Questions: Handcrafting the Standardized Questionnaire*. Newbury Park, CA: Sage Publications; 1986.
16. Fowler FJ. *Survey Research Methods*. 2nd ed. Newbury Park, CA: Sage Publications; 1993.
17. Radiologic Incidents and Emergencies. Nursing Center Web site. *http://www.nursingcenter.com*. Accessed May 31, 2005.
18. Test Your Knowledge. Oak Ridge Institute for Science and Education Radiation Emergency Assistance Center/Training (Web) Site. *http://www.orau.gov/reacts/test.asp*. Accessed June 1, 2005.
19. Baron R, Kenny D. The moderator–mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol*. 1986;51:1173–1182.
20. Bennett J. Mediator and moderator variables in nursing research: conceptual and statistical differences. *Res Nurs Health*. 2000;23:415–420.
21. Fullerton CS, Ursano RJ, Reeves J, et al. Perceived safety in disaster workers following 9/11. *J Nerv Ment Dis*. 2006;194:61–63.
22. O'Boyle C, Robertson C, Secor-Turner M. Public health emergencies: nurses' recommendations for effective actions. *AAOHN J*. 2006;54:347–353.
23. Becker S, Middleton S. Improving hospital preparedness for radiological terrorism: perspectives from emergency department physicians and nurses. *Disaster Med Public Health Preparedness*. 2008;2:174–184.
24. Qureshi K, Gershon RR, Sherman MF, et al. Health care workers' ability and willingness to report to duty during catastrophic disasters. *J Urban Health*. 2005;82:378–388.
25. Zimet GD. Reliability of AIDS knowledge scales: conceptual issues. *AIDS Educ Prev*. 1992;4:338–344.