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## Major article

## US school/academic institution disaster and pandemic preparedness and seasonal influenza vaccination among school nurses

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**Background:** School pandemic preparedness is essential, but has not been evaluated.**Methods:** An online survey was sent to school nurses (from state school nurse associations and/or state departments of education) between May and July 2011. Overall school pandemic preparedness scores were calculated by assigning 1 point for each item in the school's pandemic plan; the maximum score was 11. Linear regression was used to describe factors associated with higher school pandemic preparedness scores. Nurse influenza vaccine uptake was assessed as well.**Results:** A total of 1,997 nurses from 26 states completed the survey. Almost three-quarters (73.7%; n = 1,472) reported receiving the seasonal influenza vaccine during the 2010-11 season. Very few (2.2%; n = 43) reported that their school/district had a mandatory influenza vaccination policy. Pandemic preparedness scores ranged from 0 to 10 points, with an average score of 4.3. Determinants of school pandemic preparedness were as follows: planning to be a point of dispensing during a future pandemic ( $P < .001$ ), having experienced multiple student or employee hospitalizations and/or deaths related to H1N1 during the pandemic ( $P = .01$  or  $< .05$ , respectively), having a lead nurse complete the survey ( $P < .001$ ), and having the school nurse study participant be a member of the school disaster planning committee ( $P < .001$ ).**Conclusions:** US schools must continue to address gaps in pandemic planning.

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Disaster preparedness, including planning for bioterrorism, pandemics, and outbreaks of emerging infectious diseases, is essential for all academic institutions.<sup>1</sup> Research has shown that better disaster preparedness saves lives, and that insufficient preparedness costs lives.<sup>2,3</sup> The 2009 H1N1 influenza pandemic resulted in illnesses in more than 214 countries and was associated with more than 18,000 deaths worldwide.<sup>4</sup> Researchers using financial models have estimated that a future moderate influenza pandemic could result in more than 90 million ill individuals and more than 209,000 deaths in the United States alone.<sup>5</sup> Pandemic preparedness is critical not only because of ramifications of the 2009 H1N1 pandemic, but also because of the threat of a future pandemic or an outbreak of an emerging infectious disease, such as severe acute respiratory syndrome.

Research indicates that the US health care and public health systems are not prepared for disasters involving biological agents.<sup>6-10</sup> Focus groups conducted with health care workers in spring 2009 to examine the effect of the 2009 H1N1 influenza pandemic found that there were many challenges for health care, including insufficient supplies, difficulty communicating with other response agencies, and inadequate access to educational materials.<sup>9</sup> Two of the most significant findings from that study were the challenges of identifying individuals who were potentially infected and the lack of guidance released for non-acute care facilities/institutions.<sup>9</sup> These findings have important implications for education institutions, although the impact to schools from the 2009 H1N1 influenza pandemic has not yet been evaluated.

Few previous studies have examined school disaster preparedness. Most of the studies reported to date examined a school's ability to respond to a medical emergency involving a single child.<sup>11-14</sup> Only 2 reported studies attempted to measure aspects of school preparedness in terms a school-wide disaster response. A 2007 study by Kano et al<sup>15</sup> examined the preparedness of 83 schools in Los Angeles County and found that although most of the school

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representatives reported believing that their school was prepared for a disaster, many deficiencies in emergency planning existed. Identified deficiencies in school disaster planning included insufficient written disaster plans, staff training in disaster preparedness, and prearrangements to obtain supplies during an event.<sup>15</sup> That study did not ask evaluate the schools' pandemic and biological disaster preparedness, however. The other school study that aimed to measure school disaster preparedness only examined issues surrounding school closure during the 2009 H1N1 pandemic.<sup>16</sup> Many other aspects of school preparedness for biological disasters, such as a written plan to address biological events, school nurse/worker access to personal protective equipment, and participation in community syndromic surveillance programs, need to be assessed.

