

Hospital infectious disease emergency preparedness: A 2007 survey of infection control professionals

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Background: Hospital preparedness for infectious disease emergencies is imperative.

Methods: A 40-item hospital preparedness survey was administered to Association for Professionals in Infection Control and Epidemiology, Inc, members. Kruskal-Wallis tests were used to evaluate the relationship between hospital size and emergency preparedness in relation to various surge capacity measures. Significant findings were followed by Mann-Whitney *U* post hoc tests.

Results: Most hospitals have an infection control professional on their disaster committee, 24/7 infection control support, a health care worker prioritization plan for vaccine or antivirals, and nonhealth care facility surge beds but lack health care worker, laboratory, linen, and negative-pressure room surge capacity. Many hospitals participated in a disaster exercise recently and are stockpiling N95 respirators and medications. Few are stockpiling ventilators, surgical masks, or patient linens; those that are have ≤ 7 days worth of supplies. Less than one quarter have cross trained their staff, convened their ethics committee to discuss preparedness issues, or developed policies/procedures for altered standards of care during disasters. Approximately half of all hospitals' plans include staff work incentives. The smallest hospitals (≤ 99 beds) are less prepared than larger hospitals on a variety of surge capacity indicators.

Conclusion: US hospitals lack laboratory, negative-pressure room, health care worker, and medical equipment/supplies surge capacity. Hospitals must continue to address gaps in infectious disease emergency planning. (Am J Infect Control 2009;37:1-8.)

Biologic disasters, whether natural or man-made, have had a devastating toll on our society in terms of health, personal injury, death, and economy and social infrastructure. The bioterrorism anthrax attack of 2001 had an official victim count of 22 injuries with 5 deaths and a cost estimate of \$1 billion.^{1,2} In 2005, Hurricane Katrina had a catastrophic social and economic impact that affected 7 states. The greatest impact from Hurricane Katrina was on the Gulf Coast where it is estimated that 15 million people were affected, 1836 died, and the total costs are estimated at \$110 billion.³

It has been estimated that an influenza pandemic could affect up to 30% of the workforce and result in more than 1,800,000 deaths in the United States alone.⁴

Each biologic disaster affects the health care community in a different way, but all involve a surge of patients into the system. Having the capability in physical resources and human resources to manage a sudden influx of patients (hospital surge capacity) and having these specialized resources to treat specific groups of patients such as infectious patients (surge capability) still presents a challenge to many hospitals. For the purposes of this study, the term "surge capacity" is used.

Researchers have studied a variety of aspects of hospital disaster preparedness. Bougeois describes a survey of hospital material managers assessing plans for obtaining supplies during a pandemic and found that most facilities have very little medical equipment surge capacity; most hospitals could continue operations for less than 1 week without external resources.⁵ Bougeois also reported that most facilities have plans to obtain additional respirators during a pandemic, but the number of respirators that could be obtained was not specified.⁵ A 2006 study found that most (88%) hospitals in Los Angeles County, California, offered daycare for staff's children as an incentive to work during a disaster but that surge capacity was low in other areas, such as

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medical supplies (ventilators and antibiotics), negative-pressure rooms, and overall number of surge beds.⁶ A 2005 study assessed preparedness by hospital bed size and found that smaller hospitals are not as prepared as larger sized facilities and that, overall, US hospitals lack negative-pressure room, health care worker, and medical equipment/supplies surge capacity.⁷ The federal government spent over \$3 billion (fiscal year 2006) and much more since 2003 in preparedness issues from the international to the local level, but reports on how this money has been spent to further preparedness (ie, outcome measures) have not been released. It is vital that US hospital surge capacity issues be assessed so that gaps can be identified and filled.

The purpose of this study was to evaluate US hospitals' current readiness to respond to a bioterrorism attack or outbreak of an emerging or reemerging infectious disease. This survey is a 2-year follow-up to a similar study conducted with US hospitals. The intention of this study was to assess progress hospitals have made in readiness between 2005 and 2007. The aims of the study include the following: (1) describe the proportion of hospitals that have infection control professionals (ICP) as members of their disaster planning committee and around-the-clock infection control support; (2) identify hospitals' current surge capacity in relation to existence of an off-site facility to provide care, incentives to get health care workers to come to work, negative-pressure rooms, staffing levels, and medical equipment/supplies (ie, ventilators, surgical masks, N-95 respirators, linens, and medications); (3) describe the proportion of US hospitals who are convening their ethics committee to discuss disaster scenarios and addressing altered standards of care during a disaster; (4) describe US hospitals' participation in infectious disease disaster drills/exercises; and (5) describe the proportion of ICPs who are taking steps to become personally prepared for an infectious disease disaster.

