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Original Article

Assessing physicians' in training attitudes and behaviors during the 2009 H1N1 influenza season: a cross-sectional survey of medical students and residents in an urban academic setting

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Background Despite concern for hospital-based transmission of influenza, little research has been carried out on perceptions and behaviors of physicians in training with regard to influenza-like illness (ILI), especially in light of the recent H1N1 pandemic.

Objectives We aimed to evaluate self-reported episodes of ILI among medical students and residents to determine the impact of ILI on school and clinical performance, absenteeism, and patterns of preventive measures used by this population both in and out of the healthcare setting.

Methods We anonymously surveyed medical students and residents at an urban institution between November 3 and December 11, 2009. Data were analyzed separately for medical students and residents for frequency of close-ended responses. Open-ended answers were analyzed thematically. Our Institutional Review Board exempted this study from review.

Results Forty-five percent of medical students and 53% of resident respondents perceived the risk of acquiring H1N1 at school or work as high, and although 43% of medical students and 66% of resident respondents had received the influenza vaccination and most reported increasing non-pharmaceutical preventive measures, 9% of medical students and 61% of residents with one or more episodes of ILI chose to continue to attend class or work when ill.

Conclusions Although students and residents report high risk of infection because of work- or school-related activities, many involved in patient care activities do not comply with recommended infection control precautions. Educational campaigns should be developed and infection control guidelines should be included in routine medical student and resident curricular activities.

Keywords Infection control, influenza, medical education.

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Background

Healthcare environments pose a significant risk of nosocomial transmission of the influenza virus, including the novel H1N1 virus, which emerged in April 2009. A review by Salgado found attack rates during influenza epidemics of 0·7–20% in patients and 11–59% in healthcare workers.[1] Despite concern for hospital-based transmission[2–7] and its impact on vulnerable patient populations,[8–10] little data exist on perceptions and behaviors of physicians in training (medical students or residents) during an influenza outbreak. Physicians in training have a significant responsibility in hospital-based patient care by serving as role models for patients and others with regard to appropriate preventive behaviors.

Following the outbreak of the novel influenza A (H1N1) virus, the Centers for Disease Control and Prevention (CDC) released guidelines for healthcare workers to prevent healthcare-associated transmission of the virus.[11] These guidelines, outlining specific strategies for prevention and control of influenza in acute care facilities, supplement CDC's 2008 infection control recommendations.[12] Nonetheless, at least 48 cases of the pandemic strain were reported among healthcare personnel in the United States (US) during the initial wave of the epidemic. It can be assumed that many more cases occurred during the second wave.[13] The lack of adequate personal protective equipment (PPE) utilization in prior emerging disease outbreaks such as SARS is related to increased healthcare worker illness.[14–18]

Surveillance data indicate the burden of H1N1 disease is significantly disproportionate according to age, with the large majority of cases in the United States occurring among those under 25 years of age,[19] an age category to which many medical trainees belong. Thus, physicians in training may be more likely to acquire and transmit influenza to their patients than other healthcare workers. The potential for increased transmission is especially concerning in light of a novel pandemic strain.

Little research has been carried out regarding medical student or resident compliance with guidelines for prevention of flu transmission; research assessing behavioral changes because of the H1N1 outbreak is also lacking. The goal of this study was to reveal perceptions and behaviors of physicians in training regarding influenza during the period encompassing the first two waves of H1N1 in 2009. Specifically, the authors aimed to evaluate self-reported episodes of influenza-like illness (ILI) among medical students and residents, to determine the impact of ILI on school and clinical performance and absenteeism and to determine patterns of preventive measures used by medical students and residents in and out of the healthcare setting. Using this information, we assessed how this population's response compared to recommended health measures.

