Evaluation of 2009 Pandemic Influenza A (H1N1) Virus Exposure Among Internal Medicine Housestaff and Fellows

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Acknowledgments

Abbreviations

CDC	Centers for Disease Control and Prevention
CFR	Code of Federal Regulations
CI	Confidence interval
DFA	Direct immunofluorescence assay
GEWDVAMC	George E. Wahlen Department of Veterans Affairs Medical Center
HCH	Huntsman Cancer Hospital
HCP	Healthcare personnel
HHE	Health hazard evaluation
ICU	Intensive care unit
ILI	Influenza-like illness
IMC	Intermountain Medical Center
NAICS	North American Industry Classification System
NIOSH	National Institute for Occupational Safety and Health
OR	Odds ratio
OSHA	Occupational Safety and Health Administration
PAPR	Powered air-purifying respirator
PCMC	Primary Children's Medical Center
pH1N1	2009 pandemic influenza A (H1N1)
PPE	Personal protective equipment
RT-PCR	Reverse transcriptase polymerase chain reaction
UH	University Hospital
UUSM	University of Utah School of Medicine`

Highlights of the NIOSH Health Hazard Evaluation

The National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation (HHE) at the University of Utah School of Medicine (UUSM) in Salt Lake City, Utah. The internal medicine residency director submitted the HHE request because of concerns about the exposure of internal medicine housestaff to the 2009 pandemic influenza A(H1N1) (pH1N1) virus.

What NIOSH Did

- We visited UUSM and the four associated medical centers in September 2009. We met with housestaff, fellows, and staff members at each center to learn more about their experiences during the first phase of the pH1N1 pandemic.
- We estimated the prevalence of pH1N1 infection and influenza-like illness (ILI) and identified modes of transmission among internal medicine housestaff, cardiology fellows, and pulmonary and critical care fellows.
- We assessed their knowledge, attitudes, and practices towards influenza infection control measures.

What NIOSH Found

- We found that most of the 88 responding physicians reported exposure to patients and/or coworkers with pH1N1 or ILI at work and/or outside of work.
- Thirteen cases of ILI, with five laboratory-confirmed diagnoses of influenza A, occurred in responding physicians in May–June, 2009. Transmission likely occurred at work and outside of work.
- We found gaps in infection control knowledge and in adherence to personal protective equipment (PPE) recommendations. We also found incomplete exclusion of ill housestaff and fellows from work.
- The medical centers reported running out of supplies of N95 respirators and having difficulty obtaining additional supplies.
- Some housestaff and fellows had not been fit tested for N95 respirators.

What the Program and Medical Center Managers Can Do

- Develop procedures for tracking ill housestaff and fellows and excluding them from work.
- Develop a written plan for staffing of housestaff and fellows in the event of a pandemic or other emergency.

- Educate housestaff and fellows on the evaluation, diagnosis, treatment, and complications of patients with symptoms of influenza. Recommended isolation precautions, proper hand hygiene, and use of recommended PPE should also be covered.
- Continue to require housestaff and fellows to get the annual seasonal influenza vaccine as part of a comprehensive influenza infection control strategy.
- Place signs indicating appropriate isolation precautions outside patients' rooms as soon as patients are placed in the rooms.
- Limit healthcare personnel entering the room of a patient in isolation precautions for influenza to those performing patient care activities.
- Develop, implement, and maintain a respiratory protection program for all housestaff and fellows to protect against airborne infectious agents.
- Work with a designated person in charge to ensure an adequate inventory of N95 respirators for emergencies.

What Housestaff and Fellows Can Do

- Self assess for symptoms of ILI. Report any symptoms to appropriate supervisors as soon as possible.
- Do not report for work when ill.
- Get the seasonal influenza vaccine every year.
- Use recommended PPE when caring for critically ill and noncritically ill pH1N1 and ILI patients.

Summary

NIOSH investigators evaluated internal medicine housestaff and fellow exposure to pH1N1 virus at four medical centers in Utah. We identified 13 cases of influenza-like illness, likely acquired at work or outside of work, among this group. Lapses in administrative controls and PPE use for influenza exposure were also identified.

In August 2009, NIOSH received an HHE request from the director of the internal medicine residency program at UUSM concerning the exposure of internal medicine housestaff to the pH1N1 virus. A number of internal medicine housestaff were reportedly diagnosed with pH1N1 in June 2009, and more housestaff were reported to have ILI, leading to significant absenteeism in this program. The exact extent of the disease, risk factors leading to infection, and modes of transmission among the internal medicine housestaff were unknown at the time of the request.

In August–September 2009, we performed a cross-sectional study to examine pH1N1 exposure; determine the prevalence of pH1N1 infection and ILI; identify modes of transmission; and identify risk factors for infection among the internal medicine housestaff, cardiology fellows, and pulmonary and critical care fellows who were in the program at any time from May 1–June 30, 2009. We also assessed knowledge, attitudes, and practices towards influenza infection control measures. We made a site visit to UUSM and the four associated medical centers in September 2009, to meet with housestaff, fellows, and staff members at each of the four medical centers to learn about their experience during the early 2009 pH1N1 pandemic.

We found that most of the 88 responding physicians reported exposure to individuals with pH1N1 or ILI either at work or outside of work. Most respondents reported having contact with a patient with confirmed or probable pH1N1 or ILI but also reported contact with ill coworkers at work and outside of work. Thirteen cases of ILI, with five laboratory-confirmed diagnoses of influenza A, occurred in responding physicians in May–June 2009. Transmission likely occurred at work and outside of work.

We concluded that all four medical centers were appropriately using the occupational health hierarchy of controls approach to prevent influenza transmission within their centers and to prevent exposure of healthcare personnel. Comprehensive programs were in place, and innovative methods of infection control had been implemented with respect to engineering and administrative controls. However, our survey results show some gaps in infection control knowledge, incomplete exclusion of ill housestaff and fellows from work, and gaps in adherence to PPE use.
We recommend that the residency and fellowship programs have procedures for tracking ill and absent housestaff and fellows. The

programs should also develop a written plan for staffing in the event of a pandemic or other emergency. Housestaff and fellows should be encouraged to self assess for symptoms. Housestaff and fellows with febrile respiratory illness should be excluded from work according to the most recent CDC guidance, found at http://www.cdc.gov/flu/professionals/infectioncontrol/healthcaresettings.htm. They should also be encouraged to avoid social events outside of work.

Education and training of housestaff and fellows should be provided at least annually regarding the evaluation, diagnosis, treatment, and complications of patients with symptoms of influenza; the recommended isolation precautions at each of the four medical centers; proper hand hygiene; and the proper donning, use, and removal of recommended PPE. Housestaff, fellows, and all medical center employees should continue to be required to receive the annual seasonal influenza vaccine as part of the comprehensive influenza infection control strategy. The vaccine should be made available to all housestaff and fellows at their assigned medical centers. Signage indicating appropriate isolation precautions should be placed outside of patients' rooms concurrent with placement of patients in rooms. HCP entering the room of a patient in isolation precautions for influenza should be limited to those performing patient care activities.

A respiratory protection program should be developed, implemented, and maintained for all housestaff and fellows to protect against airborne infectious agents. All housestaff and fellows should receive training, receive medical clearance, and undergo fit testing as specified in the OSHA Respiratory Protection Standard (29 CFR 1910.134). PPE, including gloves, gowns, surgical masks, N95 filtering facepiece respirators, and eye protection, should be made readily available near patient rooms according to hospital guidelines. PPE use should be emphasized when caring for critically ill and noncritically ill pH1N1 and ILI patients. The medical centers should ensure appropriate stockpiles of N95 respirators and other PPE in preparation for potential outbreaks of airborne infectious agents.

