ORIGINAL ARTICLE

# Impact of the 2009 Influenza A (H1N1) Pandemic on Healthcare Workers at a Tertiary Care Center in New York City

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BACKGROUND AND OBJECTIVE. Assessing the impact of 2009 influenza A (H1N1) on healthcare workers (HCWs) is important for pandemic planning.

METHODS. We retrospectively analyzed employee health records of HCWs at a tertiary care center in New York City with influenza-like illnesses (ILI) and confirmed influenza from March 31, 2009, to February 28, 2010. We evaluated HCWs' clinical presentations during the first and second wave of the pandemic, staff absenteeism, exposures among HCWs, and association between high-risk occupational exposures to respiratory secretions and infection.

RESULTS. During the pandemic, 40% (141/352) of HCWs with ILI tested positive for influenza, representing a 1% attack rate among our 13,066 employees. HCWs with influenza were more likely to have fever, cough, and tachycardia. When compared with the second wave, cases in the first wave were sicker and at higher risk of exposure to patients' respiratory secretions ($P = .049$). HCWs with ILI—with and without confirmed influenza—missed on average 4.7 and 2.7 work days, respectively ($P = .001$). Among HCWs asked about working while ill, 65% (153/235) reported they did so (mean, 2 days).

CONCLUSIONS. HCWs in the first wave had more severe ILI than those in the second wave and were more likely to be exposed to patients' respiratory secretions. HCWs with ILI often worked while ill. Timely strategies to educate and support HCWs were critical to managing this population during the pandemic.

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The ability to provide health care during a pandemic is critical to ensure a functioning public health response. Healthcare workers (HCWs) are in the precarious position of working at the front line, potentially exposing themselves to the infectious agent.[1] Thus, protection of HCWs is paramount during community outbreaks of viral illnesses, since infections among HCWs can lead to increased transmission of infectious agents to patients, peers, and family members as well as increased absenteeism, depleting the healthcare response.

During the first wave of the 2009 influenza A (H1N1) pandemic, the Centers for Disease Control and Prevention noted that transmission to HCWs was occurring via 3 routes: from HCW to HCW, from patients to HCWs, and from the community to HCWs.[2] Few reports have examined the full impact of the pandemic influenza season on HCWs,[3,4] and none have evaluated the clinical impact on HCWs in New York City, one of the early epicenters of the pandemic. Better understanding of the epidemiology of pandemic influenza among HCWs could lead to possible interventions and improvements in the healthcare response during both pandemic and high-activity seasonal influenza years.

We were afforded a unique opportunity to study the impact of 2009 influenza A (H1N1) on HCWs in our tertiary care medical center located in New York City. The objectives of this study were to determine whether the clinical presentations of HCWs with confirmed influenza A differed from those of HCWs with influenza-like illness (ILI) who tested negative for influenza A and whether confirmed disease presentations in the first wave of the pandemic differed from the second wave, as described previously in the general population.[5] We also wanted to examine the incidence of employees working while ill and overall absenteeism due to illness during this season. Lastly, we sought to identify a correlation between high-risk occupational exposures to respiratory secretions and whether this was similar in the first and second wave of the pandemic.

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## METHODS

### Study Design and Clinical Setting

This is a retrospective study of HCWs who reported to Workforce Health and Safety (WHS) with ILI from March 31, 2009, to February 28, 2010, the period during which our institution saw the vast majority of its influenza A cases. A waiver of informed consent was granted for this study by the medical center's institutional review board.

The study site was the 1,200-bed Columbia University Medical Center campus of NewYork-Presbyterian Hospital, which consists of a tertiary care hospital caring for adults, a community hospital, and a children's hospital that together employ approximately 13,000 HCWs. Each hospital has an emergency department, and during the study period, there were 64,805 emergency department visits and 1,069,995 ambulatory care visits.