Methods

Data was collected via a web-based survey using close-ended multiple-choice questions, with the opportunity for open-ended comments for certain questions. The survey was developed by the authors and was informed by existing US CDC guidelines on infection control precautions for healthcare workers, recommendations for persons who become ill with H1N1 influenza, known healthcare worker reasons for seasonal influenza immunization non-compliance, and clinical and educational experience.[11,12,20–23] The survey was distributed anonymously to 709 first- through fourth-year medical students (subsequently labeled 'MS-I through MS-IV') at a single urban medical teaching center; student participation was solicited via individual medical student class listserves for the four class years (classes of 2010, 2011, 2012, and 2013). The survey was also distributed to 414 postgraduate residents and fellows (subsequently labeled 'PGY-I to PGY-III and above and fellows), including resident employees of the same urban teaching hospital and its affiliated graduate medical education programs. Each survey was completed and returned via a secure internet protocol using Surveymonkey.com (Portland, OR). A recruitment e-mail was sent with a link to the survey explaining the study's overall purpose. Subsequently, two follow-up reminder e-mails were sent at 2 weeks and 1 month after the initial e-mail. The e-mail included survey-specific instructions and provided an approximate completion time of about 15 minutes for both target populations. The survey was available between November 3 and December 11, 2009, which was after the World Health Organization's declaration of a pandemic on June 11. At the time of survey completion, by December 12th, 2009, the CDC estimated (mid-level) there had been 55 million cases of H1N1 in the United States, with 246,000 hospitalizations and 11,160 deaths.[24]

The survey included demographic questions, i.e. student age, gender, living situation, year in training, and specialty. Study-specific questions included risk factors for severe influenza as well as perceived risk regarding likelihood of acquiring H1N1 influenza, vaccination for seasonal and H1N1 influenza, and questions assessing behaviors in response to the H1N1 epidemic, including non-pharmaceutical interventions in healthcare and non-healthcare settings. Respondents who reported at least one episode of ILI since the onset of the H1N1 epidemic in April 2009 were asked to complete a series of additional questions regarding absenteeism and prevention and treatment measures during their illness. Although social desirability bias is common in medical studies, the anonymous design of this electronic survey attempted to minimize social desirability responses.

As this study was approved as exempt by our Institutional Review Board and because of the anonymous nature of the survey, informed consent was not required. However, an information sheet was distributed with the survey regarding the purpose and expected benefits and risks of survey completion. Informed consent was implied by continuing on to complete the survey.

For close-ended questions, frequencies were downloaded for each question answered and data for medical students were analyzed separately from postgraduate residents using descriptive statistics. Open-ended comments were analyzed thematically. Although the small sample size precluded data analysis for statistical significance for most outcomes, univariate analyses were conducted to examine trends in the data for outcomes of interest including perception of risk of acquiring influenza, reporting of ILI, vaccination, and knowledge of appropriate infection control precautions. SAS version 9.1.3 (SAS Institute, Inc. Cary, North Carolina, United States) using ProcGenmod and univariate regression modeling looking for trends with an alpha of 0·05 were used for all statistical analyses.

Results

Demographic information

One hundred and ninety-four medical students and 67 residents participated in the study (27% and 16% response rates, respectively). Medical students and resident respondents were similar demographically to the general population with respect to age, gender, and class distribution. Most resident respondents were in their first or second

postgraduate year (58%). The exact distribution of residents by year of training in the population was not available. More residents in internal and emergency medicine completed the survey compared to other specialties based on expected population distributions, and fewer fellows responded compared to the general population. Ninety-one percentage of student respondents and 97% of resident participants reported they had worked in a patient care setting between May and November 2009 (Table 1).

Perceived risk of H1N1 infection

Seven (4%) medical students and 5 (7%) resident respondents reported being at high risk for severe illness from influenza based on the presence of one or more of the following factors: asthma or other pulmonary disorder, cardiovascular disease, neurologic disorder, diabetes, immunosuppression, or pregnancy. Respondents were asked to assess their perceived risk for becoming infected with H1N1 at home and at work. Three quarters of medical students and residents reported being at low risk of acquiring infection from their home situation (145 and 52 people, respectively), whereas 86 (45%) medical students and 36 (53%) residents perceived themselves to be at high risk of acquiring H1N1 from school of medicine or work-related activities. This perception was highest for third- and fourth-year medical students and first- and