Keywords: NAICS 622110 (General Medical and Surgical Hospitals), pandemic, H1N1, influenza, hospital, physicians, influenza-like illness, personal protective equipment

On August 3, 2009, NIOSH received an HHE request from the internal medicine residency program director at UUSM concerning the exposure of internal medicine housestaff to pH1N1 virus. Several internal medicine housestaff were reportedly diagnosed with pH1N1 in June 2009, and more housestaff were reported to have ILI, leading to significant absenteeism. The exact extent of the disease, risk factors leading to infection, and modes of transmission among these residents were unknown.

University of Utah School of Medicine

The Internal Medicine Residency program at UUSM consisted of 120 residents or housestaff in three programs: a 3-year categorical internal medicine program, a 4-year medicine-pediatrics program, and a 1-year preliminary program for residents planning to enter noninternal medicine disciplines. Housestaff rotate biweekly or monthly through a variety of inpatient, critical care, and ambulatory training experiences at four acute care hospitals: UH/HCH, GEWDVAMC, IMC, and PCMC.

The UUSM Division of Cardiology offers subspecialty fellowships in cardiovascular disease (3 years), clinical cardiac electrophysiology (2 years), interventional cardiology (1 year), and heart failure/transplant (1 year). The UUSM Division of Pulmonary and Critical Care Medicine provides a 3-year fellowship in pulmonary and critical care medicine. Cardiology and pulmonary and critical care fellows rotate at UH, GEWDVAMC, and IMC during their clinical training.

University Hospitals & Clinics is a healthcare system that consists of UH/HCH, University Orthopaedic Center, the University Neuropsychiatric Institute, 10 community clinics, and several specialty centers. UH/HCH, located in Salt Lake City, Utah, serves as an academic tertiary care center for the area and has 500 inpatient beds. GEWDVAMC, also located in Salt Lake City, Utah, is a midsized tertiary care facility with 121 inpatient beds. IMC, a tertiary care center located in Murray, Utah, has 450 inpatient beds. PCMC, an academic tertiary care center for children located in Salt Lake City, Utah, has 271 inpatient beds. All four medical centers serve as referral centers for patients from Utah, Idaho, Wyoming, Nevada, and Montana.

2009 Pandemic Influenza A (H1N1) Virus

The pH1N1 virus, also referred to as "swine flu," was first detected in humans in the United States in April 2009. On June 11, 2009, the World Health Organization signaled that a pandemic of pH1N1 was underway. During the spring of 2009, more than 40,000 confirmed or probable cases and more than 300 deaths in the United States were reported to CDC [CDC 2009a].

Spread of the pH1N1 virus is similar to that of seasonal influenza [CDC 2009b]. Influenza viruses are spread mainly through droplet transmission though evidence for airborne transmission and transmission via direct contact also exists [CDC 2009b].

The symptoms of pH1N1 infection include fever, cough, sore throat, runny or stuffy nose, body aches, headache, chills, and fatigue. Some patients have vomiting and diarrhea, while others have respiratory symptoms without a fever. Illness with the pH1N1 virus has ranged from mild to severe. While most ill people have recovered without medical treatment, hospitalizations and deaths from pH1N1 infection have occurred. Many patients with illness resulting in hospitalization or death had one or more medical conditions previously recognized as placing people at "high risk" of serious seasonal influenza-related complications, including pregnancy, diabetes, heart disease, asthma, and kidney disease [CDC 2009b].

In the state of Utah, 210 hospitalized cases of confirmed pH1N1 infection and 10 deaths were reported as of June 24, 2009 [UDOH 2009c]. Utah was one of 11 states considered to have widespread influenza activity at the time. ILI illness rates were also reported to have been elevated above the expected level in June 2009 [UDOH 2009c].

In the United States, more than 13 million people are employed in healthcare settings, representing 9% of the entire U.S. workforce [The New York Center for Health Workforce Studies 2006]. Seasonal influenza has been shown to spread rapidly among patients and HCP in healthcare settings with attack rates among HCP from 11%–59% [Van-Voris et al. 1982; Evans et al. 1997; Cunney et al. 2000; Malavaud et al. 2001; Salgado et al. 2002; Horcajada et al. 2003]. HCP are among the occupational groups considered at highest risk for exposure to pandemic influenza virus [OSHA 2009].

Early in the pandemic in April–May 2009, CDC reported details on 26 case reports of novel influenza A (H1N1) infection in HCP that were defined as confirmed or probable [CDC 2009j]. Of the 26 cases, 13 (50%) HCP had acquired infection in a healthcare setting, including one instance defined as probable HCP to HCP transmission and 12 instances defined as probable (5) or possible (7) patient to HCP transmission. Eleven HCP were defined to have probable (10) or possible (1) transmission in the community, and two had no reported exposures in either healthcare or community settings. Among 11 HCP with probable or possible patient to HCP acquisition and available information on PPE use, only three reported always using either a surgical mask or an N95 filtering facepiece respirator. These findings suggested that transmission of pH1N1 virus to HCP was occurring in both healthcare and community settings [CDC 2009j].

Strategies for prevention and control of seasonal influenza in acute care facilities have traditionally included (1) annual influenza vaccination of all eligible patients and HCP, (2) implementation of standard and droplet precautions for infected individuals, (3) active surveillance and influenza testing for new illness cases, (4) restriction of ill visitors and personnel, (5) rapid administration of influenza antiviral medications for treatment and prevention during outbreaks, and (6) education about respiratory hygiene/cough etiquette. CDC made interim recommendations for the use of Standard and Contact Precautions [Siegel et al. 2007] plus eye protection and a fit-tested disposable N95 respirator by HCP when caring for patients with confirmed, probable, or suspected pH1N1 infection [CDC 2009i] early in the pandemic because of concerns about potential transmission of pH1N1 infections to HCP and uncertainty about virulence.

Initially, all four associated medical centers followed CDC interim guidance for PPE use by HCP when caring for pH1N1 patients [CDC 2009i]. However, because of logistical issues detailed later in this report, three medical centers deviated from this guidance beginning in June 2009. Minimum PPE recommendations for infection control when caring for patients with confirmed, probable, or suspected pH1N1 or ILI patients by medical center, as of September 2009, are shown in Table 1. All centers required the use of gloves, gown, either a fit-tested N95 filtering-facepiece respirator or PAPR, and eye protection during presence at any aerosol-generating procedures.

Table 1. Minimum personal protective equipment recommendations for infection control when caring for influenza patients (excluding aerosol-generating procedures) by medical center as of September 2009

PPE Component	UH/HCH	GEWDVAMC	IMC	PCMC
Gloves	Yes	Yes	Yes	Yes
Gown	No	Yes	No	Yes
Surgical mask	Yes	No	Yes	Yes
Fit-tested N95 respirator	No	Yes	No	No
Powered air purifying respirator	No	Yes	No	No
Eye protection	Yes	Yes	No	Yes

ASSESSMENT

Our evaluation had two components: (1) a cross-sectional survey to examine pH1N1 exposure among internal medicine housestaff and fellows and (2) a site visit to UUSM and the four associated medical centers to meet with housestaff, fellows, and staff and learn about each medical center's experience during the early pH1N1 pandemic.