### Eligible Subjects

HCWs presenting to WHS with ILI during the study period and tested for influenza A were included in this study. ILI was defined using modified Centers for Disease Control and Prevention criteria, which included fever or reported fever of 100°F or greater plus either sore throat or cough. If a HCW underwent more than 1 evaluation for ILI, only the initial evaluation was included. Those who sought care in the emergency department or with another provider and did not have an encounter at WHS were excluded.

### Influenza Testing

In response to rapidly developing technology and increased specimen burden, several different assays and testing algorithms were used during the study period to detect influenza A. These included enzyme immunoassay (Directigen EZ Flu A and B; Becton Dickinson Diagnostic Systems), polymerase chain reaction (Proflu Plus; Prodesse), direct fluorescent antibody (IMAGEN; Oxoid), and/or viral culture (shell vial and conventional tube; Diagnostic Hybrids).

### Infection Control Strategies Implemented during Influenza A (H1N1) Pandemic

Infection control strategies during the pandemic focused on communication and enforcement of policies aimed to rapidly identify and isolate patients with ILI, and measures to prevent exposures among staff, patients, and visitors. As detailed below, the Department of Infection Prevention and Control (IPC) crafted recommendations for management of ILI in the emergency department, outpatient clinics, and inpatient areas as well as for the use of antiviral agents for staff and patients.

*Patients.* Strategies directed at patients included pictorial signage of flu and provision of masks and hand hygiene sup-

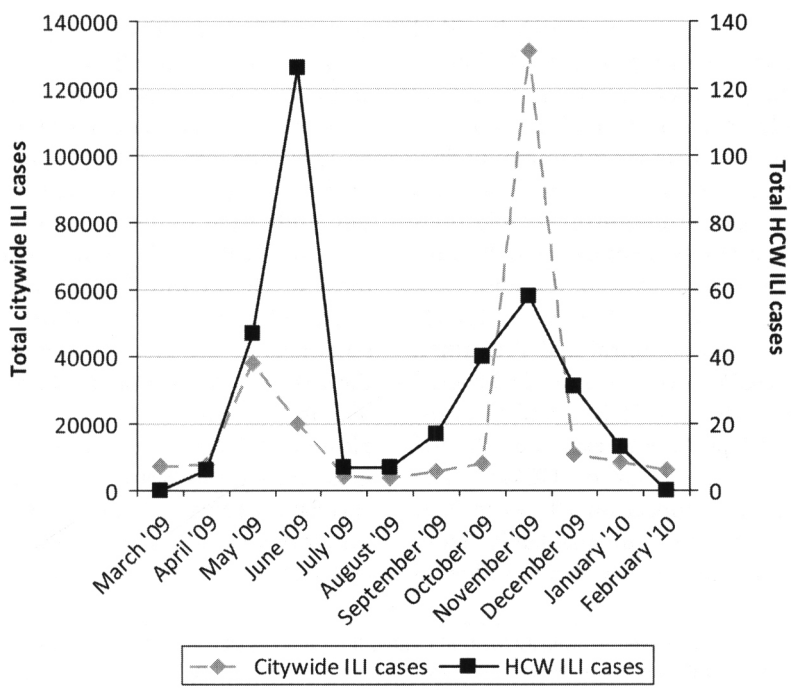


FIGURE 1. Epidemiology of influenza-like illness (ILI) in emergency departments in New York City versus among healthcare workers (HCWs) at our medical center (2009–2010).

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plies at all entrances, patient care areas, and waiting rooms for patients with ILI symptoms. Patients presenting to the emergency department or outpatient clinics with ILI were immediately instructed to don surgical masks, separated from other patients by at least 3–5 feet, and placed in a single room on droplet isolation as soon as possible. Patients with ILI were treated with oseltamivir at the discretion of the treating physicians.