The Centers for Disease Control and Prevention (CDC) released guidance for schools related to reducing the spread of influenza within schools,<sup>17</sup> but no study has examined whether these guidelines have been implemented in schools or included in school disaster plans. Influenza can spread rapidly within schools; fall school openings during the 2009 pandemic are believed to have triggered the second wave of the H1N1 pandemic.<sup>18</sup> In addition, some strains of influenza, such as the 2009 H1N1 strain, affect children disproportionately.<sup>19</sup> Finally, school preparedness for all types of disasters, including biological events, is mandated by the US Department of Education to reduce morbidity and mortality.<sup>20</sup>

The purpose of the present study was to evaluate US schools' and academic institutions' current state of readiness to respond to a disaster, particularly focusing on preparedness for infectious disease disasters, such as bioterrorism, pandemics, and outbreaks of emerging infectious diseases.

## METHODS

This study consisted of a survey administered to US school nurses between May and July 2011 through the online program Qualtrics. Subjects were recruited from a variety of sources, including state school nurse associations, state departments of education, and individual school Web sites for school nurse contact information. Twenty-five school nurse organizations agreed to assist by sending out a recruitment e-mail to their members/contacts or posting a recruitment statement on their organization's Web site. (A list of participating organizations/agencies is available on request.) A modified Dillman total design method was used to maximize response rates.<sup>21</sup> Two recruitment e-mails (sent 2-4 weeks apart) were distributed to school nurses for whom an e-mail address was available. The Saint Louis University Institutional Review Board approved this study.

## INSTRUMENT

Surveys used in earlier studies examining school disaster preparedness<sup>14,15</sup> served as the basis for our questionnaire. CDC recommendations related to pandemic planning for schools<sup>22</sup> and colleges/universities<sup>23</sup> also were incorporated into the questionnaire. Finally, questions specific to the purposes of this study were added. A group of 10 US pandemic preparedness researchers provided feedback on content validity. A content validity index (CVI) was computed for each item<sup>24</sup>; no items had a CVI below 0.80, and so no items were deleted. The final survey contained 26 questions plus demographic items. Twenty St Louis area school nurses pilot-tested the instrument. Feedback from pilot testing was used to further refine the instrument.

The survey assessed the following areas: (1) school disaster preparedness, (2) school pandemic preparedness, (3) school plan to function as a point of dispensing (POD) in a future disaster,

(4) personal protective equipment (PPE) stockpiled by the school, (5) access to and cost of seasonal influenza vaccine, and (6) existence of a mandatory influenza vaccination policy for a variety of school employees. The components of school preparedness were categorical items, with most answer options "yes" or "no": (1) written disaster plan, (2) plan coordinated with local and regional agencies, (3) participation in regional disaster exercise in previous 2 years, (4) plan addresses pandemics, (5) plan updated since/in response to the 2009 H1N1 pandemic, (6) infectious disease scenario used in a disaster drill in the previous 2 years, (7) medications stockpiled/available from district, (8) PPE stored/available, (9) school nurse mandated to receive seasonal influenza vaccine, (10) plan to increase environmental decontamination/cleaning during pandemic, and (11) participation in a community syndromic surveillance program. The remaining school preparedness indicators were categorical variables that had nominal answer categories: (1) frequency that school plan is reviewed/updated (every 1, 2, or 3 or more years), (2) staff receiving disaster plan training (all, some, or none), (3) frequency with which school conducts a disaster drill/exercise (every month, quarter, semester, year, or less than once per year), (4) continuity of operations plan and/or distance-based program (yes, no, or currently working on it), (5) staff receiving respiratory hygiene training (all, some, or none), (6) frequency with which students receive infection prevention training (less than once per year or 1, 2, or 3 times per year). Pandemic preparedness was assessed using a subset of the school preparedness indicators, namely the items specific to an infectious disease disaster (eg, having a pandemic preparedness plan).

The temporal stability of the instrument was assessed using a 2-week test-retest procedure among 57 school nurses from the across the United States. The questionnaire demonstrated good temporal stability, with correlation coefficients varying from 0.84 to 0.96.