It was hypothesized that larger sized hospitals (in terms of the number of beds in a facility, as reported by the ICP) would report more preparedness activities than smaller sized hospitals. It was also hypothesized that most US hospitals do not have the surge capacity needed to care for an influx of potentially infectious patients in terms of staff to care for the patients and/or medical equipment/supplies needed.

METHODS

This study was a survey of US hospital emergency preparedness conducted by the Association for Professionals in Infection Control and Epidemiology, Inc. (APIC), Emergency Preparedness Committee in 2007, in conjunction with Trust for America's Health (TFAH).

This survey is a follow-up to the APIC/TFAH hospital emergency preparedness surveys conducted in 2005. The intention of this survey was to assess progress hospitals have made in readiness for infectious disease emergencies in the 2 years since the previous survey. ICPs completed the survey as representatives from their hospital. Participants were recruited through monthly e-mail newsletters from APIC headquarters, and a link to the survey was available on the APIC Web site. Five gift certificates for APIC products were offered as an incentive for survey participation; winners were chosen randomly from the list of respondents. The Saint Louis University Institutional Review Board approved this study.

Sample

ICPs who are members of the APIC from all US hospitals, regardless of size, location, or for-profit status were invited to complete a survey; therefore, the sample was nonrandom. The only exclusion criteria were hospital location outside the United States. The database was assessed for respondents who completed multiple surveys (as defined by having the same APIC identification number) or blank surveys; 11 blank surveys were deleted. No duplicates were found. The final database contained 633 subjects. An accurate response rate is impossible to calculate because the true denominator (the number of US hospitals that have an ICP who is an APIC member) is not known. However, using demographic data from the APIC, the American Hospital Association,⁸ and the US Census,¹⁰ the response rate is estimated to be at least 13% to 20%. After checking for duplicate surveys, APIC identification numbers were deleted from the database so that all data were anonymous, and there were no identifiers within the database that could link an ICP or hospital to the data.

Responses were received from participants in all US states except Delaware. There was a higher response rate in the Midwest (33.5%, $n = 211$) and South (32.5%, $n = 205$) than in the West (18.4%, $n = 116$) or Northeast (15.61%, $n = 98$) ($\chi^2 = 65.9$; $P < .001$) (Table 1). There are differences between hospital distributions across the United States in relation to geographic region, but the response distribution for this study is slightly different than would be expected given the hospital locations according to the US Census data.¹⁰ This sample contained a disproportionately slightly higher number of respondents from hospitals located in the Midwest and Northeastern states than would be expected ($\chi^2 = 93.33$; $P < .001$).⁸ There was also a higher proportion of respondents from smaller sized hospitals (≤ 199 beds) than from hospitals with 200 or more beds ($\chi^2 = 51.35$; $P < .001$; Table 1). This is consistent with the higher number of

Table 1. Number and percentage of respondents' hospital location by US Census region and hospital bed size

| | N (%) |
|----------------------|------------|
| States grouped | |
| by US Census regions | |
| Midwest | 211 (33.5) |
| South | 205 (32.5) |
| West | 116 (18.4) |
| Northeast | 98 (15.6) |
| Hospital bed size | |
| ≤99 Beds | 220 (34.8) |
| 100-199 Beds | 155 (24.5) |
| 200-399 Beds | 165 (26.1) |
| ≥400 Beds | 93 (14.7) |

hospitals in that size range across the United States.¹⁰ However, there were a higher proportion of respondents from the smallest sized hospitals (≤99 beds) than would be expected ($\chi^2 = 61.37$, $P < .001$).¹⁰

Survey questionnaire

The National APIC Emergency Preparedness Committee (of which the authors are members) and Trust for America's Health representatives developed the survey. The survey consisted of 29 items that measure components of hospital preparedness for infectious disease emergencies and 2 items that measure personal preparedness. The hospital preparedness indicators included the following: (1) ICP participation in a hospital disaster preparedness committee; (2) plans for alternative/off-site care; (3) incentives for health care workers; (4) plan for health care worker and their family prioritization plan; (5) around-the-clock infection control support; (6) participation in the Health Alert Network (HAN); (7) participation and community involvement in disaster exercises; (8) compilation and communication/staff education of lessons learned from disaster exercises; (9) plan for staff, laboratory, and negative-pressure room surge capacity; (10) cross training of staff; (11) stockpiling of medications, masks, N-95 respirators, ventilators, and linens; (12) plan for designated staff during a pandemic; (13) administrative encouragement for development of a personal response plan; (14) convening of ethics committee, (15) development of algorithms or policies/procedures related to altered standards of care; (16) plans for a "working quarantine"; and (17) communication of health alert messages. The 2 hospital preparedness indicators included development of a personal response plan and discussion with family regarding working during a pandemic. In addition, 2 demographic questions (hospital location by state and hospital bed size) were included. All items provided nominal level data.