*Staff.* IPC considered guidance from the Centers for Disease Control and Prevention, New York State, and the New York City Department of Health and Mental Hygiene to develop algorithms for HCWs with ILI and for the use of personal protective equipment. When performing routine care for patients with suspected or proven influenza, HCWs donned surgical masks with face shields or surgical masks and goggles. Standard precautions were recommended if contact with respiratory secretions was anticipated. Because we experienced limited supplies of PFR-95 masks, we prioritized their use for the highest-risk exposures, that is, performance of aerosol-generating procedures. IPC initiated a 24/7 flu pager carried by hospital epidemiologists/infectious diseases physicians to answer clinicians' questions about patients with ILI, to provide recommendations for the use of oseltamivir, and to support HCWs with ILI or with family members with ILI. WHS also had a similar pager.

*Visitor policies.* Visitors were generally not restricted, although those with ILI were instructed not to visit. Visitors to patients with suspected or proven influenza were required to perform hand hygiene before and after patient contact.

## Management of HCWs with ILI or Exposures to Influenza

IPC and WHS developed an algorithm to manage staff with ILI. This included testing of all HCWs who developed symptoms at work and testing HCWs who developed symptoms at home when feasible. Workers with confirmed influenza were provided oseltamivir prescriptions. Oseltamivir was provided free through WHS as a result of an agreement between our human resources department and health plan to waive copayments. In addition, the algorithms addressed criteria for WHS clearance for ill HCWs to return to work, which included being afebrile for at least 24 hours without the use of antipyretics. WHS extended their hours of operation to include evenings and Saturdays, and the algorithms provided information about whom to contact when WHS was closed (such as the emergency department).

HCWs with unprotected exposures to confirmed cases of influenza during aerosol-generating procedures were provided with oseltamivir prophylaxis by WHS free of charge. Those with unprotected exposure to confirmed cases that did

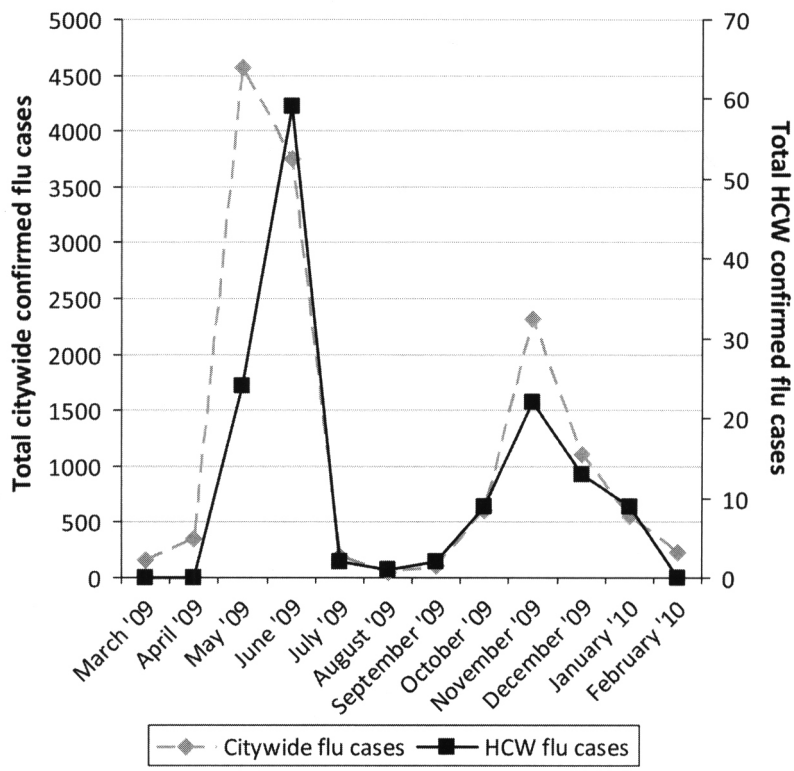


FIGURE 2. Epidemiology of confirmed influenza A cases in New York City versus among healthcare workers (HCWs) at our medical center (2009–2010).

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not occur during aerosol-generating procedures were provided prophylaxis only if they had underlying medical conditions placing them at risk of severe influenza. Others were counseled to be vigilant for ILI symptoms.