## DATA ANALYSIS

SPSS version 19.0 (IBM, Armonk, NY) was used for all analyses. An overall school preparedness score was calculated by assigning 1 point for each component that nurses reported in their school disaster plans. Thirteen of the 17 school preparedness indicators were scored only as 1 or 0. Examples include having a written plan (plan, 1; no plan, 0), having a stockpile of or access to PPE (yes, 1; no, 0), and frequency of disaster drills/exercises (at least once a year, 1; less than once a year, 0). Indicators that could be partially met were assigned 1, 0.5, or 0 points. These indicators included disaster plan and respiratory hygiene training for staff (all staff trained, 1; some staff trained, 0.5; no staff trained, 0), school nurse mandatory influenza vaccination policy (immunization mandated, 1; encouraged, but not mandated, 0.5; neither mandated nor encouraged, 0), and continuity of operations plan (distance-based program in place, 1; working on plan, 0.5; no plan for distance education, 0). The highest possible score for school disaster was 17, and that for pandemic preparedness was 11 (ie, 1 point for each of the 17 or 11 components). Descriptive statistics were computed for each question and used to describe the components of the school's disaster and pandemic preparedness and the plan to function as a POD in a future disaster. Fisher's exact test was used to compare rates of mandating vaccine across the types of school employees (eg, nurses, teachers, counselors). The  $\chi^2$  test was used to identify any differences between public versus private schools when comparing the stockpiling of infection prevention supplies. Linear regression was used to describe factors associated with higher school and pandemic preparedness scores. Nonsignificant variables were not included in the final models; only final models are reported.

## RESULTS

A total of 1,997 nurses from 26 states completed the survey. The overall response rate was 21.9%, although it was 50.2% among states who sent a recruitment e-mail to their members (as opposed to posting a link to the survey on their Web site or sending the link via a newsletter). The majority of nurses (61.8%;  $n = 1,228$ ) reported covering only a single school. Among nurses who cover only one school, 41.3% ( $n = 413$ ) worked in an elementary school, 36.5% ( $n = 440$ ) worked in a high school, and 21.0% ( $n = 253$ ) worked in a middle school; only 1.2% ( $n = 14$ ) provided care to college or university students. Of those nurses who reported covering multiple schools (38.2%,  $n = 769$ ), most (40.1%,  $n = 304$ ) covered 2 schools, with a range of 2 to 86 schools covered. The study group was predominately female (99.1%;  $n = 1,980$ ) and Caucasian (94.8%;  $n = 1,894$ ). Nurses of all ages and with all educational levels participated, but the largest group of responders (48.2%;  $n = 963$ ) were aged 51-60 years and had a Bachelor's degree (40.9%;  $n = 817$ ); only 3.8% ( $n = 76$ ) were nurse practitioners (NPs). More than half (59.5%;  $n = 1,188$ ) self-identified as a school nurse in a nonadministrative or lead nurse role, and as a member of her school/district disaster planning committee (57.7%;  $n = 1,153$ ).

### *School disaster and pandemic preparedness*

This survey included 17 indicators of school preparedness, for a maximum total preparedness score of 17 points. School preparedness scores ranged from 0 to 15.5, with an average score of 7.7. Of the 17 school preparedness indicators, 11 were specific to pandemic preparedness; thus, the maximum pandemic preparedness score was 11 points. School pandemic preparedness scores ranged from 0 to 10 points, with an average score of 4.3. Components of school disaster and pandemic preparedness plans and the frequency with which schools reported having each component are listed in Table 1. Infection prevention supplies that schools have stockpiled or would have access to during a disaster are presented in Table 2. Private schools were more likely than public schools to report having stockpiled alcohol-based hand rub ( $P < .05$ ), eye protection ( $P < .05$ ), and gloves ( $P < .05$ ) (Table 2).

Although it is not a direct indicator of pandemic preparedness, school designation as a POD during a future pandemic was assessed because of the belief that schools designated as a POD need to have worked closely with community disaster planners; this collaboration between schools and disaster planners may increase awareness of the need for pandemic preparation and subsequent preparedness. Half of the nurses (50.9%;  $n = 1,016$ ) reported not knowing whether or not their school would be a POD during a future pandemic. Of those who did know, most (61.1%;  $n = 599$ ) indicated that their school would not serve as a POD. Schools designated to serve as a POD had significantly higher pandemic preparedness scores than schools not so designated (5.1 vs 4.1;  $t = 9.3$ ;  $P < .001$ ). Determinants of school disaster and pandemic preparedness were identified as (1) located in a southern state, (2) designated to be a POD during a future pandemic, (3) experienced multiple student or employee hospitalizations and/or deaths related to H1N1 during the pandemic, (4) had a lead nurse complete the survey, and (5) had the school nurse study participant as a member of the school disaster planning committee (Table 3).