Cross-Sectional Study

We performed a cross-sectional study to examine pH1N1 exposure among internal medicine housestaff, cardiology fellows, and pulmonary and critical care fellows who were in the program at any time from May 1–June 30, 2009. Our objectives were to determine the prevalence of pH1N1 infection and ILI, identify modes of transmission, and identify risk factors for infection. We also sought to assess knowledge, attitudes, and practices towards use of hospital-recommended PPE and other influenza infection control measures.

We e-mailed an electronic questionnaire to the current and recently graduated housestaff and fellows and extracted information from multiple sources including: (1) residency program records regarding rotation schedules, (2) medical records of ill housestaff and fellows, and (3) medical records of confirmed and probable pH1N1 patients hospitalized at the four associated medical centers. We also reviewed the medical centers' infection control and PPE policies and procedures.

Electronic Questionnaire

In August and September 2009, we e-mailed an electronic questionnaire to 210 current and recently graduated internal medicine housestaff, cardiology fellows, pulmonary fellows, and critical care fellows. Because the period of interest was May 1–June 30, 2009, any internal medicine resident or cardiology or pulmonary and critical care fellow in the program at any time during this period was invited to participate. The questionnaire included questions regarding personal characteristics, work history, history of exposure to pH1N1, and ILI symptoms.

A confirmed case of pH1N1 infection was defined as a person with ILI and laboratory-confirmed pH1N1 virus infection by real-time RT-PCR and/or viral culture. A probable case of pH1N1 infection was defined as a person with ILI who was positive for influenza A, but negative for human H1 and H3 by influenza RT-PCR. In the questionnaire, ILI regarding individuals to whom respondents were exposed was defined as fever (temperature of 100°F or greater) and a cough and/or a sore throat in the absence of a known cause other than influenza. We classified responding physicians as having ILI if they reported being sick with fever and either sore throat or cough. This latter definition is consistent with the case definition used in other CDC pH1N1 investigations [CDC 2009i, 2010b].

Knowledge and attitudes regarding use of PPE and adherence to other influenza infection control measures were also examined. We used some questions adapted from a previously published paper regarding PPE use for control of influenza among critical care clinicians [Daugherty et al. 2009] that applied the Theory of Planned Behavior, a widely accepted approach in predicting social and health behavior, and also developed new questions applying this approach [Ajzen 1991]. A central factor in the Theory of Planned Behavior is the individual's intention to perform a given behavior. Intention is predicted directly by three intermediate variables: attitude (feelings towards the behavior), subjective norm (a person's perception of the social pressure to perform or not perform the behavior), and perceived behavior control (a person's perception of the ease or difficulty in performing a target behavior) [Ajzen 1991]. Some PPE knowledge and attitudes questions were examined by degree of agreement with statements about influenza infection control, using a five-point Likert scale (i.e., disagree, tend to disagree, neither agree nor disagree, tend to agree, and agree). Respondents were also given a list from which to choose PPE that

were included in infection control precautions when caring for the patients being evaluated for pH1N1 at each medical center.

Practices regarding use of PPE and adherence to other influenza infection control measures, including previous seasonal influenza vaccination, hand hygiene, respirator training, and respirator fit testing, were also examined. Respondents were asked to report the proportion of time (never, some of the time, most of the time, and always) they used PPE when in close contact with patients with confirmed or probable pH1N1 or ILI at each medical center.

Record Review

We reviewed residency and fellowship program records to extract information on year of training, rotation location and type, and absenteeism. We also obtained and reviewed results of laboratory tests from the medical records of housestaff and fellows reporting ILI. With the assistance of the infection preventionists from the associated medical centers, we reviewed the medical records of confirmed and probable pH1N1 patients hospitalized during the period May 1–June 30, 2009. We determined housestaff and fellow exposure to infected patients based on authorship of admission, progress and discharge notes, and signatures of physician orders.

Data Analysis

We summarized survey results using medians and proportions as appropriate. Likert scale responses were categorized as "expressed agreement" if they marked "agree" or "tend to agree," and as "expressed disagreement" if they marked "disagree" or "tend to disagree." Characteristics and survey responses of respondents who reported ILI were compared to those of respondents not reporting ILI. Characteristics and survey responses of respondents who reported ILI and had a diagnosis of influenza A were compared to those of respondents not reporting ILI.

We categorized respondents as knowing or not knowing the infection control precautions related to PPE when caring for a patient being evaluated for pH1N1 infection at each medical center. Those respondents who indicated a higher level of respiratory protection than the minimum recommendation in Table 1 were also classified as knowing the respiratory recommendations. We decided that we could not discern whether

the selection of full-facepiece PAPR demonstrated the knowledge of an eye protection recommendation. We only categorized respondents who had rotated at that center at any time during May 1–June 30, 2009, or who reported close contact (defined as <6 feet) with a patient with confirmed or probable pH1N1 or ILI.

For respondents who reported close contact with a confirmed or probable pH1N1 or ILI patient and provided responses to questions on use of PPE components for infection control, we categorized respondents into high and low PPE adherence groups to determine rates of adherence to the minimum PPE recommendations shown in Table 1.

We included respondents reporting presence at aerosol-generating procedures and those reporting not being present at the procedures with respect to adherence to the minimum PPE recommendations in Table 1. Although the potential for aerosol generation during certain procedures is still unknown, in the questionnaire we considered intubation, suctioning, administration of nebulizing medications, bronchoscopy, acquisition of a nasopharyngeal sample, and ventilation with bilevel positive airway pressure or continuous positive airway pressure to be aerosol-generating procedures.

Respondents indicating "never" or "some of the time" for use of any of the required PPE components were classified into the low PPE adherence group. Respondents indicating "most of the time" or "always" for use of all the required PPE components were classified into the high PPE adherence group. Those respondents who indicated wearing a higher level of protection than was recommended (e.g., an N95 respirator when only a surgical mask was required or a gown when it was not required) were classified into the high PPE adherence group as long as the required PPE components were also used. We reasoned that respondents using a level of protection beyond minimum PPE recommendations would be adequately protected. Respondents who indicated wearing a PAPR were also classified as wearing eye protection because the medical centers provided full-facepiece PAPRs. We then determined factors associated with high and low PPE adherence.

Bivariate analyses were conducted using the student's *t*-test, Pearson's chi-square test, and Fisher's exact test using SAS 9.2 (SAS Institute, Cary, North Carolina). All tests were two-tailed, and statistical significance was set at $p<0.05$. We calculated odds ratios and 95% confidence intervals.

Site Visit

Meetings with Housestaff and Fellows

We visited UUSM and the four associated medical centers on September 14–17, 2009. During our site visit, we attended noon conferences for the housestaff, cardiology fellows, and pulmonary and critical care fellows assigned to three of the affiliated hospitals: UH/HCH, GEWDVAMC, and IMC. During these conferences, we discussed the HHE request and the objectives and methods of our investigation. We answered questions from the housestaff and fellows and discussed their experiences and concerns regarding pH1N1.

Meetings with Medical Center Staff

During our visit, we also held meetings with staff at each associated medical center. These meetings were attended by representatives from graduate medical education, infection control and hospital epidemiology, employee health, nursing administration, hospital administration, safety and environmental health, and emergency management. We used these meetings as a forum to learn about each medical center's experience during the early pH1N1 pandemic and discuss their implementation of infection control guidance.