### Data Collection and Analysis

The electronic medical records at WHS were searched for HCWs presenting with a chief complaint of ILI, influenza, or viral respiratory illness. Data collected from eligible subjects included demographic and clinical characteristics, including comorbidities (when available) and findings on physical exams, potential exposures to patients or family members with influenza/ILI, days working while ill, and days absent from work. Data regarding overall sick hours used by employees in 2008, 2009, and 2010 was obtained from the human resources department. Total sick hours during peak months of the first and second wave, namely June and November, were compared with 2008 and 2010 data.

HCWs were stratified by their likelihood of exposure to patient respiratory secretions: (1) highest risk (ie, physicians, nurses, respiratory technicians, physician assistants), (2) high risk (ie, social workers, medical technicians), (3) moderate risk (ie, medical unit assistants, environmental service workers), and (4) low risk (ie, administrative and research personnel).

The demographic and clinical characteristics of HCWs with positive versus negative influenza A tests were compared, using descriptive statistics. Only those symptoms noted in 10% or more of HCWs with ILI were analyzed. In addition, the clinical presentations of those HCWs with confirmed H1N1 disease during the first wave (March to August 2009) versus the second wave (September 2009 to February 2010) were compared. We used $\chi^2$ (or Fischer exact test when appropriate) for analysis of categorical variables, and Student $t$ test was used for analysis of continuous variables. We created logistic regression models to examine the association of confirmed influenza A with demographic characteristics, exposure risk to respiratory secretions, and clinical signs and symptoms during the first wave versus the second wave of the pandemic. A stepwise backward elimination process for nonsignificant variables was used. All reported $P$ values were 2 sided, and results with $P < .05$ were considered significant. For regression models, $P < .1$ was used for exclusion.

Finally, we utilized Poisson regression to compare the epidemiology of confirmed influenza A and ILI among our HCWs with the epidemiology of influenza A and ILI in New York City, as obtained by the New York City Department of Health and Mental Hygiene through the Influenza-Like Illness Network (ILINet) as well as laboratory reporting of confirmed cases during the study period.[6]

TABLE 1. Characteristics of Healthcare Workers by Results of Influenza A Testing, Univariate Analysis

| Characteristic | Positive influenza A ($n$ = 141) | Negative influenza A ($n$ = 211) | OR (95% CI) |
|---|---|---|---|
| Age, mean, years (range) | 37.7 (21–68) | 38.1 (22–67) | 0.74[a] |
| Sex, male | 32 (25.5) | 56 (26.5) | 0.81 (0.494–1.338) |
| Race/ethnicity | | | |
| White | 34 (24.1) | 56 (26.5) | Reference category |
| Hispanic[b] | 54 (38.3) | 68 (32.2) | 1.31 (0.75–2.28) |
| Asian | 21 (14.9) | 21 (9.9) | 1.65 (0.79–3.45) |
| Black | 25 (17.7) | 42 (19.9) | 0.98 (0.51–1.88) |
| Other | 7 (4.9) | 24 (11.3) | 0.48 (0.19–1.23) |
| Comorbid conditions | | | |
| Diabetes | 8 (5.7) | 5 (2.3) | 2.50 (0.79–7.7) |
| Asthma | 11 (7.8) | 22 (10.4) | 0.72 (0.34–1.55) |
| Obesity | 7 (4.9) | 11 (5.2) | 0.95 (0.35–2.5) |
| Pregnancy | 3 (2.1) | 6 (2.8) | 0.74 (0.18–3) |
| Immunocompromised[c] | 1 (0.07) | 2 (0.1) | 0.75 (0.07–8.3) |
| Smoker | 8 (5.7) | 9 (0.04) | 1.35 (0.5–3.6) |
| Risk of unprotected exposures | | | |
| Highest | 58 (41.1) | 91 (43.1) | Reference category |
| High | 18 (12.7) | 34 (16.1) | 0.83 (0.43–1.60) |
| Moderate | 55 (39) | 77 (36.5) | 1.21 (0.69–1.80) |
| Low | 10 (7) | 9 (4.2) | 1.74 (0.67–4.54) |

NOTE. Data are no. (%), unless otherwise indicated. CI, confidence interval; OR, odds ratio.