### *Seasonal influenza vaccine*

Three-quarters of the nurses (74.5%;  $n = 1,488$ ) reported that their school, district, or employer offered the seasonal influenza vaccine during the 2010-11 season, and almost as many (73.7%;  $n = 1,472$ ) reported receiving the vaccination. Of the nurses who

were offered the vaccine and were vaccinated, 64.5% ( $n = 949$ ) reported receiving the vaccine free of charge. Very few nurses (2.2%;  $n = 43$ ) reported that their school/district had a mandatory influenza vaccination policy for nurses during the 2010-11 season; even fewer (0.1%;  $n = 1$ ) reported a mandatory influenza vaccination policy for other school staff (eg, counselors, teachers, administrators). Nurses were more likely than all other school employees ( $P < .001$ ) to be mandated to receive the seasonal influenza vaccine (Table 4). Most nurses (80.6%;  $n = 1,609$ ) reported being encouraged by their employer to receive the seasonal influenza vaccine, but 17.3% ( $n = 345$ ) reported being neither mandated nor encouraged to get immunized.

## DISCUSSION

Similar to previous research,<sup>15</sup> the present study found that most schools have a written disaster plan in place. There remains room for improvement, however, given that a fair percentage of participating schools reported not having a written disaster plan despite the American Academy of Pediatrics recommendation that all schools have a disaster preparedness plan in place.<sup>14</sup> Even more alarming, almost half of all school plans were not coordinated with local and regional response agencies, and many schools did not train staff in the disaster plan. The previous study reported similar findings regarding the need to improve schools' written plans and increase staff disaster plan training.<sup>15</sup> These are areas of school preparedness that do not appear to be improving much, despite the increased number of disasters over the past few years, including the H1N1 pandemic. It is vital that schools become more actively involved in disaster preparedness and coordinate these efforts with regional response agencies, to increase their ability to respond effectively to a future event.

Perhaps even more important than improving overall school disaster preparedness is improving preparedness for a biological event. Findings from this study suggest that most schools are even less prepared for an infectious disease disaster, such as a pandemic, compared with a natural disaster or other type of event. Despite the recent H1N1 pandemic, which disproportionately affected school-aged children, many schools do not have an adequate plan in place for a future biological event. Less than half of the participating schools reported having a plan to address biological events or updating their existing plan in response to the H1N1 pandemic, and almost no schools reported using an infectious disease scenario in a school disaster exercise to test their plan. These actions are basic tenets of disaster and pandemic preparedness,<sup>22,25</sup> and schools need to be encouraged to examine these more complex issues involved in disaster preparedness.

The present study also found that less than half of all responding schools were participating in a community syndromic surveillance program, such as reporting numbers of students experiencing influenza-like illness, gastrointestinal illness, or absenteeism rates. School-based syndromic surveillance programs are effective early detection systems for identifying outbreaks of emerging pathogens,<sup>26,27</sup> and the CDC recommends that schools consider implementing such a system in conjunction with local public health agencies.<sup>22</sup> Schools' participation in community syndromic surveillance programs would strengthen community pandemic preparedness by providing more accurate syndromic surveillance data and potentially increasing the speed with which a biological event is detected in the community. This would also strengthen the school's coordination with regional disaster planning agencies, such as the public health department. Lack of coordination between school and community disaster plans has been identified as a gap in disaster planning.<sup>15</sup> Schools should partner with local