Answer options for all questions except one consisted of the following: *yes*, *no*, or *I don't know*. One question assessing laboratory surge capacity had 4 answer options: *yes*, *no*, *I don't know*, and *not applicable*. Internal consistency testing could not be conducted because the items were all single item measures and there was no associated total score.⁹

Data analysis

The Statistical Package for the Social Sciences (SPSS, Inc, Chicago, IL) 14.0 was used for all analyses. All items were dummy coded because they consisted of nominal data.¹¹ Items that were answered "I don't know" were coded as missing data and excluded from analysis. Respondents who indicated "not applicable" to the laboratory surge capacity question were counted as a "yes" answer for data analysis. Hospital locations were categorized into 4 regions (Midwest, Northeast, South, and West) based on US Census divisions.⁸ Hospital bed size was divided into 4 categories: (1) ≤99 beds, (2) 100 to 199 beds, (3) 200 to 399 beds, and (4) ≥400 beds. Descriptive statistics were computed for each question and used to describe surge capacity and other infectious disease emergency preparedness issues; questions had varying denominators because of missing data (ie, skipped questions or an "I don't know" answer). A series of Kruskal-Wallis 1-way analysis of variance tests were used to evaluate the relationship between a hospital's bed size (independent variable) and its ability to care for an influx of potentially infectious patients in relation to various surge capacity and infectious disease emergency preparedness measures (dependent variables); nonparametric tests were conducted because the questions provided nominal level data.¹¹ Significant findings were followed by Mann-Whitney *U* post hoc tests. A series of χ^2 goodness-of-fit tests were used to evaluate whether there were significant differences between the proportion of respondents from the US Census regions and those from varying sized hospitals and whether the response rates by region and hospital bed size were as would be expected.¹²

RESULTS

Infectious disease emergency preparedness

Almost all respondents reported that their facility has an ICP as a member of their hospital disaster preparedness committee (93.5%, $n = 587$), with no difference between hospital bed size and having ICP representation on this committee. Most facilities (78.5%, $n = 497$) also reported that they have around-the-clock infection control support in the form of an ICP who can be reached within 15 minutes

Table 2. Means and standard deviation of bioterrorism/infectious disease disaster exercise participation by hospital bed size

| | Mean* | SD | N | Kruskal-Wallis |
|---|-------|-----|-----|--------------------|
| Participation in an infectious disease exercise in past year ^{†,‡} | | | | |
| ≤99 Beds | 1.17 | .38 | 220 | 9.63 [§] |
| 100-199 Beds | 1.12 | .33 | 155 | |
| 200-399 Beds | 1.10 | .30 | 165 | |
| ≥400 Beds | 1.05 | .23 | 93 | |
| Exercise included community involvement ^{†,‡,} | | | | |
| ≤99 Beds | 1.60 | .84 | 220 | 22.10 [¶] |
| 100-199 Beds | 1.43 | .74 | 155 | |
| 200-399 Beds | 1.30 | .66 | 165 | |
| ≥400 Beds | 1.27 | .61 | 93 | |
| Exercise lessons learned compiled and used to revise plan ^{†,‡,##} | | | | |
| ≤99 Beds | 1.23 | .42 | 220 | 23.63 [¶] |
| 100-199 Beds | 1.16 | .37 | 155 | |
| 200-399 Beds | 1.07 | .25 | 165 | |
| ≥400 Beds | 1.09 | .28 | 93 | |

*1 = Yes, 2 = no.

[†]Significant difference between ≤99 beds and 200 to 399 beds.[‡]Significant difference between ≤99 beds and ≥400 beds.[§] $P < .05$.^{||}Significant difference between ≤99 beds and 100 to 199 beds.[¶] $P < .001$.[#]Significant difference between 100 to 199 beds and 200 to 399 beds.

for verbal consultation (via telephone or face-to-face) on a 24-hour/7-days a week basis. However, the smallest hospitals (those with ≤99 beds) were significantly less likely to have around-the-clock infection control support (Kruskal-Wallis $\chi^2_3 = 15.60$, $P = .001$) than hospitals with 200 to 399 beds ($U = 15317.5$, $P < .001$) or ≥400 beds ($U = 8857.5$, $P = .01$). There was no difference among larger sized hospitals (those with 100-199 beds, 200-399 beds, or those with ≥400 beds) and having around-the-clock infection control support.