RESULTS

Cross-Sectional Study

Of 210 current and recently graduated housestaff and fellows, 88 (42%) completed the electronic questionnaire. The median age of respondents was 30 years (range: 25–53 years). Other demographic characteristics of survey respondents are shown in Table 2. The respondents consisted of 75 internal medicine housestaff, 7 cardiology fellows, and 6 pulmonary and critical care fellows. Work characteristics, including rotation locations and types during the period May 1–June 30, 2009, are shown in Table 3.

Table 2. Demographic characteristics of survey respondents

Demographic Characteristic	No. Respondents (%) n = 84–88*
Median age, years	30
Male sex	57 (65)
Race	
Asian	7 (8)
Black or African American	2 (2)
White	77 (88)
Other	2 (2)
Hispanic or Latino ethnicity	3 (4)
Household included:	
One or more adults ≥ 18 years old (excluding respondent)	71 (81)
One or more child/ren ≤ 5 years old	23 (26)
One or more child/ren between 5–18 years old	9 (10)

* Sample sizes varied due to missing values.

Table 3. Work history characteristics of survey respondents

Work Characteristic	No. Respondents (%) n = 85–88*
Training program	
Internal medicine residency	
Categorical medicine residency	49 (56)
Preliminary medicine residency	19 (22)
Medicine-pediatrics residency	7 (8)
Cardiology fellowship	7 (8)
Pulmonary and critical care fellowship	6 (7)
Rotation location during study period†	
UH/HCH	51 (59)
GEWDVAMC	51 (59)
IMC	29 (34)
PCMC	5 (6)
Rotation type during study period*	
ICU	31 (36)
Inpatient wards	39 (46)
Ambulatory care	36 (42)
Night float	8 (9)
Emergency medicine	8 (9)
Consult service	21 (25)

* Sample sizes varied due to missing values.
† Housestaff and fellows had more than one rotation location and type during the study period.

According to infection control records at each medical center, 35 patients at UU/HCH, 4 patients at GEWDVAMC, 39 patients at IMC, and 95 patients at PMC with confirmed pH1N1 infection were seen May 1–June 30, 2009. UU/HCH and GEWDVAMC did not have total numbers of patients with probable pH1N1 infection, but IMC reported 19 probable cases, and PMC reported 4 probable cases for this period. Between May 1–June 30, 2009, 56 (65%) of 86 respondents reported having close contact with a patient with confirmed or probable pH1N1 or ILI while working. Forty-five (52%) of 87 respondents reported having close contact with a coworker with confirmed or probable pH1N1 or ILI at work, while 28 (32%) of 88 respondents reported having close contact with a coworker with confirmed or probable pH1N1 or ILI outside of work. Twelve (14%) of 88 respondents reported having close contact with someone in their household or in the community outside of the hospital with confirmed or probable pH1N1 or ILI. Thirteen (15%) of 88 respondents reported no close contact with any of the above possible sources of exposure.

Between May 1–June 30, 2009, 13 (15%) of the 88 respondents reported symptoms of ILI. Seven (54%) of the 13 reported seeking medical care from a healthcare provider for their illness. Upon medical record review, five (71%) of the seven had a laboratory-confirmed diagnosis of influenza A by either viral culture or DFA. These five laboratory specimens did not undergo further sub-typing by RT-PCR, appropriately following the guidance of the Utah Department of Health and the Utah Public Health Laboratories [UDOH 2009d]. None of the seven who sought medical care were hospitalized.

The earliest date of symptom onset for ILI was May 10, 2009, reported by one respondent. Another respondent reported ILI symptoms starting May 30, 2009, and was diagnosed with influenza A by DFA on June 2, 2009. The next date of onset of ILI was not until June 13, 2009. The epidemic curve illustrating the number of cases of ILI and influenza A infection among respondents for June 2009 is shown in Figure 1. A cluster of 8 cases of ILI occurred in the 48–96-hour period after the resident dinner. Six of these 8 individuals reported attending the resident dinner. While it is unknown how many total housestaff and fellows attended the resident dinner, 32 (37%) of 86 survey respondents reported attending the dinner.

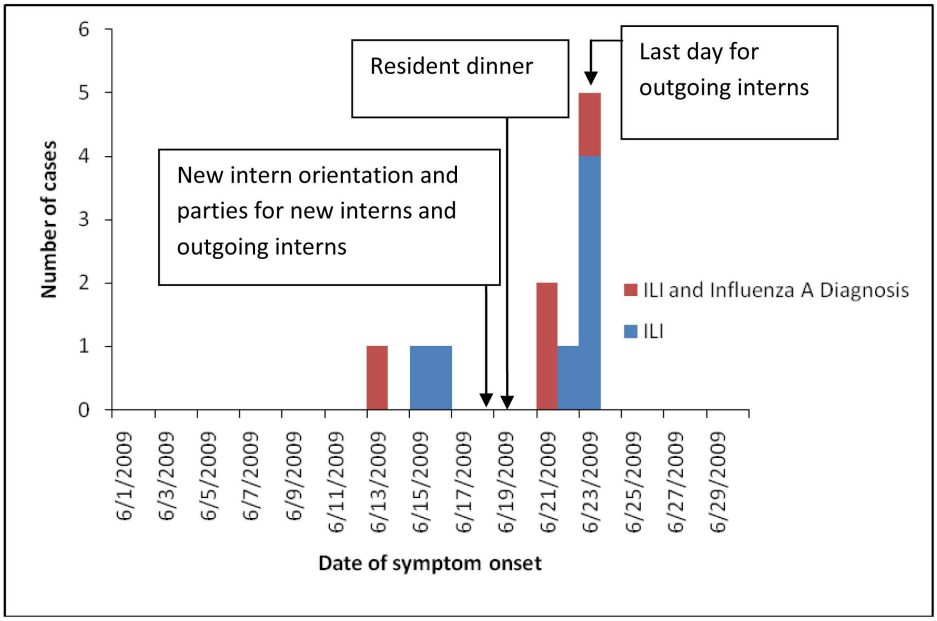

Figure 1. Graph illustrating the number of cases of ILI and influenza A infection among respondents by date of symptoms onset in June 2009.

Respondents with ILI were asked if they had close contact with anyone with confirmed or probable pH1N1 or ILI in the 7 days before symptom onset. Of the 13 respondents with ILI, two reported no known exposure. Two reported only having known close contact with one or more confirmed or probable pH1N1 or ILI patients, and two reported only having known close contact with coworkers with confirmed or probable pH1N1 or ILI at work, making healthcare-associated acquisition of infection likely for these four respondents. One respondent with ILI reported only having contact with coworkers with confirmed or probable pH1N1 or ILI outside of work. One respondent with ILI reported only having known close contact with someone in the household or community with ILI. Five respondents with ILI reported multiple sources of exposure to individuals with confirmed or probable pH1N1 or ILI.

Of the 13 respondents reporting ILI, 10 reported working while ill with a range of 1–4 days. The most common reasons for working while ill are shown in Table 4 and included having a professional obligation to patients (n=4) and coworkers (n=4).

Table 4. Most common reasons cited by respondents for working while ill

Reason Cited*	No. Respondents n = 10
I have a professional obligation to patients	4
I have a professional obligation to my coworkers	4
I did not think I would put patients at risk	3
I did not think I would put any coworkers at risk	2
I did not think I was contagious	2
I did not want to admit feeling sick	2

*Participants could cite more than one reason.