Table 1. Demographic characteristics of medical students and residents

	Medical student respondents (*N*, %)	Medical student survey population (*N*, %)	Residents (*N*, %)	Resident survey population (*N*, %)
Gender				
Male	74 (38%)	291 (41%)	34 (50%)	215 (52%)
Female	119 (62%)	418 (59%)	34 (50%)	199 (48%)
Age				
<24 years old	50 (26%)	Average age at matriculation 24–25 years old	0	Average age of all residents is 31
24–29	119 (61%)		37 (55%)	
30–34	19 (10%)		24 (36%)	
35 and older	6 (3%)		6 (9%)	
Living situation				
Live alone	54 (28%)	Unknown	24 (35%)	Unknown
With roommates	61 (32%)	Unknown	2 (3%)	Unknown
With significant other	56 (29%)	Unknown	35 (52%)	Unknown
With family	22 (11%)	Unknown	7 (10%)	Unknown
Children under 18 in household	14 (7%)	Unknown	11 (16%)	Unknown
Year of medical school or number of years in residency training				
MSI	45 (23%)	183 (26%)	–	–
MSII	53 (27%)	177 (25%)	–	–
MSIII	45 (23%)	171 (24%)	–	–
MSIV	50 (26%)	178 (25%)		
PGY-I	–	–	21 (8%)	Unknown
PGY-II	–	–	18 (7%)	Unknown
PGY-III or higher	–	–	24 (9%)	Unknown
Fellow	–	–	5 (2%)	57 (14%)
Resident specialty				
Internal medicine	–	–	23 (35%)	83 (20%)
OBGYN	–	–	7 (11%)	40 (10%)
Surgery or surgical subspecialty (i.e. general surgery, ENT, ophthalmology, ortho, etc.)	–	–	4 (6%)	83 (20%)
Anesthesiology	–	–	2 (3%)	22 (5%)
Emergency medicine	–	–	15 (23%)	38 (9%)
Other (includes fellows in all specialties)	–	–	14 (21%)	148 (36%)

Table 2. Medical student and resident perceptions of risk of H1N1 infection from home and school or work activities

Perceived risk	Home			Work/School		
	High	Medium	Low	High	Medium	Low
All medical students	7 (4%)	42 (22%)	145 (75%)	86 (45%)	83 (43%)	23 (12%)
MS-I	1 (2%)	16 (35%)	29 (63%)	11 (25%)	23 (52%)	10 (23%)
MS-II	1 (2%)	9 (17%)	43 (81%)	9 (17%)	36 (67%)	8 (15%)
MS-III	2 (4%)	7 (1%)	36 (80%)	28 (62%)	13 (29%)	4 (9%)
MS-IV	3 (6%)	10 (20%)	37 (74%)	38 (76%)	11 (22%)	1 (2%)
All residents	5 (7%)	11 (16%)	52 (77%)	36 (53%)	27 (40%)	5 (7%)
PGY-I	1 (5%)	3 (14%)	17 (81%)	15 (71%)	4 (19%)	2 (10%)
PGY-II	1 (6%)	4 (22%)	13 (72%)	10 (56%)	8 (44%)	None
PGY-III and above	2 (8%)	4 (17%)	18 (75%)	10 (42%)	11 (46%)	3 (13%)
Fellow	1 (20%)	None	4 (80%)	1 (20%)	4 (80%)	None

second-year residents, compared to their peers (Table 2). Univariate analysis showed significant trends for children in the household as a risk factor for perception of high risk from the home situation (RR = 1·18, $P = 0·003$) and being a resident for a perception of high risk from the work/school situation (RR = 1·22, $P = 0·02$).

Univariate anlaysis also showed an association between ILI and perception of high risk from the school or work situation (RR = 1·13, $P = 0·03$), although the effect was modest.

Vaccination

Seasonal influenza vaccination

The majority of respondents received the seasonal flu vaccine for the 2009–2010 influenza season [129 (69%) medical students and 57 (84%) residents], and among those who have not yet been vaccinated, 38 (60%) students and 6 (46%) residents planned on doing so. There was also a higher than expected vaccination rate for the 2008–2009 flu season with 112 (60%) medical students and 55 residents (82%) reporting receiving that vaccine.

Rates of seasonal influenza vaccination for the 2009–2010 season were highest among third- and fourth-year students [37 (86%) and 40 (82%), respectively], compared to pre-clinical students [23 (54%) for first years, 29 (55%) for second years]. Of those who had not received the vaccine and were not planning on it, only one reported a contraindication to the vaccine; the most common reason for not receiving the seasonal influenza vaccine was a response of ''I don't think I'll get sick so don't need [a vaccination]'' [15 (54%)]. Two medical students who did not receive the vaccine additionally commented, ''I've never had the flu'' and ''I heard that you should not get H1N1 and the seasonal vaccine – not sure why.''