Almost all hospitals (84.2%, $n = 533$) report having participated in a disaster exercise involving a bioterrorism or infectious disease scenario during the past year, and almost all of those exercises included community involvement (86.5%, $n = 461$). Most hospitals (85.0%, $n = 538$) compiled lessons learned from the exercise that was used to revise their emergency plan; far fewer (64.3%, $n = 407$) communicated these plan changes to their staff. The smallest hospitals (those with ≤99 beds) were significantly less likely to have participated in a disaster exercise (Kruskal-Wallis $\chi^2_3 = 9.63$, $P = .05$) than larger sized hospitals (Table 2). The smallest hospitals (those with ≤99 beds) were also significantly less likely to have involved the community in their disaster exercise (Kruskal-Wallis $\chi^2_3 = 22.1$, $P < .001$) than other hospitals (Table 2). There was no difference among larger sized hospitals (those with 100-199

beds, 200-399 beds, or those with ≥400 beds) and participation in a disaster exercise or having community involvement in the exercise (Table 2).

Almost all (92.6%, $n = 586$) hospitals participate in their local or state health department's HAN, and most (82.9%, $n = 525$) also have a mechanism in place for the rapid receipt and posting of public health alerts within their facility. The smallest hospitals (those with ≤99 beds) were significantly less likely than all other sized hospitals to participate in HAN (Kruskal-Wallis $\chi^2_3 = 17.8$, $P < .001$) or to have procedures/plans to post public health alerts (Kruskal-Wallis $\chi^2_3 = 9.17$, $P < .05$).

Surge capacity

Approximately three quarters of all ICPs (76.5%, $n = 484$) reported that their hospital has surge capacity plans to care for patients at a nonhealth care facility, such as a community center, sports arena, or hotel. There was no difference between hospital size and having plans for off-site surge capacity. The majority of hospitals do not have plans for laboratory surge capacity (39.9%, $n = 253$). The smaller sized hospitals (those with ≤99 beds or 100-199 beds) were less likely than larger sized hospitals (those with 200-399 beds or ≥400 beds) to have laboratory surge capacity plans (Kruskal-Wallis $\chi^2_3 = 34.1$, $P < .001$).

Negative-pressure rooms surge capacity

Approximately 15% of ICPs ($n = 89$) reported that their hospital does not have sufficient numbers of negative-pressure rooms to accommodate their current isolation needs. Many hospitals (71.1%, $n = 450$) have plans for interim negative-pressure room surge capacity (rooms or areas to safely house patients on an emergency basis until longer term negative-pressure rooms/areas can be enacted). Less than half of all ICPs (47.1%, $n = 298$) reported that their hospital has plans for long-term negative-pressure room surge capacity. The smaller sized hospitals were less likely than larger sized hospitals to have interim negative-pressure room surge capacity plans (Kruskal-Wallis $\chi^2_3 = 60.93$, $P < .001$) or plans for long-term negative-pressure room surge capacity (Kruskal-Wallis $\chi^2_3 = 42.85$, $P < .001$) (Table 3).

Health care worker surge capacity

Approximately half of all ICPs (52.6%, $n = 333$) reported that their hospital has plans for obtaining additional staff during an infectious disease disaster. The smaller sized hospitals were less likely than larger hospitals to have staff surge capacity plans (Kruskal-Wallis $\chi^2_3 = 9.2$, $P < .05$) (Table 3). Less than half of all hospitals (43.6%, $n = 276$) reported that their disaster plan includes incentives for encouraging health care workers

Table 3. Means and standard deviation of negative pressure, health care worker, laboratory, ventilator, surgical mask, and medication surge capacity by hospital bed size