**Table 1**  
School and pandemic preparedness indicators

| Component of school disaster plan  | Has a plan component, % (n) |
|--|-----------------------------|
| Written disaster plan  | 85.2 (1,701)                |
| Plan coordinated with local and regional agencies  | 59.7 (1,192)                |
| Frequency with which plan is reviewed and updated  |                             |
| Every year   | 40.7 (813)                  |
| Every 2 years  | 6.7 (133)                   |
| Every 3 or more years  | 52.6 (1,051)                |
| Staff members who receive disaster plan training   |                             |
| All staff are trained on the plan  | 37.1 (740)                  |
| Some staff are trained on the plan   | 40.0 (799)                  |
| No staff are trained on the plan (plan creator excepted)   | 22.9 (458)                  |
| Frequency with which the school conducts disaster exercises  |                             |
| Once a month   | 30.7 (613)                  |
| Once a quarter   | 23.9 (477)                  |
| Once a semester  | 13.8 (275)                  |
| Once a year  | 19.5 (390)                  |
| Less often than once a year  | 12.1 (88)                   |
| School participated in regional disaster exercise in last two years  | 15.0 (299)                  |
| Continuity of operations plan and/or distance-based program  |                             |
| Distance education is in place   | 7.5 (150)                   |
| Working on plan for distance education   | 9.8 (196)                   |
| No plan for distance education   | 82.7 (1,651)                |
| Components specific to infectious disease disasters/events   |                             |
| School plan addresses pandemic preparedness  | 47.8 (955)                  |
| Plan updated since/in response to the 2009 H1N1 pandemic   | 40.8 (814)                  |
| Infectious disease scenario used in disaster drill in last 2 years   | 4.0 (79)                    |
| Stockpile of medications   | 1.5 (29)                    |
| Stockpile of personal protective equipment   | 29.7 (593)                  |
| School nurse mandated/encouraged to receive seasonal flu vaccine   | See Table 4                 |
| Staff members who receive respiratory hygiene training   |                             |
| All staff are trained in respiratory hygiene   | 62.1 (1,241)                |
| Some staff are trained in respiratory hygiene  | 22.8 (456)                  |
| No staff are trained in respiratory hygiene  | 15.0 (300)                  |
| Frequency with which students are trained in infection prevention  |                             |
| 3 or more times per year   | 44.1 (881)                  |
| 2 times a year   | 7.1 (141)                   |
| 1 time per year  | 15.1 (301)                  |
| Less than once per year  | 33.8 (674)                  |
| Plan to increase school cleaning frequency/intensity after high rates of absenteeism or reopening after closure due to outbreak/pandemic | 51.1 (1,021)                |
| Participation in community syndromic surveillance program (could select more than one)   |                             |
| Report absenteeism rates   | 33.9 (677)                  |
| Report number of cases of influenza-like illness   | 48.1 (961)                  |
| Report number of cases of gastrointestinal-like illness  | 19.7 (393)                  |
| Do not participate in community syndromic surveillance program   | 43.7 (873)                  |

**Table 2**  
Infection prevention supplies being stockpiled by private versus public schools for use during a disaster

| Infection prevention product/item | All schools (n = 1,997) stockpiled, % (n) | Private vs public schools (n = 262)  |                                     | P value* |
|-----------------------------------|---|--------------------------------------|-------------------------------------|----------|
|                                   |   | Public (n = 1,850) stockpiled, % (n) | Private (n = 130) stockpiled, % (n) |          |
| Gloves                            | 26.0 (520)                                | 25.5 (472)                           | 33.1 (43)                           | NS       |
| Surgical or medical mask          | 22.7 (454)                                | 22.6 (418)                           | 24.6 (32)                           | NS       |
| Alcohol-based hand rub            | 19.7 (394)                                | 19.1 (354)                           | 26.2 (34)                           | <.05     |
| N-95 respirator or equivalent     | 14.6 (291)                                | 14.2 (262)                           | 17.7 (23)                           | NS       |
| Eye protection                    | 11.8 (235)                                | 11.3 (209)                           | 17.7 (23)                           | <.05     |
| Gown                              | 6.1 (121)                                 | 5.8 (107)                            | 8.5 (11)                            | <.05     |

NS, not significant.