[a] $P$ value for $t$ test.

[b] Workforce Health and Safety records did not record Latino race; hence, our analysis is adapted to this terminology.

[c] Healthcare workers with malignancies or primary immunologic deficiencies, on immunosuppressive therapy, or positive for human immunodeficiency virus were defined as immunocompromised.

## RESULTS

During the study period, 393 HCWs presented to WHS with ILI, of whom 352 (90%) were tested for influenza and 141 (40%) were positive for influenza A by 1 or more of the assays described above. Overall, this represented an attack rate of approximately 1.1% (141/13,066) for HCWs at our campus. Among the 211 HCWs with negative tests, 24 (11.4%) were tested 5 days or more after the onset of ILI. Of the 42 cases not tested for influenza, 21 presented more than 72 hours after symptom onset and had clinical improvement, 12 had received oseltamivir, 8 were not thought to have ILI by WHS clinicians, and 1 had influenza A confirmed at an outside hospital. In addition, 9 HCWs presented with a second episode of ILI (all of which were negative for influenza A). The rates of ILIs and confirmed influenza A cases in New York City and among our HCWs showed similar trends ($P = .93$) during both waves (Figures 1, 2).

### Characteristics of HCWs with Positive versus Negative Influenza A

The demographic and baseline clinical characteristics of HCWs with positive versus negative tests for influenza A were similar (Table 1). The proportion of HCWs with positive versus negative influenza A tests who reported unprotected exposures was also comparable, although exposures to ill patients were more common than exposures to ill HCWs (Table 2). Among the 141 confirmed influenza A cases, the source of exposure was known or suspected for 19% ($n = 27$), of which 59% (16/27) were thought to have occurred at the medical center and 41% (11/27) in the community. The duration of ILI symptoms before evaluation by WHS was the same in those with positive versus negative influenza A tests (Table 2). However, those with influenza A were more likely to have both reported and documented fever ($P < .001$), cough ($P = .023$), and tachycardia ($P < .001$). Nausea, vomiting, and abdominal pain were uncommonly reported (fewer than 10% of HCWs with ILI). In multivariable analysis, those with confirmed influenza were more likely to have documented fever ($P < .005$) or cough ($P = .051$).

### HCWs with Influenza A during First versus Second Wave

More than half (61%) of the influenza A cases among HCWs occurred during the first wave of the pandemic (Table 3). The comorbid illnesses among those with influenza A during the first and second wave were generally similar, although diabetes was more common in the first wave.

During the first wave, cases were more likely to report and have documented fever ($P = .024$ and $.043$), tachycardia ($P = .024$), and sore throat ($P = .059$). In the multivariable analysis, confirmed cases in the first wave were more likely to have the highest risk of exposure to patients' respiratory tract secretions ($P = .049$).

### Staff Absenteeism and Working with ILI

During the study period, 327 (93%) of 352 HCWs with ILI missed at least 1 day of work, resulting in 1,095 days of missed work. Those with confirmed influenza A missed more days of work than those with negative tests (4.7 vs 2.7 days, respectively; $P = .001$). The likelihood of missing a day of work as a result of ILI was similar among HCWs with differing risks of exposure to respiratory secretions ($P = .168$).

