2012

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Reviewed work(s):
Source: *Infection Control and Hospital Epidemiology*, Vol. 33, No. 9 (September 2012), pp. 952-954
Published by: The University of Chicago Press on behalf of The Society for Healthcare Epidemiology of America
Stable URL: http://www.jstor.org/stable/10.1086/667394
Accessed: 07/09/2012 16:59

RESEARCH BRIEFS

Hospital Flood Preparedness: A Survey of 15 Provinces in Central Thailand

Between September and November 2011, Thailand experienced its worst flooding in modern history. Central Thailand was severely affected by flooding, which resulted in the closure of more than 30 hospitals in the region. Lack of evidence-based practices, limited resources, and the inexperience of infection control preventionists (ICPs) were obstacles to prioritizing investment in infection control (IC) measures after flooding. We conducted a survey to evaluate hospital flood preparedness (HFP) in central Thailand and to guide future HFP plans.

On January 6, 2012, a workshop entitled “Hospital Preparedness for Flooding” was conducted with faculty from the Division of Infectious Diseases of Thammasat University (Pathumthani, Thailand) and Washington University (St. Louis, Missouri). All 104 secondary care hospitals (>100 beds) and tertiary care hospitals (>250 beds) in 15 central Thailand provinces were invited to participate on the basis of a hospital list from the Thailand Ministry of Public Health. Of these, 72 hospitals (69%) attended the workshop. A survey of HFP plans was distributed to an ICP or a hospital epidemiologist (HE) at each participating hospital. The survey instrument assessed ICP, HE, and hospital characteristics; HFP; institutional safety culture; and administration support to resolve flood-related problems.[1,2] This survey instrument was pilot-tested by 10 IC experts, including ICPs and HEs, to ensure its validity, reliability, and acceptability. The administration support was categorically ranked as poor, fair, good, very good, and excellent. The institutional safety culture was measured by safety score (a detailed description is provided in Table 1). A higher safety score indicated greater safety centeredness.[1,2] Statistical analyses were performed using SPSS, version 15 (SPSS). Adjusted odd ratios and 95% confidence intervals were calculated by logistic regression to determine factors associated with each HFP protocol and plan.

Of the 72 hospitals that attended the workshop, 72 (100%) consented to study participation and responded to the survey. The median age of the responding ICPs and HEs was 44 years (range, 24–56 years). Eighty-nine percent of the respondents (64 of 72) were ICPs, and 11% (8 of 72) were HEs. The median amount of time that the respondents had been in their current position was 7 years (range, 0.3–27 years). Characteristics of the hospitals, HFP plans, extent of flood-related damage, and infection control problems are summarized in Table 1. Of the 72 hospitals, 27 (38%) had received flood damage. The median institutional safety score was 8.7 (range, 6–10). Although the majority of the participating hospitals had an HFP protocol (92%), only 52% had exercises to test their flood protocols. During and after the flooding, significant proportions of the hospitals surveyed had plans for opening flood-unaffected units for use (89%), had surge capacity planning (79%), had protocols to help hospital personnel and their families (76%), had plans to stockpile personal protective equipment (PPE; 75%), and had plans for operating a laboratory unit (67%; Table 1). Notably, only 51% had plans for operating an isolation unit, and 32% had environmental cleaning and mold remediation protocols. By multivariate analysis, being a tertiary care hospital was associated with having an HFP protocol ($P = .05$) and having a plan for opening flood-unaffected units for use during and after flooding ($P = .05$), whereas having an institutional safety score of 10 was associated with having practiced an exercise drill for flood protocol ($P = .006$), having a plan for adequate PPE stockpile ($P = .007$), and having a cleaning and mold remediation protocol and a plan for operation of laboratory units during and after flooding ($P = .04$).