\*Private versus public,  $\chi^2$  test.

public health agencies in sharing absenteeism information and/or other syndromic surveillance indicators when feasible.

Most of the schools in this study reported lacking access to supplies needed to respond to a biological event, including medications and PPE, a finding that was also reported by Kano et al,<sup>15</sup> indicating that schools need to make prearrangements to ensure access to supplies during a disaster. Although the majority of schools reported training all staff on respiratory hygiene practices, many do

not provide annual student training on basic infection prevention practices. Infection prevention training and access to PPE are important not only for disaster preparedness, but also for everyday minimization of infection transmission in schools. In 2002, Robinson<sup>28</sup> asserted that it is the role of school nurses to develop and implement infection prevention policies and programs to decrease disease transmission in schools, including educational programs such as respiratory hygiene. Schools need to partner with local

**Table 3**  
Determinants of school disaster and pandemic preparedness

| Factor  | Disaster preparedness |      |         | Pandemic preparedness |      |         |
|---|-----------------------|------|---------|-----------------------|------|---------|
|   | $\beta$               | SE   | P value | $\beta$               | SE   | P value |
| School location*                                    |                       |      |         |                       |      |         |
| Midwest   | -0.48                 | 0.19 | .01     | -0.18                 | 0.12 | .16     |
| Northeast   | -0.73                 | 0.16 | <.001   | -0.31                 | 0.10 | <.01    |
| West  | -0.02                 | 0.22 | .36     | -0.14                 | 0.15 | .34     |
| Does not plan to be a POD during a future pandemic  | -0.92                 | 0.16 | <.001   | -0.67                 | 0.11 | <.001   |
| Member of disaster planning committee               | 2.1                   | 0.13 | <.001   | 1.20                  | 0.09 | <.001   |
| Lead nurse  | 0.54                  | 0.13 | <.001   | 0.46                  | 0.09 | <.001   |
| School H1N1 morbidity/mortality <sup>†</sup>        |                       |      |         |                       |      |         |
| Student or employee illness related to H1N1         | -1.02                 | 0.40 | .01     | -0.64                 | 0.26 | <.05    |
| Student or employee hospitalization related to H1N1 | -0.67                 | 0.40 | .10     | -0.39                 | 0.26 | .14     |

SE, standard error.

\*School location referent: south.

<sup>†</sup>School H1N1 morbidity/mortality referent: student or employee multiple hospitalizations and/or deaths related to H1N1.

**Table 4**  
Extent to which the 2010-11 seasonal influenza vaccine was mandated or encouraged by occupation

| Occupation                    | Mandated to receive vaccine, % (n) | Encouraged to receive vaccine, % (n) | Neither mandated nor encouraged to receive vaccine, % (n) |
|-------------------------------|------------------------------------|--------------------------------------|---|
| School nurse                  | 2.2 (43)*                          | 80.6 (1,609)                         | 17.3 (345)  |
| Teacher or teaching assistant | 0.1 (2)*                           | 79.1 (1,580)                         | 20.8 (415)  |
| Administrator or staff        | 0.1 (2)*                           | 78.7 (1,571)                         | 21.2 (424)  |
| Counselor or librarian        | 0.1 (1)*                           | 77.8 (1,554)                         | 22.1 (442)  |
| Custodian                     | 0*                                 | 76.5 (1,527)                         | 23.5 (470)  |
| Volunteer                     | 0*                                 | 51.5 (1,029)                         | 48.5 (968)  |

\*Significant difference between nurses and all other groups determined by Fisher's exact test ( $P = .001$  for teachers, administrators, and counselors;  $P < .001$  for custodians and volunteers).

planning agencies to ensure that they will have access to supplies during a disaster, including being designated as a priority group for receiving pandemic-related vaccines or medication and PPE.

In this study, schools that reported being better prepared for a future disaster or pandemic were more likely to be designated as a POD and to have experienced increased student or employee morbidity or mortality related to H1N1 during the pandemic. The POD designation may be a significant factor in readying schools for disasters or pandemics, because it requires that the school be actively engaged in local or regional disaster planning efforts. This involvement likely influences the school in preparing for future disasters and may provide additional guidance to the school on disaster planning efforts, such as plan development and testing, through interaction with regional emergency managers/experts.