| | Mean [¶] | SD | N | Kruskal-Wallis |
|---|-------------------|-----|-----|---------------------|
| Interim negative-pressure room surge capacity ^{*,†,‡,§,} | | | | |
| ≤99 Beds | 1.46 | .50 | 220 | 60.93 [#] |
| 100-199 Beds | 1.29 | .46 | 155 | |
| 200-399 Beds | 1.13 | .33 | 165 | |
| ≥400 Beds | 1.16 | .37 | 93 | |
| Negative-pressure room surge capacity ^{*,†,‡,§,} | | | | |
| ≤99 Beds | 1.67 | .47 | 220 | 42.85 [#] |
| 100-199 Beds | 1.57 | .41 | 155 | |
| 200-399 Beds | 1.40 | .40 | 165 | |
| ≥400 Beds | 1.35 | .48 | 93 | |
| Health care worker surge capacity ^{*,§} | | | | |
| ≤99 Beds | 1.51 | .50 | 220 | 9.20 ^{**} |
| 100-199 Beds | 1.52 | .50 | 155 | |
| 200-399 Beds | 1.38 | .48 | 165 | |
| ≥400 Beds | 1.47 | .50 | 93 | |
| Laboratory surge capacity ^{†,‡,§,} | | | | |
| ≤99 Beds | 1.86 | .60 | 220 | 34.12 ^{**} |
| 100-199 Beds | 1.81 | .55 | 155 | |
| 200-399 Beds | 1.54 | .51 | 165 | |
| ≥400 Beds | 1.61 | .53 | 93 | |
| Ventilator stockpile ^{*,†,‡} | | | | |
| ≤99 Beds | 1.73 | .44 | 220 | 13.43 ^{††} |
| 100-199 Beds | 1.57 | .50 | 155 | |
| 200-399 Beds | 1.60 | .49 | 165 | |
| ≥400 Beds | 1.58 | .50 | 93 | |
| Surgical mask stockpile ^{†,‡} | | | | |
| ≤99 Beds | 1.60 | .49 | 220 | 9.86 ^{**} |
| 100-199 Beds | 1.56 | .50 | 155 | |
| 200-399 Beds | 1.47 | .50 | 165 | |
| ≥400 Beds | 1.45 | .50 | 93 | |
| Medication stockpile ^{*,†,‡} | | | | |
| ≤99 Beds | 1.45 | .50 | 220 | 9.53 ^{**} |
| 100-199 Beds | 1.35 | .48 | 155 | |
| 200-399 Beds | 1.32 | .40 | 165 | |
| ≥400 Beds | 1.32 | .47 | 93 | |

*Significant difference between ≤99 beds and 100 to 199 beds.

†Significant difference between ≤99 beds and 200 to 399 beds.

‡Significant difference between ≤99 beds and ≥400 beds.

§Significant difference between 100 to 199 beds and 200 to 399 beds.

||Significant difference between 100 to 199 beds and ≥400 beds.

¶1 = Yes, 2 = no

#P < .001.

**P < .05.

††P < .01.

to continue to work during an infectious disease disaster. Of those hospitals that do plan to offer incentives, the 2 most common incentives offered are free child or adult family member care and temporary housing and subsistence (Table 4). Table 4 outlines incentives offered by hospitals and differences between the incentives offered based on hospital bed size.

The majority of hospitals (79.1%, n = 501) reported that they have worked with their local or state health department to plan for prioritizing health care workers to receive vaccine or antiviral medications in the event of an infectious disease emergency; far fewer hospitals (49.8%, n = 315) reported that their disaster plan includes health care workers' family members in this prioritization plan. There was no difference between hospital size and having such a prioritization plan for health care workers or their family members.

Approximately one quarter of all ICPs (24.6%, n = 156) reported that their hospital has cross trained their employees to provide patient care outside their routine area/specialty to allow for staff resource distribution during an infectious disease disaster. The smaller sized hospitals (those with ≤99 beds or 100-199 beds) were less likely than larger sized hospitals (those with 200-399 beds or ≥400 beds) to have cross trained their staff (Kruskal-Wallis $\chi^2_3=46.05$, $P < .001$). Few hospitals (39.2%, n = 248) have plans to designate staff limited to treating influenza or noninfluenza patients during an influenza pandemic to limit secondary spread and potentially maximize staff capacity. The smallest sized hospitals (those with ≤99 beds) were less likely than larger hospitals to have plans to designate staff to infected patients (Kruskal-Wallis $\chi^2_3=14.40$, $P < .01$). Very few hospitals (29.1%, n = 184) reported having plans to institute a work quarantine for staff during an infectious disease disaster. There was no difference between hospital size and having plans for a work quarantine.