Among 235 HCWs who were asked about working while

TABLE 2. Clinical Presentations of Healthcare Workers by Results of Influenza A Testing, Univariate Analysis

| Presentations | Positive influenza A ($n = 141$) | Negative influenza A ($n = 211$) | OR (95% CI) |
|---|---|---|---|
| Reported unprotected exposures | 27 (19.1) | 52 (24.6) | 0.72 (0.43–1.22) |
| Exposures | | | |
| Exposed at home | 11 (40.7) | 19 (36.5) | 1.20 (0.46–3.09) |
| Exposed at work | 16 (59.3) | 30 (57.7) | 1.10 (0.41–2.74) |
| From patient | 13 (81.2) | 26 (86.6) | 0.94 (0.19–4.59) |
| From coworker | 3 (18.7) | 5 (16.6) | 1.20 (0.24–5.60) |
| Symptom duration before evaluation, mean, days | 2.6 | 2.7 | 0.66[a] |
| Signs and symptoms on presentation | | | |
| Fever 100°F or greater | 38 (26.9) | 10 (4.7) | 7.41 (3.55–15.48)[b] |
| Cough | 122 (86.5) | 162 (76.7) | 1.94 (1.09–3.46)[b] |
| Sore throat | 68 (42.2) | 115 (54.5) | 0.78 (0.51–1.19) |
| Rhinorrhea | 88 (62.4) | 133 (63) | 0.97 (0.63–1.51) |
| Fatigue | 103 (73.0) | 143 (67.7) | 1.29 (0.81–2.10) |
| Tachycardia | 32 (22.6) | 18 (8.5) | 3.15 (1.68–5.87)[b] |
| Received oseltamivir | 105 (74.4) | 65 (30.8) | 6.50 (4.1–10.6)[b] |

NOTE. Data are no. (%), unless otherwise indicated. CI, confidence interval; OR, odds ratio.

[a] $P$ value for $t$ test.

[b] Denotes significance.

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TABLE 3. Comparison of Healthcare Workers with Influenza A during First and Second Wave of 2009 Influenza A (H1N1) Pandemic, Univariate Analysis

| | First wave ($n$ = 86) | Second wave ($n$ = 55) | OR (95% CI) |
|---|---|---|---|
| Risk of unprotected exposures | | | |
| Highest | 41 (47.6) | 17 (31) | Reference category[a] |
| High | 10 (11.6) | 8 (14.5) | 0.52 (0.17–1.54) |
| Moderate | 33 (38.4) | 22 (40) | 0.62 (0.28–1.36) |
| Low | 2 (2.3) | 8 (14.5) | 0.10 (0.02–0.54) |
| Signs and symptoms on presentation | | | |
| Fever 100°F or greater | 29 (33.7) | 9 (16.3) | 2.60 (1.12–6.04)[a] |
| Cough | 74 (86) | 48 (87.3) | 0.89 (0.33–2.44) |
| Sore throat | 36 (41.8) | 32 (64) | 0.52 (0.26–1.03) |
| Rhinorrhea | 52 (60.4) | 36 (65.4) | 0.81 (0.39–1.63) |
| Fatigue | 63 (73.2) | 40 (72.7) | 1.03 (0.48–2.2) |
| Tachycardia | 25 (29) | 7 (12.7) | 2.81 (1.12–7.05)[a] |

NOTE. Data are no. (%), unless otherwise indicated. CI, confidence interval; OR, odds ratio.

[a] Denotes significance.

ill, 65% ($n$ = 153) reported working with ILI symptoms (mean, 2 days; range, 1–5 days). Physicians (66.7% [26/39]) and nurses (62.5% [30/48]) were equally likely to work while symptomatic ($P$ = .81). Compared with June and November of 2008, there was a 26% increase in the number of sick hours used by staff in June 2009 and a 13.6% increase noted in November 2009. In June 2010, sick hours dropped 12.2% compared with the pandemic year.