We found no statistically significant differences in demographic characteristics (age, sex, race, Hispanic or Latino ethnicity) and rotation location during May 1–June 30, 2009, among respondents reporting a history of ILI compared to those not reporting ILI. In addition, we found no statistically significant differences in exposures to pH1N1 or ILI patients (either reported by the respondent or documented in the chart) or classification of high or low adherence to the minimum PPE recommendations among respondents reporting a history of ILI compared to those not reporting ILI. Respondents reporting a history of ILI were more likely to be a resident in their second post-graduate year than all other years of residency (OR = 6.79, 95% CI = 1.24, 34.56, n = 75) and to have been on a night float rotation in the 2-month period (OR = 8.62, 95% CI = 1.28, 54.42, n = 85).

We also found no statistically significant differences in demographic characteristics, exposures to pH1N1 (either reported by the respondent or documented in the chart), and classification of high or low adherence to the minimum PPE recommendations among respondents with a history of influenza A compared to those not reporting ILI. Respondents with a history of influenza A diagnosis reported a higher mean number of coworkers with confirmed or probable pH1N1 infection or ILI with whom they came in contact outside of work than those not reporting ILI (2.2 coworkers vs. 0.56 coworkers, $P < 0.01$).

Twenty-five of 59 (42%) respondents at UH/HCH, 7 of 55 (13%) at GEWDVAMC, 28 of 32 (88%) at IMC, and 3 of 5 (60%) at PCMC knew the correct infection control precautions regarding

the minimum PPE recommendations. Eye protection was a component that respondents often did not know was included in a center's infection control precautions. For example, at UH/HCH 34 of 59 (57.6%) respondents either reported eye protection was not included in infection control precautions or that they did not know if it was included. Only 9 of 59 (15%) did not know gloves were included in infection control precautions.

Survey results regarding infection control knowledge and attitudes are shown in Table 5. Most respondents (71%–100%) who rotated at a particular associated medical center or who reported close contact with a patient with confirmed or probable pH1N1 or ILI at that center, reported knowing when patients were on influenza precautions at that particular medical center. Nearly all respondents expressed agreement that proper hand hygiene protected them (90%) and patients (91%) from acquiring influenza. Sixty-five percent of respondents expressed agreement that recommended influenza PPE was available near the rooms of patients in isolation. Eighty percent of respondents expressed agreement that PPE use protected patients from acquiring influenza, while 90% of respondents expressed agreement that PPE use protected them. However, 31% of respondents expressed agreement that PPE use interfered with patient care, and 67% felt confident that they knew how to use PPE. Fifty-three (60%) respondents indicated that surgical masks and N95 respirators are not equally protective in preventing the acquisition of influenza while 21 (24%) of respondents indicated they are equally protective, and 14 (16%) were neutral. Most of the 88 respondents considered intubation (98%), suctioning (97%), administration of nebulizing medications (77%), bronchoscopy (98%), acquisition of a nasopharyngeal sample (80%), and ventilation with bilevel positive airway pressure or continuous positive airway pressure (77%) to be aerosol-generating procedures.

Regarding infection control practices, 79 (90%) of respondents reported receiving the seasonal influenza vaccination the previous year between October 2008 and August 2009. Thirty-eight (43%) respondents reported having had N95 respirator training since the start of their program, 29 (33%) reported having had PAPR training since the start of their program, and 19 (22%) had undergone respirator fit testing between the start of their program and June 2009. Sixty-eight (77%) respondents reported always washing their hands before a patient encounter, while 71 (81%) respondents reported always washing their hands after a

patient encounter. None of the respondents reported never washing their hands before or after a patient encounter. Thirty-one (35%) of respondents reported taking antiviral medicine as influenza prophylaxis in the period May 1–June 30, 2009.

Table 5. Infection control knowledge and attitudes

Knowledge or Attitude Statement	No. Respondents Who Expressed Agreement (%)
I know when patients are on influenza precautions at UH/HCH*	52/56 (93)
I know when patients are on influenza precautions at GEWDVAMC*	43/51 (84)
I know when patients are on influenza precautions at IMC*	20/28 (71)
I know when patients are on influenza precautions at PCMC*	5/5 (100)
Proper hand washing by me keeps me from getting the flu	81/88 (92)
Proper hand washing by me keeps patients from getting the flu	80/88 (91)
My PPE use keeps me from getting the flu	79/88 (90)
My PPE use keeps patients from getting the flu	70/87 (80)
Surgical masks and N95 respirators are equally protective in helping to protect me from getting the flu	21/88 (24)
Using recommended influenza PPE interferes with patient care	27/87 (31)
All recommended influenza PPE is available near the rooms of patients in isolation	57/88 (65)
The charge nurse or attending would remind me if I did not use PPE when caring for flu patients	49/88 (56)
I feel confident that I know how to use PPE	59/88 (67)

*Analysis limited to respondents who rotated at a particular medical center at any time during May1–June 30, 2009, according to residency program records, or respondents who reported close contact with a patient with confirmed or probable pH1N1 or ILI at that center.

Fifty-three (60%) of the 88 respondents reported close contact with a confirmed or probable pH1N1 or ILI patient and provided PPE adherence information. Of those, we classified 19 (36%) as having high PPE adherence and 34 (64%) as having low PPE adherence.

Fifty-two respondents self reported whether or not they used all of the recommended PPE when in close contact with a confirmed or probable pH1N1 or ILI patient. Four respondents did not answer this specific question in the survey. Forty respondents answered that they did not always wear the recommended PPE and provided reasons. The most common reasons for not using recommended PPE were not knowing the patient had pH1N1 or ILI (n=22) and that PPE was unavailable near patients' rooms (n=12). The most common reasons are shown in Table 6.

Table 6. The most common reasons cited by respondents for not using recommended PPE

Reason Cited*	No. Respondents (%) n = 40
I did not know the patient had pH1N1 or ILI	22 (55)
The recommended PPE was not available near my patients' rooms	12 (30)
I did not think I needed it for the activity I was performing	8 (20)
The facility ran out of the recommended PPE	7 (18)
I just entered the room for a brief time	5 (13)
I did not touch the patient	5 (13)
The facility did not provide the recommended PPE	4 (10)
I did not come within 6 feet of the patient	4 (10)
I was too busy to wear PPE	4 (10)
I did not know I was supposed to wear any PPE	3 (8)
I did not know which PPE I was supposed to wear	3 (8)
It is inconvenient to use recommended PPE when taking care of flu patients	4 (10)

* Respondents could cite more than one reason and cited one to seven reasons each.
† Respondents consisted of those who reported close contact with confirmed or probable pH1N1 or ILI patient and self reported that they did not always wear recommended PPE.

We found no statistically significant differences in demographic characteristics (age, sex, race, Hispanic or Latino ethnicity) or rotation location among respondents classified as having high adherence to the minimum PPE recommendations compared to those classified as having low adherence. We did not have enough information to analyze agreement with knowing when patients were on influenza precautions at three of the four individual medical centers and their association with classification into high or low adherence to the minimum PPE recommendations. Agreement and disagreement (when dichotomized and neutral responses were excluded) with the other infection control knowledge and attitudes statements shown in Table 5 were not associated with classification into high or low adherence to the minimum PPE recommendations. In addition, knowledge of the correct infection control precautions regarding recommended PPE at each medical center was not associated with classification into high or low adherence to the minimum PPE recommendations.

Respondents classified as having high adherence to the minimum PPE recommendations were more likely to have performed or been present at an aerosol-generating procedure on a confirmed or probable pH1N1 patient (OR = 5.20, 95% CI = 1.54, 17.55).