Among resident participants who had not yet had the vaccine, 7 (54%) did not plan on getting it, most commonly because they did not feel they would become ill from influenza. Refer to Table 3 for additional details regarding seasonal vaccination behaviors.

H1N1 influenza vaccination

Several free clinics for medical students were held at the medical school for distribution of the H1N1 vaccine.

Table 3. Medical student and resident reasons for not receiving seasonal and H1N1 vaccination

Reasons	Seasonal influenza vaccination		H1N1 vaccination	
	Medical students	Residents	Medical students	Residents
Contraindication	1 (4%)	None	1 (3%)	None
Afraid of side effects	4 (14%)	1 (13%)	12 (32%)	1 (17%)
Afraid of getting the flu from the vaccine	3 (11%)	None	4 (11%)	2 (33%)
Don't think I'll get sick	15 (54%)	2 (25%)	10 (27%)	2 (33%)
Don't have time	10 (36%)	2 (25%)	7 (19%)	None
Vaccine not available	13 (46%)	1 (13%)	19 (52%)	2 (33%)
Other	2 (7%)	4 (50%)	11 (30%)	2 (33%)

Seventy-nine students (43%) and 45 residents (66%) received the H1N1 vaccine at the time of responding to the survey. Of those who had not yet been vaccinated against H1N1, 75 (69%) students and 18 (75%) residents were planning on being vaccinated. The most common reason for not getting the H1N1 vaccine was that it was not available. Medical student comments in response to the question ''If you do not plan on getting the H1N1 flu vaccine, why not'' included that the vaccine was ''too new'', prior exposure without becoming ill, not being at risk, and concerns about side effects and ''rushed vaccine production'':

Being a resident (RR = 1·23, $P = 0·02$) and perception of high risk from the home (RR = 1·15, $P = 0·04$) or work/school situations (RR = 1·31, $P < 0·0001$) were found to be associated with H1N1 vaccination based on our univariate analyses.

Behavioral changes in response to the H1N1 epidemic

Medical student behavioral changes in response to the H1N1 epidemic

Both students and residents reported an increased use in hand sanitizer as the most frequently increased behavior during patient care activities since the H1N1 outbreak, whereas hand washing was the most commonly increased behavior at home. Only 44 (27%) students reported increasing usage of surgical facemasks and 21 (13%) reported wearing N95 masks when seeing patients with respiratory complaints compared to 19 (31%) and 13 (21%) residents, respectively (Table 4).

When presented with the following scenario: ''You are seeing a patient in the emergency department/clinic or on the ward with the following symptoms: fever to 102, productive cough, runny nose, and headache. Which of the following PPE would you put on prior to entering the room? Please check all that apply'', students and residents responded as follows:

One hundred and ten (61%) students and 37 (59%) residents would use gloves, 75 (41%) students and 28 (44%) residents would use surgical masks, and 32 (18%) students and 22 (35%) residents would use N95 masks. Thirty-eight (22%) students and 8 (3%) residents indicated they would not use any PPE. Only 50 (28%) students and 29 (46%) residents were able to correctly identify the recommended isolation and personal protection precautions for the patient case described as set forth by the CDC.

Univariate analysis showed an association between level of training and use of currently recommended CDC guidelines for patients with ILI for fellows only (RR = 1·95, $P = 0·003$); however, the number of fellows was small.

For sources of information, 143 (80%) students received information on H1N1 from school activities compared to 92 (52%) from public health authorities and 81 (46%) from the media, whereas residents turned to CDC or health department websites in 46 (75%) cases compared to supervisors in 36 (59%) of cases, and 20 (33%) reported the media being an information source.