Medical equipment/supplies surge capacity

Five types of medical equipment/supplies were assessed by this survey: (1) ventilators, (2) National Institute for Occupational Safety and Health-approved respirators for airborne precautions (N95s), (3) surgical masks for droplet precautions, (4) linens, and (5) medications (antibiotics, antivirals, and others). Approximately one third of hospitals (36.3%, n = 230) reported stockpiling ventilators. The number of ventilators stockpiled ranged from 1 to 250, with half of the respondents (50.8%, n = 117) reporting stockpiling 10 or fewer. Many ICPs (66.8%, n = 423) reported that their hospitals have stockpiled N95 respirators. Of those who reported stockpiling N95s, half (50.1%, n = 212) indicated they had enough N95s for ≤7 days; the range was 1 to 365 days. Less than half of all hospitals (46.3%, n = 293) reported that they have stockpiled surgical masks. Of those that reported stockpiling surgical masks, 56.5% (n = 166) indicated they had enough masks for ≤7 days; the range was 1 to 365 days. Very few hospitals (18.6%, n = 118) reported stockpiling or working with their state to

Table 4. Incentives included in hospital plans to encourage employees to work during a disaster by hospital size*

| Incentive, hospital bed size | Incentive offered N (%) [†] | Mean | SD | Kruskal-Wallis |
|---|--------------------------------------|------|-----|---------------------|
| Monetary incentive, n = 107 | | | | |
| ≤99 Beds | 38 (41.8) | 1.58 | .50 | NS |
| 100-199 Beds | 30 (42.9) | 1.57 | .50 | |
| 200-399 Beds | 22 (30.1) | 1.70 | .46 | |
| ≥400 Beds | 17 (40.5) | 1.60 | .50 | |
| Transportation, n = 116 | | | | |
| ≤99 Beds | 30 (33.0) | 1.67 | .47 | NS |
| 100-199 Beds | 33 (47.1) | 1.52 | .50 | |
| 200-399 Beds | 31 (42.5) | 1.58 | .50 | |
| ≥400 Beds | 22 (52.4) | 1.48 | .51 | |
| Housing and subsistence, ^{‡,§} n = 161 | | | | |
| ≤99 Beds | 41 (45.1) | 1.55 | .50 | 13.99 |
| 100-199 Beds | 39 (55.7) | 1.44 | .50 | |
| 200-399 Beds | 50 (68.5) | 1.32 | .47 | |
| ≥400 Beds | 31 (73.8) | 1.26 | .44 | |
| Child/adult family member care [‡] n = 174 | | | | |
| ≤99 Beds | 46 (50.5) | 1.49 | .50 | 11.98 |
| 100-199 Beds | 45 (64.3) | 1.36 | .48 | |
| 200-399 Beds | 56 (76.7) | 1.23 | .43 | |
| ≥400 Beds | 27 (64.3) | 1.36 | .48 | |
| Pet care [‡] n = 52 | | | | |
| ≤99 Beds | 9 (9.9) | 1.90 | .30 | 12.51 |
| 100-199 Beds | 13 (18.6) | 1.81 | .39 | |
| 200-399 Beds | 23 (31.5) | 1.68 | .47 | |
| ≥400 Beds | 7 (16.7) | 1.83 | .38 | |

*Only hospitals that answered that their hospital has plans for offering incentives (43.6%, n = 276) are included in the denominator.

[†]1 = Yes, 2 = no.

[‡]Significant difference between ≤99 beds and 200 to 399 beds.

[§]Significant difference between ≤99 beds and ≥400 beds.

^{||}p < .01.

stockpile patient linens (gowns, sheets, and others). Of those that reported stockpiling linens, approximately half of the respondents (51.5%, n = 61) indicated they had enough linen for ≤5 days; the range was 1 to 90 days. Many hospitals (62.6%, n = 396) reported stockpiling or making agreements to obtain additional medications (antibiotics, antivirals, and others) not counting those available through the Strategic National Stockpile.

The smallest sized hospitals (those with ≤99 beds) were less likely than larger hospitals to have stockpiled ventilators (Kruskal-Wallis $\chi^2_3=13.43$, $P < .01$) or medications (Kruskal-Wallis $\chi^2_3=9.53$, $P < .05$) (Table 3). The smallest sized hospitals (those with ≤99 beds) were also less likely than the largest hospitals (those with 200-399 or ≥400 beds) to have stockpiled surgical masks (Kruskal-Wallis $\chi^2_3=9.86$, $P < .05$) (Table 3). There was no difference between hospital bed size and the likelihood of stockpiling N95s respirators or linens.

Altered standards of care during disasters

Few ICPs (22.7%, n = 144) reported that their hospital has convened their ethics committee to help with

decisions regarding altered standards of care during a pandemic. The smallest sized hospitals (those with ≤99 beds) were also less likely than the largest hospitals (those with 200-399 or ≥400 beds) and smaller sized hospitals (100-199 beds) were less likely than the largest sized hospitals (those with ≥400 beds) to have convened their ethics committee (Kruskal-Wallis $\chi^2_3=13.67$, $P < .01$). Approximately one quarter of hospitals (24.5%, n = 155) reported having developed algorithms or policies/procedures for providing altered standards of care during a pandemic. There was no difference between hospital bed size and the likelihood of having developed these standards of care.