They were also more likely to have been on an ICU rotation in the 2-month period (OR = 3.43, 95% CI = 1.02, 11.56), but less likely to have been on a general inpatient wards rotation (OR = 0.22, 95% CI = 0.06, 0.80).

Twenty-four respondents reported being present at or performing any aerosol-generating procedures. Thirteen of the 24 (54%) were classified as high adherence, and 11 were classified as low adherence (46%) to the minimum PPE recommendations in Table 1. In this stratified analysis, the definitions of high and low adherence remained consistent with the original definitions. Since we did not differentiate aerosol-generating procedures from other close contact when asking about use of all recommended PPE components in the questionnaire, we were unable to ascertain adherence to the all of the minimum PPE components recommended for aerosol-generating procedures. However, of the 24 who reported being present at or performing aerosol-generating procedures, 3 (13%) reported never wearing appropriate respiratory protection (N95 or PAPR), one (4%) reported wearing it some of the time, 7 reported wearing it most of the time (29%), and 12 reported wearing it all the time (50%). One did not answer this question (4%).

For those not present at aerosol-generating procedures but reporting close contact with a patient with confirmed or probable pH1N1 infection or ILI, 6 of 28 (21%) were classified as high adherence and 22 (79%) were classified as low adherence. Being on an ICU rotation or general inpatient wards rotation were not significantly associated with PPE adherence when we removed those who reported having performed or been present at an aerosol-generating procedure on a confirmed or probable pH1N1 patient.

Site Visit

Meetings with Housestaff and Fellows

During our meetings with housestaff and fellows, we learned that, overall, caring for influenza patients during the spring and summer raised few issues for discussion among the housestaff and fellows. However, those that were raised included confusion about the appropriate evaluation and diagnosis of hospitalized patients with influenza symptoms. We heard about instances where patients' rapid influenza antigen tests had returned with negative results, and the patients were taken out of appropriate isolation precautions, but later, the DFA or viral culture returned with a positive result. In these

instances, the patients may have exposed others to the virus. Some of these instances occurred with patients transferred from another hospital. Housestaff also expressed concern with the length of time it took to receive influenza diagnostic test results with some reports of up to 2 weeks.

Some housestaff expressed confusion about the appropriate PPE that should be worn when entering the room of a patient with an undetermined febrile respiratory illness or confirmed, probable, or suspected pH1N1 influenza infection. They noted that PPE recommendations were not consistent across the four hospitals, especially regarding the use of gowns, eye protection, and respiratory protection. They voiced a variety of opinions about the availability of the recommended PPE near the patient's room and the presence of appropriate signage depicting isolation. Some felt that eye protection was not necessary when treating influenza patients. They had a variety of opinions on whether to use surgical masks or respirators in certain instances. Some asserted that surgical masks were more comfortable to wear especially for longer periods. Some felt that N95s were hot, uncomfortable, muffled their voices, and caused more difficulty because of greater breathing resistance, but others felt that N95 respirators or PAPRs were also tolerable. A few of the housestaff noted that it is difficult to auscultate (listening for sounds made by internal organs) a patient while wearing a PAPR. Some also expressed concern they had not been fit tested to wear an N95 respirator during the residency or fellowship, and many reported they had not been trained on the proper use of PAPRs.

Some housestaff voiced concerns that the initially recommended furlough period of 7 days for ill HCP was too long, noting that this might actually deter them from reporting that they were ill. While the "pull system" (where residents are "pulled" from other rotations in the hospital to replace ill housestaff) in place at the residency is an effective method of dealing with absences, the housestaff voiced concern and reluctance in having one of their colleagues cover for them. Some housestaff did report being exposed to other housestaff who were ill and at work.

Meetings with Medical Center Staff

During our meetings, we learned that all four medical centers were using the occupational health hierarchy of controls approach to prevent influenza transmission within their settings and to prevent exposure of HCP. Comprehensive programs were in place, and

innovative methods of infection control had been implemented with respect to engineering and administrative controls (examples in Figures 2 and 3).

Figure 2. Photograph of patient room door containing recommended PPE and appropriate signage at one medical center.

Figure 3. Photograph of table containing alcohol-based hand sanitizer, surgical masks, and instructions for their use at the main entrance of one medical center.

Prior to the pH1N1 pandemic, the seasonal influenza vaccination rates of employees at the four medical centers ranged from 69%–90%. Some of the hospitals had implemented creative methods to increase vaccination rates, including badge scanning systems, influenza vaccine clinics, drive-through vaccination programs, and bringing vaccine carts to each unit. We learned that most of the medical centers had secret observers who monitored compliance with hand hygiene. One of the medical centers placed this hand hygiene data in graph form in locations visible to patients and staff as the screensavers for all hospital computers (Figure 4).

During our meetings with staff, we also learned about the logistical issues associated with the CDC interim infection control guidance [CDC 2009i]. First, the limited supply of N95 respirators was a significant problem for at least three hospitals. Staff reported short supplies of N95 respirators since the pandemic began. A major manufacturer had not fulfilled its contracts, and N95 respirators had been on back order since June 2009. In addition, the price of the N95 respirators had increased substantially since the beginning of the pandemic. Two of the hospitals reported that in

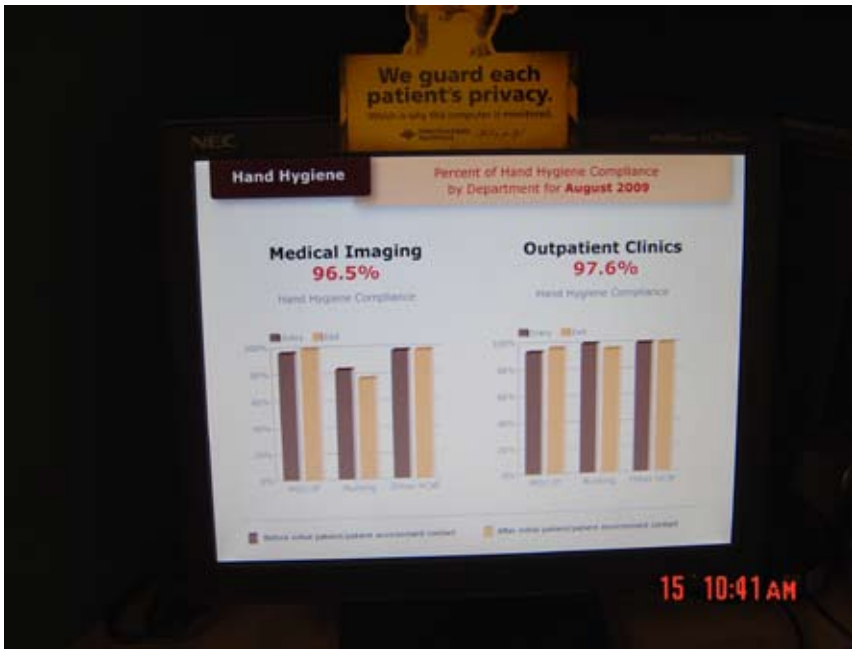

Figure 4. Photograph of screensaver containing hand hygiene compliance data displayed on a hospital computer at one medical center.

May and June 2009, boxes of N95 respirators and surgical masks had disappeared. Some of the hospitals were also making PAPRs available for use by employees. However, it was reported that the price of PAPRs had more than tripled since the pandemic began and that this had presented an additional barrier to obtaining the appropriate PPE.