Among the 27 hospitals that experienced flood damage, the median duration of flooding was 30 days (range, 7–60 days), the median duration of hospital renovation (with units open in service at reduced capacity) was 45 days (range, 7–60 days), and 63% (17 of 27 hospitals) reported good-to-excellent hospital administration support (Table 1). The major flood-related IC problems cited by hospitals that underwent flooding included no containment of mold-contaminated areas during clean up and demolition (85%), no air sampling to assess fungal bioburden (67%), unavailability of HEPA filtration in flooded units during demolition (63%), and no mold remediation protocol (56%).

Although the majority of surveyed hospitals (92%) had a flood protocol, only 52% had conducted any exercises to test their protocols. These data are consistent with earlier studies of hospital disaster preparedness in various settings.[3,4] Our survey highlighted the need for national education on environmental decontamination, mold remediation, and isolation unit operation after flooding, which deserves further evaluation in resource-limited settings.[5] Because Thailand had previously been affected by an outbreak of avian influenza and the 2009 H1N1 pandemic, the high response rates for several aspects of hospital disaster preparedness (eg, stockpiling of PPE and plans for surge capacity and operation of laboratory units) were not surprising.[6,7] Finally, our study emphasizes the role of a “safety culture” in a hospital as a strong predictor for HFP plans in this middle-income country.

There are some limitations to this study. With a 69% response rate, our results have some susceptibility to nonresponse bias. If the 32 hospitals (31%) that did not respond to the survey were systematically different from the 72 hospitals that did respond, generalization of our results to nonparticipating Thai hospitals and hospitals in other countries may not be possible. We relied on self-reported data from

TABLE 1. Characteristics of 72 Participating Hospitals

Variable	Hospitals
Hospital characteristic ($n = 72$)	
Type of hospital	
Secondary care	23 (32)
Tertiary care	49 (68)
Have an infection diseases specialist	35 (49)
Have a hospital epidemiologist	24 (33)
Safety score[a] (mean, range)	8.7 (6–10)
Experienced flooding during October–December 2011	27 (38)
Hospital preparedness plans for flooding ($n = 72$)	
Have existing flood protocol developed during and after flood	66 (92)
Ever conducted an exercise or drill of flood protocol	34/66 (52)
Have protocol to help hospital personnel and families during/after flood	55 (76)
Adequate stockpile of PPE for use during and after flood	54 (75)
Have surge capacity plans during and after flood	57 (79)
Have plans for opening flood-unaffected units for use during and after flood	64 (89)
Have environmental cleaning and fungal decontamination protocols during and after flood	32 (44)
Have plans for operating isolation units during and after flood	37 (51)
Have plans for operating clinical laboratories during and after flood	48 (67)
Flood damage ($n = 27$)	
Affected units	
Outpatient department	13 (48)
Central supply sterilization department	13 (48)
Inpatient department	12 (44)
Other[b]	23 (85)
Duration of flood, median days (range)	30 (7–60)
Duration of hospital renovation, median days (range)[c]	45 (7–60)
Cost of hospital renovation in millions of USD, median (range)[d]	4.8 (0.5–12)
Good to excellent hospital administration support to resolve flood problems[e]	17 (63)
Flood-related infection control problems ($n = 27$)	
Meeting and updating flood problems by hospital administration	
No meeting or updating flood problems	10 (37)
Mold contamination and decontamination in the hospital	
No mold decontamination protocol	15 (56)
No air sampling for mold bioaerosols in flooded units	18 (67)
No HEPA use before opening flooded units	17 (63)
No containment policy for mold-contaminated areas	23 (85)
Inappropriate mold decontamination procedures	12 (45)
Inappropriate method of equipment sterilization and disinfection	8 (30)
PPE	
Inadequate PPE	4 (15)
Inappropriate use of PPE	4 (15)
Air conditioning ventilating and air filtration system evaluation	
Unavailable specialist to inspect the systems	11 (41)
Bad odor before and/or after demolition and repairs	9 (34)
Waste management	
No waste pickup by the designated authority	6 (22)
No separation of infectious waste from general waste	3 (11)
Administration support	
Lack of understanding of mold-related problems	3 (11)
Lack of prioritization of the problems	2 (7)

NOTE. Data are no. (%) of hospitals, unless otherwise indicated. HEPA, high-efficiency particulate air; PPE, personal protective equipment.