One hundred and twenty-four (69%) medical students and 40 (70%) residents reported the healthcare response to H1N1 was adequate, with fourth year medical students, interns and senior residents, and fellows comprising the highest percentage [41 (87%)]. Almost half of students (87) and over two-thirds of residents (43) reported family members and friends had asked their advice regarding ILI, with 29 (16%) students and 2 (3%) residents indicating they were ''not at all comfortable with giving advice''. In general, higher levels of comfort were reported as a

Table 4. Medical student and resident behaviors in response to H1N1

	Patient care		Home	
	Medical students	Residents	Medical students	Residents
Hand sanitizer	138 (86%)	41 (67%)	107 (71%)	20 (53%)
Hand washing	140 (87%)	40 (66%)	133 (89%)	32 (84%)
Cough etiquette	97 (60%)	25 (41%)	86 (57%)	17 (45%)
Disinfection	36 (22%)	17 (28%)	43 (29%)	12 (32%)
Surgical mask when ill with ILI	20 (12%)	11 (18%)	3 (2%)	17 (45%)
Use of surgical mask in patient care when seeing patients with ILI	44 (27%)	19 (31%)		
Use of N95 in patient care when seeing patients with ILI	21 (13%)	13 (21%)		
Prophylactic medications	2 (1%)	2 (3%)		
Social distancing			19 (13%)	4 (11%)
Other	0	2 (3%)	3 (2%)	1 (3%)

ILI, influenza-like illness.

function of increasing levels of training, e.g. 17 (37%) of fourth-year medical students compared to only 1 (2%) of first years reported being very comfortable, compared to 2 (40%) fellows and 5 (38%) of first-year residents. Univariate analysis showed fellows had the greatest positive association (RR = 1·95, $P = 0·003$) and first- and second-year medical students had the greatest negative association (RR = 0·69 and 0·72, $P = 0·001$ and $P = 0·003$, respectively) reporting "very comfortable" with giving advice about ILI to family and friends.

Trainees' experience with ILI

Among respondents, 53 (29%) students and 20 (32%) residents reported having ILI since May 2009. ILI was defined as fever or feverishness plus one of the following: cough, stuffy or runny nose, headache, body aches, and/or fatigue. Eleven (30%) students reported being on non-clinical rotations during their ILI episode. Forty-one students (80%) had one episode of ILI with 10 (20%) reporting two or more episodes of ILI between May and November 2009. To decrease spread of illness, 31 (67%) students reported staying home until 24 hours after resolution of their fevers, but only 6 (33%) residents did. Only 13 (27%) students and 5 (28%) residents sought care for their illness, and 11 (85%) students sought care through a visit; only 2 (15%) were assessed by telephone compared to 2 (40%) via phone triage for residents. Twenty-three (88%) students reported complying with healthcare provider recommendations for absenteeism. Most students missed fewer than 3 days of work [23 (56%)], and 11 students (27%) did not miss any. The most common reason for not staying home was "didn't want to miss class/work" (nine students, 60%), equally reported for the pre-clinical and clinical years. Twenty-two (58%) students and 6 (38%) residents reported that supervisors were supportive of their staying home, although 10 (27%) did not report their illness. Thirty-nine (85%) students and 14 (82%) residents reported no to minimal effect on grades or work performance. Twenty-three (89%) medical students and 5 (71%) residents reported complying with healthcare provider recommendations to stay home. However, only 3 (43%) residents were told to stay home for 24 hours after resolution of fever, compared to 13 (54%) medical students, contrary to CDC guidelines. See Table 5 for details.

Table 5. Measures taken by medical students and residents with ILI to decrease spread and reasons for not staying home when ill with ILI

Measures taken to decrease spread of disease	Medical students ($n = 46$)	Residents ($n = 18$)
Stayed home 24 hours after fever resolved	31 (67%)	6 (33%)
Stayed home until I felt better but less than 24 hours after fever resolved	10 (22%)	2 (11%)
Continued to go to work/school and wore a surgical mask in common areas	4 (9%)	11 (61%)
Rearranged furniture at home or moved to a different room to avoid close contact with others	1 (2%)	1 (6%)
Other measure	2 (4%)	1 (6%)
Reason for not choosing to stay home when ill	**Medical students ($n = 15$)**	**Residents ($n = 11$)**
No one to cover for me	0	5 (46%)
Didn't want to miss class/work	9 (60%)	6 (55%)
Afraid of appearing weak	1 (7%)	2 (18%)
Didn't feel that sick	6 (40%)	5 (46%)
Other reason	3 (20%)	2 (18%)

ILI, influenza-like illness.