We also learned that none of the medical centers' respiratory protection programs included all employees with patient contact. Before this pH1N1 pandemic, HCP wore N95 respirators mainly when in contact with patients with known or suspected active tuberculosis. Because Salt Lake City is an area with a low incidence of tuberculosis, most of the medical centers included in their respiratory protection programs only those employees with patient contact in designated units for tuberculosis patients. Since the pandemic began, the medical centers found it difficult to conduct respirator fit testing of all employees with potential contact to known or suspected pH1N1 patients because of time and financial constraints, scheduling difficulties, and limited number of personnel trained to conduct fit testing. Additionally, some employees had been previously fit tested for one model of N95 respirator, but when supplies ran out, needed to be fit tested for a different model. The cost of fit-testing kits had increased significantly. According to two of the medical centers, the high

RESULTS (CONTINUED)

cost of the kits and the time necessary to conduct the testing was considered prohibitive.

During our meetings with the staff, they also discussed the difficulty in complying with the 7-day furlough period for ill employees recommended at that time. Some employees were frustrated at not being allowed to come back to work earlier. Two of the medical centers provided separate vacation and sick leave, but the other two provided general paid time off, which included both vacation and sick leave. In some instances, employees had already used all of their paid time off before they became ill. One medical center had explored alternative work arrangements such as teleworking but noted that it was not possible to offer this to everyone and thus was not implemented.

DISCUSSION

Most respondents reported exposure to individuals with confirmed or probable pH1N1 or ILI either at work or outside of work early in the pandemic. Most respondents (65%) reported having contact with a patient with confirmed or probable pH1N1 or ILI. Respondents also reported contact with ill coworkers both at work (52%) and outside of work (32%).

The prevalence of ILI among responding internal medicine housestaff and cardiology and pulmonary and critical care fellows in May–June 2009, was 15%. Eight of the 13 cases were clustered between the dates of June 21–23, 2009. Healthcare-associated acquisition of infection was likely in two cases via patient to physician contact and likely in two cases via physician-to-physician contact at work. One case was likely due to exposure to ill coworkers outside of work. The other respondents with ILI either reported none or multiple sources of exposure to pH1N1 or ILI, making it difficult to determine their source of exposure. Our findings are consistent with the report of 26 cases among HCP where transmission of pH1N1 virus occurred in both healthcare and community settings [CDC 2009j]. Given the date proximity of the resident dinner to the cluster of cases, it is plausible that attendance at the resident dinner facilitated the spread of illness.

Most responding physicians (77%) with ILI reported working while ill. In addition, over half (52%) of the responding physicians reported having contact with a coworker with confirmed or probable pH1N1 or ILI at work. These results highlight the need for prompt identification and exclusion of ill housestaff and fellows from work.

During our meetings with housestaff and fellows, we learned about their frustration with the poor sensitivity of the rapid influenza antigen tests, which possibly contributed to their exposure to pH1N1 virus. The overall sensitivity of the rapid influenza antigen tests in diagnosing pH1N1 infection is low, ranging from 40%–69% [CDC 2009c]. One investigation of its performance during two school outbreaks found that it had a negative predictive value of 32% [CDC 2009k]. Thus, a negative result does not rule out infection with pH1N1 virus.

Our findings also reveal gaps in knowledge about correct infection control precautions regarding PPE at each hospital. We found a wide range of responding physicians (13%–88%) who knew which PPE were included in infection control precautions for caring for patients with ILI (see Table 1) across medical centers. In particular, many responding physicians did not recognize that eye protection was included the medical center's infection control precautions at three of the medical centers. In contrast, most responding physicians recognized that glove use was a component of infection control precautions at all medical centers. The vast majority of respondents agreed that hand hygiene and PPE use are effective prevention methods in influenza transmission. Much lower percentages of respondents (22%–43%) reported having had respirator training or fit testing since the start of their program.

The rate of seasonal influenza vaccination in the previous year was high in this group of responding physicians at 90%. This is consistent with the seasonal influenza vaccination rates of all employees at the four medical centers during the previous year reported during our meetings, which ranged from 62%–90% and demonstrates the commitment to this administrative control by the medical centers. The seasonal vaccination rate of 90% among respondents is far greater than overall influenza vaccination rates for HCP nationwide, which have never exceeded 49% in any season since 1989, according to estimates from the National Health Interview Survey [Walker et al. 2006; Caban-Martinez et al. 2010].

Most ILI or pH1N1 patient-exposed responding physicians (64%) were classified as having low adherence to the minimum PPE recommendations in accordance with hospital policies. Lack of awareness of a patient having pH1N1 or ILI and reporting that PPE was unavailable near patients' rooms were the most common reasons cited for not using recommended PPE. Although most respondents agreed that they knew when patients were on influenza precautions

at the four medical centers, the percentages ranged from 71%–100%, showing that improvements can still be made at some centers. Only 22% of respondents reported having been fit tested for a respirator during their training prior to the pH1N1 pandemic. Our discussions with medical center staff also revealed problems with the supply of N95 respirators.

We classified 36% of responding physicians as having high adherence to the minimum PPE recommendations; this is lower than that found by Daugherty et al., who found that 62% of critical care HCPs reported PPE adherence >80% [Daugherty et al. 2009]. Their classification of PPE adherence differed from ours. In that study, respondents were asked to report a percentage of time as adhering to PPE use and were classified as having high adherence if >80%. In addition, their study population only included critical care HCPs, who may have higher PPE adherence rates.

Physicians classified as having high adherence to the minimum PPE recommendations were more likely to have performed or been present at an aerosol-generating procedure on a confirmed or probable pH1N1 patient and have been on an ICU rotation. Physicians classified as having low adherence to the minimum PPE recommendations were more likely to have been on a general inpatient wards rotation. This suggests a lack of emphasis or training on PPE use when caring for noncritically ill pH1N1 or ILI patients.

Our evaluation was subject to some limitations. Our response rate was 42% despite multiple e-mail reminders to the housestaff and fellows. Thus, our results may not be representative of all physicians in these programs. However, housestaff in all years of training in the internal medicine residency and fellows from each program were represented in our sample. Although 13 (15%) of respondents reported symptoms of ILI, two additional internal medicine residents were identified by the residency program as being absent with ILI symptoms during May 1–June 30, 2009. These residents did not complete a survey and were not included in our evaluation. Our sample size of respondents reporting ILI and of respondents with a laboratory confirmed diagnosis of influenza A also may have been too small to detect statistically significant differences. We note that this evaluation was exploratory, many analyses were performed to examine possible relationships, and some significant findings may have occurred by chance. Thus, our results might be best used for hypothesis generation.

Discussion (continued)

Also, though the period of highest absenteeism was in June 2009, we did not receive the HHE request until August 2009. Thus, respondents' ability to recall may have affected some of our results. Our classification of adherence to the minimum PPE recommendations was based on self-reported behaviors by survey respondents. Henry et al. demonstrated that self-reported rates for PPE use, especially gloves, masks, and gowns were significantly higher for all emergency department personnel when compared to observed rates [Henry et al. 1994]. Therefore, our findings that 36% of respondents fit into the high adherence to the minimum PPE recommendations group may be an overestimation.