Personal disaster preparedness

ICPs were asked 2 questions regarding personal preparedness: Did he/she have a personal or family disaster plan and emergency supply kit (including food, water, and others), and has he/she discussed with his/her family whether or not they would work during a pandemic if hospital employees were becoming ill? Approximately half of ICPs (53.7%, n = 340) reported that they have a personal or family disaster plan and emergency supply kit; 56.6% (n = 358) reported that their

employer encouraged them to have such a plan. Many (67.3%, $n = 426$) reported that they have discussed with their family whether they would continue working during a pandemic. ICPs working in the smallest hospitals (those with ≤ 99 beds) were also less likely than ICPs in larger hospitals to report having a personal disaster plan (Kruskal-Wallis $\chi^2_3 = 13.04$, $P < .01$), being encouraged by their employer to have a personal disaster plan (Kruskal-Wallis $\chi^2_3 = 12.72$, $P < .01$), or having discussed working during a pandemic with their family (Kruskal-Wallis $\chi^2_3 = 18.9$, $P < .001$).

DISCUSSION

The findings of this study indicate that US hospitals have made little progress in infectious disease emergency planning since 2005. Similar to previously published research, this study indicates that many US hospitals have infection control representation on their disaster planning committee, 24/7 access to infection control consultation, plans for off-site surge capacity, interim negative-pressure room surge capacity plans, participation in a bioterrorism exercise, and inclusion of health care workers in prioritization plans for vaccinations and medication during a pandemic.⁸

Findings from new infectious disease indicators assessed by this study indicate that many US hospitals are compiling lessons learned from exercises and using them to update hospital disaster plans, participating in the HAN, have mechanisms to rapidly receive and post health alert messages to their staff, and are stockpiling or making arrangements to obtain additional medications (antibiotics, antivirals, and others) during a pandemic. Many hospitals also have sufficient negative-pressure rooms for current patient needs and plans for interim negative-pressure room surge capacity.

However, for many of the preparedness indicators (24/7 infection control coverage, participation in a bioterrorism exercise, lesson learned compilation, making health care workers a priority for vaccinations and treatment, receipt and posting of health alert messages, negative-pressure rooms for current patient loads, interim negative-pressure room surge capacity, and off-site surge capacity plans), a fair percentage (15%-30%) of respondents reported not having plans to address these infectious disease disaster planning gaps. More work needs to be done in these areas to increase hospital preparedness.

Major gaps in infectious disease disaster planning identified by this study include failure to communicate lessons learned from exercises and updated plan changes to hospital staff, lack of inclusion of health care workers' family members in prioritization plans for medications and vaccines, few opportunities for cross training staff, no plan for work quarantine, and

failure to develop plans to designate staff limited to treating infected patients during a pandemic. Many hospitals also lack surge capacity measures, including laboratory, long-term negative-pressure rooms, staff, and medical supplies surge capacity. Only one third of US hospitals reported stockpiling ventilators, less than half are stockpiling surgical masks, and fewer than 20% are stockpiling linens. Although many hospitals reported stockpiling N95 respirators, most have less than a week's worth of respirators stockpiled.

Very few facilities reported having convened their ethics committee to address pandemic planning issues, and less than one quarter have developed algorithms or procedures for providing altered standards of care during a pandemic. Given the projected lack of resources that will be available during a pandemic, alternative approaches to patient care must be considered. It would be best if ethics committees were involved in the planning stages so that tough decisions can be made before an event occurs. These plans can be communicated to health care providers and the general public to enable more transparent decision making and potentially decrease the emotional burden placed on health care providers and families.

Another gap in infectious disease disaster planning is the failure to provide incentives for encouraging health care workers to continue working during a pandemic; less than half of US hospitals reported having such plans. This is approximately the same proportion of hospitals that reported including health care incentives in their disaster plan in 2005, implying that the proportion of hospitals including incentives to increase health care worker surge capacity is not increasing. Of those hospitals that are planning to offer incentives, the most frequently reported incentives are free child or adult family member care and temporary housing and subsistence for health care workers during a disaster. Hospitals should consider offering other incentives, such as monetary bonuses, transportation assistance or pet care, to increase the likelihood of staff coming to work during a disaster; this may decrease some of the need for health care worker surge capacity.