Discussion

Perceived risk of H1N1

Perceived risk of H1N1 illness is a major determinant not only of vaccination behaviors but predicts health behaviors in general, with compliance directly associated with higher perceived risk and susceptibility.[25,26] A 2008 population-based survey on emergency preparedness estimated approximately one-third of responders had not taken any action nor made any effort to learn more about how to prepare for any type of emergency.[27] Gaps in health communication and insufficient knowledge of key public health risks strongly hinder awareness and overall capacity to respond to a public health emergency.

Although few students and residents in our study were themselves at high risk of severe influenza based on the presence of other risk factors [23 (12%) and 5 (7%), respectively], their work in patient care settings increases the risk of transmitting the influenza virus to patients who are at risk. This is especially true among those working in such specialties as internal medicine, emergency medicine, pediatrics, and obstetrics and gynecology. Furthermore, both medical student and resident perceptions of illness from school or work-related activities were higher than for their home situations in most cases. These findings are very concerning given the risk of transmission of illness to susceptible individuals and the ethical responsibility to "do no harm", including avoiding unintentional transmission of illness to patients and colleagues by not choosing to self-isolate when ill with ILI.

Perceived high risk for acquiring H1N1 was found to be positively associated with children in the household, which is consistent with the population at risk. Being a resident was associated with perceived high risk from the work or school situation, likely because of increased clinical contact with patients and possibly greater knowledge of risk of influenza transmission. Our sample size for the number of questions assessed limits our analysis to trends only.

Vaccination

The CDC recommends annual vaccinations for people currently working or training to work in any healthcare capacity. However, election of the vaccine even while understanding its importance may not be much higher; for example, healthcare workers traditionally have low rates of immunization against influenza, ranging from 25% to 57%.[28–32] However, a study of hospital healthcare workers showed higher rates of vaccination in physicians (69%) and medical students (63%).[33] For H1N1, the CDC listed healthcare workers and younger age groups as high priorities.[34] National surveillance data indicate immunization rates of less than 20% for 18- to 49-year-olds[35] for prior seasons, possibly owing to lack of official public health recommendations and lower priority of these individuals for vaccination. H1N1 vaccination coverage as of December 2009 ranged from 12·9% to 38·8%, with rates of 27·9% for those in the initial priority groups, 17·3% for adults over 18, and 22·3% for healthcare personnel.[36]

We were pleasantly surprised to report high compliance rates with both seasonal and H1N1 influenza vaccination among both medical students and residents. While the inherent nature of surveys can lead to selection and reporting bias, the high rates of vaccination in our population may reflect the university's ongoing educational campaign during the H1N1 season as well as the availability of the vaccine free of charge to eligible individuals. However, because vaccination rates for seasonal influenza in 2008–2009 were similar when the vaccine was not offered free of charge, this may reflect improved awareness. These results may also be an indication concerning availability of the vaccine on campus, compared to the general population and practicing physicians, who may have limited time. Resident rates of vaccination were higher than for medical students, which may be because of higher perceived risk or to increased patient care activities in high-risk settings. Vaccine availability may also have influenced rates of vaccination for both seasonal and H1N1 because of shortages. Regardless, significant room exists for education and correction of misinformation among trainee physicians, as a large percentage of respondents reported not receiving the influenza vaccines because of concerns about side effects, getting the flu from the vaccination, or lack of perceived risk. In our study, H1N1 vaccination was found to be associated with age, resident status, and perception of high risk from the home or work situation.

Behavioral changes in response to the H1N1 epidemic

Models designed to predict social distancing effectiveness suggest age-specific social distancing methods may have success when implemented immediately and in conjunction with other non-pharmaceutical interventions.[37] Hand hygiene is perhaps the most well-documented, effective, and recommended behavioral practice known to protect the individual and mitigate H1N1 transmission.[6,14,15,19] Use of PPE (specifically facemasks) is not consistently supported for the general public and compliance tends to be lower compared to other preventive behaviors.[12,25,38] Young people between the ages of 16–24 tend to be the least willing to comply with use of a facemask.[27]

Both students and residents reported increasing usage of hand sanitizer and hand washing. Hand sanitizer use was more frequently increased at school and work than at home, which may be because of lower perceived risk of influenza in the home setting. The lack of knowledge of recommended CDC guidelines for ILI as well as the low usage of N95 and surgical masks by both medical students and residents is of concern. Residents and medical students have the most contact with patients, aside from nurses and ancillary staff, and are frequently responsible for multiple patients on different wards. Our academic institution is a tertiary care center, and physicians in training frequently care for at-risk patients. Whether lack of compliance with appropriate precautions is because of a lack of perceived risk to self, lack of education and training, or a perceived lack of importance of preventing transmission of the virus to at-risk patients, education is critical for this population to prevent nosocomial transmission.