Five (71%) of the 13 respondents who reported ILI symptoms sought medical care from a healthcare provider, underwent laboratory testing, and had a laboratory-confirmed diagnosis of influenza A by either viral culture or DFA. Following the guidance of the Utah Department of Health and the Utah Public Health Laboratories [UDOH 2009d], these five laboratory specimens did not undergo further subtyping by RT-PCR. This leads to uncertainty as to whether these five respondents were truly infected with the pH1N1 virus. However, CDC surveillance data from May 24–June 27, 2009, shows that approximately 82%–99% of all influenza viruses reported to CDC nationwide during this period were pH1N1 viruses. [CDC 2009d,e,f,g,h]. Utah Department of Health data show that 90%–95% of all influenza viruses tested by the Utah Public Health Laboratory were pH1N1 viruses [UDOH 2009a,b,c]. Given these local and national numbers, it is likely that these respondents with a diagnosis of influenza A were infected with the pH1N1 virus.

Conclusions

Most internal medicine housestaff and cardiology and pulmonary and critical care fellows reported exposure to pH1N1 or ILI at work, from both patients and coworkers. The occupational health hierarchy of controls approach to prevent influenza transmission was being used to prevent exposure to HCP. Innovative methods of infection control have been implemented with respect to engineering and administrative controls. However, significant gaps in infection control knowledge, exclusion of ill housestaff and fellows from work, and adherence to PPE use exist.

On the basis of our findings, we recommend the actions listed below to create a more healthful workplace. Our recommendations are based on the hierarchy of controls approach and are intended for the residency and fellowship programs and/or the associated medical centers. This approach groups actions by their likely effectiveness in reducing or removing hazards. In most cases, the preferred approach is to eliminate hazardous materials or processes and install engineering controls to reduce exposure or shield employees. If they are not effective or feasible, administrative measures and/or personal protective equipment may be needed. This list is not meant to be comprehensive, and more information on infection control measures can be found on the CDC website at http://www.cdc.gov/flu/professionals/infectioncontrol/healthcaresettings.htm.

Elimination

Eliminating the potential source of exposure is a highly effective means for reducing hazards and ranks highest in the hierarchy of controls.

1. Institute procedures for tracking housestaff and fellows who are ill and absent.
    a. Encourage housestaff and fellows to self assess for symptoms and report symptoms to their attending physicians, their program, and the chief residents (if applicable).
    b. Exclude housestaff and fellows with febrile respiratory illness from work according to the most recent CDC guidance, which can be found on the CDC website at http://www.cdc.gov/flu/professionals/infectioncontrol/healthcaresettings.htm.
    c. Develop a written plan for staffing of housestaff and fellows in the event of a pandemic or other emergency.
    d. Encourage housestaff and fellows with febrile respiratory illness to avoid social events outside of work.
2. Continue procedures for managing visitors to the facility because visitors could be a source of influenza. Post signage at entry points in appropriate languages that educate visitors on the symptoms of influenza and instruct them not to enter if ill. Consider establishing a mechanism to screen visitors for influenza symptoms upon entry to the medical center or entry into the patient unit. Limit visitors of patients in isolation for influenza to those necessary for the patient's emotional well-being and care.

Engineering Controls

Engineering controls reduce exposures to employees by removing the hazard from the process or placing a barrier between the hazard and the employee. Engineering controls are very effective at protecting employees without placing primary responsibility of implementation on the employee.

1. Conduct aerosol-generating procedures in an airborne infection isolation room, whenever possible, to prevent the spread of aerosols to other parts of the facility.
2. Continue to install and use hands-free soap and water dispensers and receptacles for garbage and linens to minimize environmental contact.

Administrative Controls

Administrative controls are management-dictated work practices and policies to reduce or prevent exposures to workplace hazards. The effectiveness of administrative changes in work practices for controlling workplace hazards is dependent on management commitment and employee acceptance. Regular monitoring and reinforcement is necessary to ensure that control policies and procedures are not circumvented in the name of convenience or production.

1. Provide education and training to the housestaff and fellows at least annually about the evaluation, diagnosis, treatment, and complications of patients with symptoms of influenza; the recommended isolation precautions at each medical center; proper hand hygiene; and the proper donning, use, and removal of recommended PPE. Methods to conduct this training include conferences, other teaching sessions, and computer-based modules.
2. Provide specific instructions to housestaff emphasizing the importance of not reporting to work when ill, and have a discussion of scheduling plans for when illness occurs and for when a pandemic or other emergency occurs.
3. Continue to require housestaff and fellows to receive the annual seasonal influenza vaccine as part of the comprehensive influenza infection control strategy. Instituting an employer requirement of influenza vaccine has been associated with higher rates of seasonal influenza vaccination compared

with rates among HCP whose employers neither required nor recommended seasonal influenza vaccination [CDC 2010a]. The 2010–2011 trivalent vaccines will contain A/California/7/2009 (H1N1)-like, A/Perth/16/2009 (H3N2)-like, and B/Brisbane/60/2008-like antigens [CDC 2010c]. Make the vaccine available to all housestaff and fellows at their assigned medical centers and consider administering the vaccine to housestaff and fellows before or after morning report, grand rounds, lectures, or conferences. The residency and fellowship programs should keep track of these vaccination rates.

4. Include housestaff and fellows rotating at each medical center on e-mail disseminated by each medical center to its employees regarding influenza and general infection control information.
5. Place signs indicating appropriate isolation precautions outside patients' rooms as soon as patients are placed in the rooms.
6. Limit HCP entering the room of a patient in isolation precautions for influenza to those performing patient care activities. Attending physicians should consider eliminating bedside teaching rounds for those patients in isolation and instead present and discuss the case outside the patient's room.
7. The overall sensitivity of the rapid influenza antigen tests in diagnosing pH1N1 infection is low, ranging from 40%–69% [CDC 2009c,k]. A negative result does not rule out infection with pH1N1 virus. Evaluate patients with illnesses compatible with pH1N1 infection but a negative rapid test based on level of clinical suspicion. This also applies to patients transferred from outside hospitals. More information on diagnostic tests for pH1N1 influenza can be found at http://www.cdc.gov/h1n1flu/guidance/rapid_testing.htm and http://www.cdc.gov/h1n1flu/specimencollection.htm.

Personal Protective Equipment

PPE is the least effective means for controlling employee exposures. Proper use of PPE requires a comprehensive program, and calls for a high level of employee involvement and commitment to be effective. The use of PPE requires the choice of the appropriate equipment to reduce the hazard and the development of supporting programs such as training, change-out schedules, and medical assessment if needed.

RECOMMENDATIONS (CONTINUED)

PPE should not be relied upon as the sole method for limiting employee exposures. Rather, PPE should be used until engineering and administrative controls can be demonstrated to be effective in limiting exposures to acceptable levels.

1. Train housestaff and fellows on medical center PPE requirements, and emphasize PPE use to those who care for both critically ill and noncritically ill pH1N1 and ILI patients.
2. Develop, implement, and maintain a respiratory protection program for all housestaff and fellows to protect against airborne infectious agents. Train, medically clear, and fit test all housestaff and fellows as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).
3. Make PPE, including gloves, gowns, surgical masks, N95 respirators, and eye protection readily available according to hospital guidelines near patient rooms. Designate individuals responsible for stocking these supplies on each floor or wing. Housestaff and fellows who encounter a lack of available PPE should alert appropriate floor personnel or seek out appropriate PPE from an alternate location.
4. Coordinate with a designated person in charge at each medical center to ensure an adequate inventory of N95 respirators for emergency purposes. As part of the respiratory protection program, conduct annual audits of respirators (which have finite shelf-lives) and ensure adequate sizing for current housestaff.

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