[a] The institutional safety score was defined as the average of responses regarding agreement to 2 statements about safety (ie, "Leadership is driving us to be a safety-centered institution" and "I would feel safe being treated here as a patient"). The statements are based on a conceptual model that seemed to best represent the elements of safety culture for the issue under study and our outcomes of interest.[1,2] Both statements were scored from 1 (strongly disagree) to 5 (strongly agree). The sum of the scores from both statements was the safety score, which ranges from 2 to 10.

[b] Includes emergency department, intensive care units, hemodialysis units, laboratory department, isolation unit, operating room, blood bank, endoscopy suite, nutrition department, laundry department, and pharmacy and engineer department.

[c] Units open in service at reduced capacity.

[d] 1 USD = 30 baht.

[e] The administration support was defined by a composite response to staffing, financial, and political aspects from hospital administration.

ICPs and HEs from each hospital to determine HFP. It is possible that an individual respondent may have overstated or understated how frequently HFP plans were used; however, we have no reason to believe that this would be a systematic issue. Finally, the small sample size might limit detection of other factors associated with HFP planning.

In conclusion, we provide an important first step that suggests opportunities to develop national guidelines on HFP that emphasize issues relevant to environmental decontamination, mold remediation, isolation, and surge capacity after flooding.[8] Additional studies that rigorously evaluate such strategies would help bolster HFP efforts in developing countries and elsewhere.

ACKNOWLEDGMENTS

Financial support. National Research University Project of the Thailand Office of Higher Education Commission (to A.A. and T.K.).

Potential conflicts of interest. All authors report no conflicts of interest relevant to this article. All authors submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest, and the conflicts that the editors consider relevant to this article are disclosed here.

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Received January 27, 2012; accepted April 5, 2012; electronically published July 24, 2012.

Infect Control Hosp Epidemiol 2012;33(9):952-954

 0899-823X/2012/3309-0015$15.00. DOI: 10.1086/667394

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Carbapenem-Resistant *Enterobacteriaceae*: A Statewide Survey of Detection in Massachusetts Hospitals

The prevalence of antibiotic resistance is increasing worldwide. Although infection control efforts have largely been focused on gram-positive organisms, concern is growing regarding more extensive antimicrobial resistance in gram-negative organisms. Carbapenems have been used increasingly over the past decade to treat infections due to *Enterobacteriaceae*-producing extended-spectrum β-lactamases (ESBLs). The emergence of carbapenem-resistant *Enterobacteriaceae* (CRE) severely limits antibiotic options to treat such infections.[1] Moreover, it has been shown that patients infected with CRE experience a 3-fold increase in mortality compared with patients with infection due to susceptible strains.[2]

Because of the threat that CRE pose and the increased reliance on automated susceptibility testing, it is important to assess the prevalence of CRE and how reliably they are detected. It is particularly important to know the current variance in testing methods in light of recent changes in guidelines for antimicrobial susceptibility testing of *Enterobacteriaceae* released by the Clinical and Laboratory Standards Institute (CLSI) in June 2010 and updated in January 2011.[3]

Online surveys were sent to all 70 Massachusetts acute care hospital microbiology laboratories and corresponding infection prevention teams in December 2010. Standardized questions were used to estimate the proportion of hospitals that detected CRE in 2010 and to analyze current microbiological methods for CRE detection. Hospitals were asked what platforms were routinely used to work-up *Enterobacteriaceae* and confirm carbapenemase production; whether laboratories were adhering to the June 2010 CLSI guidelines; and what carbapenem minimum inhibitory concentration (MIC) cutoff values were used to prompt CRE consideration. Data were analyzed using SPSS software (SPSS) to calculate χ^2 statistics and a Spearman rank correlation coefficient.