## DISCUSSION

This study is the largest series conducted to date in the United States examining the impact of the 2009 influenza A (H1N1) among HCWs. More HCWs with confirmed influenza presented in the first wave of the pandemic than in the second wave. One possible explanation for this observation may be increased rates of immunity during the second wave due to exposures during the first wave resulting in subclinical disease and due to vaccination for the pandemic strain. Additionally, staff may have had better adherence to infection control policies during the second wave, as suggested by the finding that HCWs with influenza A during the first wave had increased risk of exposure to respiratory secretions. Nonetheless, the epidemiology of confirmed influenza in our HCWs trended with that noted in emergency departments across New York City, as reported by the New York City Department of Health and Mental Hygiene (Figure 2), suggesting that the burden of disease in the community also affected our HCWs. Confirmed cases of influenza A were more likely to have fever, cough, and tachycardia than those with ILI without confirmed influenza. HCWs with influenza A also missed more work days as a result of either the greater severity of illness, as above, or more stringent clearance procedures for those with confirmed influenza.

Among confirmed cases of influenza A, workers presenting in the first wave had more fever and tachycardia compared with cases in the second wave. A decreased severity of illness during the second wave has previously been noted in the community setting as well as in our hospitalized pediatric population.[6,7] This may be a result of more timely access to antiviral therapy or the introduction of the H1N1 vaccine.

During the peak months of the pandemic, our institution witnessed a tenth to a quarter more sick hours compared with the prior year, placing additional strain on our labor force during a time of high patient volumes. Despite the increased demands of a pandemic, healthcare institutions must ensure the safety of patients, visitors, and personnel while ensuring availability of adequate staff. Surveys have found that 75%–88% of staff in emergency medical units, emergency departments, and intensive care units are willing to work during a pandemic.[8] In contrast, factors such as negotiating between risk and duty, feeling unsupported by the healthcare facility because of perceived inadequate protections to protect staff while caring for ill patients, and concerns over childcare/family illness have been reported as barriers to working during the influenza pandemic.[9] Effective strategies to mitigate staff absenteeism have included providing personal protective equipment and oseltamivir to HCWs and their families and monetary compensation.[10] We provided additional strategies to support ill HCWs, including the flu pager, expanded access to WHS, as well as free oseltamivir to those meeting criteria.

Our study highlights the challenges of managing ill HCWs. We found that despite a hospital policy requiring that HCWs not work while ill, more than half of our staff with ILI worked with symptoms for an average of 2 days. We speculate that HCWs worked while ill for various reasons. HCWs cite they work while ill because of their work ethic and unwillingness to let their colleagues down;[11] others work while ill for financial reasons, while others may minimize their symptoms and infectivity. Our experience suggests that in pandemic

settings, sick leave policies should be reevaluated and may need to be adjusted to accommodate local public health, human resources, and economic priorities.

This study had several limitations. We likely underestimated the attack rate at our institution; only those HCWs presenting to WHS were included, and it is unknown how many HCWs sought care in alternative sites. Furthermore, 24 HCWs presented 5 or more days after the onset of ILI symptoms and thus may have had false negative tests for influenza A. It is also feasible that selection bias occurred if less ill HCWs did not present to WHS. Influenza was diagnosed using different assays on the basis of availability, and these assays have different sensitivities and specificities. Data on comorbidities for HCWs were likely incomplete; for example, we suspect that obesity was underreported, since WHS providers do not routinely calculate body mass indices. The proportion of staff working while ill may have been underreported as well, since such data were available only for 66.7% of HCWs and staff may have been reluctant to acknowledge that they violated hospital policy. Assumptions of exposure to patients' respiratory secretions based on job description may not accurately reflect true exposure. We were unable to assess the efficacy of the 2009 influenza A (H1N1) vaccine, since this vaccine was not available until October 2009 in New York. Changes in sick hours may be affected by minimal changes in employee numbers between the 3 years compared in this study. Finally, we did not have complete subtype data for influenza A, but national data during the study period demonstrated that 99.6% of strains were 2009 pandemic H1N1.[12]

## CONCLUSION

This study elucidated important patterns of influenza infections in HCWs working in an urban tertiary center located in an epicenter of the 2009 influenza A (H1N1) pandemic. The experience at our medical center provides insight into disaster preparedness and management of HCW illness during an influenza epidemic. Strategies that support HCWs and provide immediate access to information, care, and treatment are critical to minimize the impact of a pandemic on HCWs.

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