Educational efforts should focus on medical students, who will soon be residents and primarily be responsible for "frontline" patient care under supervision. Assessing and promoting certain sources of education for both students and residents may be influential with regard to increasing preventive behavior compliance. Specifically, 46 (75%) postgraduate trainees received information from official sources, while 141 (80%) students received information from school and 80 (46%) from the media. As the vast majority of respondents indicated both official sources and school as resources for H1N1 information and policy, communication efforts tailored to these settings may continue to promote successful dissemination of important health guidelines. Although increasing seniority of training appeared to cause greater percentages being comfortable giving advice about ILI, there were still a substantial percentage of residents who were not compliant with public health recommendations or were not aware of these

policies. Because of limitations of our survey design, with multiple options being available for selection in response to which non-pharmaceutical behaviors were increased during this influenza season, we did not calculate univariate analyses for the use of non-pharmaceutical interventions.

Students and residents presenting with ILI

We found trends for respondents reporting at least one episode of ILI with perceptions of high-risk status from the work/school situation greater than the home situation. This may be because students who reported ILI and became ill during a clinical rotation perceived a higher risk of acquiring infection from that setting than those who had not become ill; thus, this result may be misleading. Among study participants who reported at least one episode of ILI and sought clinical care, there were high rates of compliance with recommendations to stay home. The accuracy of recommendations and how they were interpreted, however, remain to be determined. Most participants did not seek care and chose to continue to attend school or work while ill because of a number of factors, including not feeling very ill and not wanting to miss work. Healthcare worker compliance to guidelines should be emphasized. Although students and residents reported little effect in terms of absenteeism or performance, concerns remain regarding hospital- or clinic-based transmission of the virus and school-based transmission to susceptible peers and staff. Further study should be undertaken to determine whether this reflects the work culture of medicine, lack of knowledge, or lack of systems in place to cover for ill students or residents or provide alternative sources of education and testing.

Limitations

This study was a small study of students and residents in a single institution. Although the distribution of students and residents who participated was fairly even, it is possible that our study suffers from selection bias. Only one pediatric resident completed the survey, possibly because the pediatrics program is affiliated with but not located at our institution, and thus, there may have been less incentive to complete the survey. Although our resident response rate was low [68 (16%)], our medical student survey response rate of 194 (27%) was similar to the mean response rates (20–39·6%) reported in recent meta-analyses of response rates for web-based surveys.[39,40] The busy schedules of medical students and residents with multiple demands on their time may impact the likelihood of completing even a short survey, especially if they do not perceive any benefit from participation. Those who were most likely to be working with high-risk patients (i.e. emergency medicine, obstetrics and gynecology, and internal medicine) responded at a higher rate. The few numbers of surgical residents and fellows who responded may reflect lack of perceived importance or the time demands of their schedules. Participation and responses to this study may also have been influenced by media reports and university educational campaigns. Because of the small sample size and survey design, the study was not powered to show significant associations between the outcomes of interest we examined in our univariate analyses; thus, we only included those trends that were significant.

Conclusions

Physicians in training have significant patient care obligations and are also frequently asked by both patients and non-medical family members and friends to provide advice on ILI. Although they have not completed training, in the case of residents especially, they serve as role models for peers, their students, patients, and the community. This study suggests that although reported compliance with vaccination is better than average, rates of vaccination are not as high as they could be in part because of misconceptions and unfounded fears about influenza vaccination. Although students and residents report high risk of infection because of work or school-related activities, many students and residents involved in patient care activities do not comply with recommended infection control precautions. Any lack of compliance will continue to be of concern as the potential for transmission of the virus in the healthcare setting persists with the ongoing H1N1 pandemic. Educational campaigns should be developed and infection control guidelines included in routine medical student and resident curricular activities. To successfully implement interventions targeting both school and hospital settings, additional research activities need to be undertaken to better define student perceptions and patterns of behavior during epidemics to better target interventions in the school and hospital setting.

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