Schools with better disaster and pandemic preparedness scores were also more likely to have had a lead nurse or a school nurse involved in the school disaster planning committee complete the survey compared with schools that had a non-lead nurse or a nurse not on the disaster planning committee participate in the study. This finding has critical implications for schools wishing to improve their disaster and pandemic planning efforts. One simple strategy for increasing school disaster preparedness appears to be involving school nurses in planning efforts. School nurses are the health professionals responsible for implementing policies and programs to prevent infection transmission in schools,<sup>28</sup> and thus are those best able to inform school disaster planning committees on aspects of plan development that will affect infection transmission. In addition, the National Association of School Nurses recommends that school nurses be involved in school disaster preparedness activities.<sup>29</sup> School nurses may require additional training in pandemic planning to feel comfortable in this role. Future research should evaluate competencies for school nurses related to pandemic planning and assess school nurses' current comfort and ability related to performing in this crucial role.

Similar to previous research,<sup>30</sup> this study found that many school nurses have access to and are receiving the seasonal influenza vaccine. Although three-quarters of the school nurses in this study reported receiving the seasonal influenza vaccine during the 2010-11 season, the uptake rate remains well below the target of 90% compliance outlined in Healthy People 2020.<sup>31</sup> It is essential that school districts work to increase influenza vaccine uptake among school nurses, because this will likely result in decreased influenza-related morbidity and mortality. One factor that may be influencing school nurse influenza vaccine uptake is the low prevalence of mandatory vaccine policies reported by the school nurses in this study. Previous research indicates that approximately 12% of nonhospital agencies have a mandatory vaccination policy,<sup>30,32,33</sup> yet only approximately 2% of the school nurses in this study reported having such a policy. Mandatory vaccination policies have been found to be very strong predictors of vaccine uptake,<sup>30</sup> and multiple organizations, including the CDC<sup>34</sup> and the Society for Healthcare Epidemiology of America,<sup>35</sup> recommend that all health care workers be vaccinated against influenza every year. School administrators should consider implementing a seasonal influenza vaccination policy for nurses that is a condition of employment.<sup>35</sup> School districts also should create a system to track nurses' seasonal influenza vaccine compliance, a recommendation made by the CDC for US health care agencies.<sup>36,37</sup> This will facilitate vaccine compliance during a disaster or pandemic, which should decrease event-related morbidity and mortality. It also may be prudent for schools to mandate seasonal influenza vaccination for teachers and other staff who have close contact with students. Influenza can readily spread within schools when staff and students are in close proximity to each other; vaccination of key staff would decrease infection transmission.

This study has several notable strengths. Previous research has focused primarily on schools' ability to respond to a single-child medical emergency rather than a school-wide disaster response. None of the limited studies available on school-wide disaster



response examined pandemic planning. This is the first study to examine school pandemic preparedness. The use of a national sample increases the generalizability of our findings. Several limitations of this study must be noted. One limitation is the potential issue of nonresponder bias. We could not directly assess individual characteristics of the nonresponders, a common issue in survey research. Very few nurses who work with college or university students participated in this study; thus, the findings may not be generalizable to institutions of higher learning. There was a low response rate in some states, namely those states that posted a link about the study rather than sending an e-mail recruitment letter to their members. This low response rate may reflect school nurses' unawareness of the study, a selection bias, or some other bias. This could potentially limit the generalizability of our findings. In addition, because only US school nurses were invited to participate in this study, the findings might not be generalizable to school preparedness in other countries. Despite these limitations, this study provides a foundation for future work examining school pandemic preparedness.

## CONCLUSION

School preparedness for disasters and infectious disease emergencies is essential, yet many schools are lacking in adequate plans. US schools must continue to address gaps in infectious disease emergency planning, including developing better plans, coordinating these plans with local and regional disaster response agency plans, and testing the plans through disaster drills and exercises. Whenever possible, school nurses should be involved in these planning efforts, because health care professionals can best inform school administrators about unique aspects of pandemic planning that need to be included in school disaster plans.

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