Improvements in disaster planning identified in this study compared with the 2005 study include a higher proportion of hospitals reporting that health care workers are listed as a priority group for receiving medications or vaccines during a pandemic (79.1% vs 69.6%, respectively), and plans for off-site surge capacity have been developed (76.5% vs 63.3%, respectively). However, these results should be interpreted with caution because the findings may be related to responder bias between the 2 surveys and not actual improvements in disaster planning.

Overall, smaller sized hospitals are less prepared than larger facilities for an infectious disease disaster.

Smaller hospitals are less likely than larger facilities to have around-the-clock infection control consultation, procedures for posting health alerts, participated in a bioterrorism exercise in the last year or community involvement in the exercise, convened their ethics committee to discuss pandemic planning, involvement with the HAN, plans to designate staff to infected patients, or cross trained their staff. Smaller sized hospitals were also less likely than larger facilities to have surge capacity in terms of laboratory, negative-pressure rooms, staff, or medical equipment (ventilators, surgical masks, and medication). These differences in infectious disease disaster planning most likely relate to an inequitable distribution of resources within communities, with larger facilities having more resources than smaller hospitals. However, in the event of a pandemic, all health care facilities in a community will be affected, and it is imperative that smaller hospitals are able to handle a surge of potentially infectious patients. Regional planning efforts should include smaller facilities and assist with resource distribution as needed.

A few limitations of this study must be noted. One limitation is the potential issue of responder bias. Characteristics of the nonresponders and/or their facility could not be directly assessed, a common issue in survey research. It is also possible that multiple ICPs from the same facility completed a survey (ie, provided information about the same hospital), thereby possibly decreasing data validity and reducing sample size. There was a higher than expected response rate from ICPs in Midwest and Northeastern hospitals and those in the smallest sized facilities based on the AHA hospital demographics and US Census data.^{8,10} This is likely due to the increased interest and awareness surrounding infectious disease emergency preparedness in the Northeast (because of the 2001 terrorist events) and in smaller sized hospitals (because of the lack of resources faced by these facilities). One final limitation is the lack of available validity and reliability data related to the survey questionnaire.

CONCLUSION

Hospital preparedness for infectious disease emergencies remains essential. This study involving a non-random sample of APIC members identifies new and persistent gaps in US hospital preparedness and highlights the areas most in need of being addressed: negative-pressure room, health care worker, and medical equipment/supplies surge capacity and ethical considerations in disaster planning. Differences between hospitals of various sizes and gaps in planning are outlined. US hospitals must continue to address gaps in infectious disease emergency planning.

References

1. Cymet T. What is the true number of victims of the postal anthrax attack of 2001. *J Am Osteopath Assoc* 2004;104:452.
2. Barnes K. Cost of anthrax attacks "surges." 2001. Available at: <http://news.bbc.co.uk/1/hi/world/americas/1629872.stm>. Accessed January 27, 2005.
3. Kurpis B. Hurricane Katrina relief. Frequently asked questions. 2006. Available at: <http://www.hurricanekatrinarelieff.com/faqs.html>. Accessed November 12, 2007.
4. Leavitt M. Pandemic planning update IV. July 18, 2007. Available at: <http://www.pandemicflu.gov/plan/panflureport4.pdf>. Accessed November 12, 2007.
5. Bourgeois A. Novation survey on pandemic flu preparedness shows hospitals will run out of supplies in less than one week. Available at: http://www.novationco.com/pressroom/releases/news_070521.asp. Accessed November 12, 2007.
6. Kaji AH, Lewis RJ. Hospital disaster preparedness in Los Angeles County. *Acad Emerg Med* 2006;13:1198-203.
7. Rebmann T, Carrico R, English J. Hospital infectious disease emergency preparedness: a survey of infection control professionals. *Am J Infect Control* 2007;35:25-32.
8. Energy Information Administration. US census regions and divisions. 2000. Available at: http://www.eia.doe.gov/emeu/rep/maps/us_census.html. Accessed August 17, 2007.
9. Knapp TR. Coefficient alpha: Conceptualizations and anomalies. *Res Nurs Health* 1991;14:457-60.
10. American Hospital Association. American Hospital Association health statistics. Chicago, IL: Healthcare InfoSource; 2006.
11. Stevens JP. Applied multivariate statistics for the social sciences. 4th ed. Mahwah, New Jersey: Lawrence Erlbaum Associates; 2002.
12. Siegel S, Castellan NJ Jr. Nonparametric statistics for the behavioral sciences. 2nd ed. New York: McGraw Hill; 1988.