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Brief Report

Intermittent occurrence of health care–onset influenza cases in a tertiary care facility during the 2017-2018 flu season

Werner Bischoff MD, PhD, FSHEA [a,*], Mark Petraglia BSN, RN [b], Christopher McLouth PhD [c], James Viviano MS [b], Tammy Bischoff RN, BSN, MPH, CIC [a], Elizabeth Palavecino MD [d]

[a] Department of Internal Medicine, Section on Infectious Diseases, Infection Prevention and Health System Epidemiology, Wake Forest Baptist Medical Center, Winston-Salem, NC
[b] Infection Prevention and Health System Epidemiology, Wake Forest Baptist Medical Center, Winston-Salem, NC
[c] Department of Biostatistical Sciences, Wake Forest School of Medicine, Winston-Salem, NC
[d] Department of Pathology, Wake Forest School of Medicine, Winston-Salem, NC

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Health care–onset influenza (HOI) poses a major risk for hospitalized patients. During the 2017-2018 season, 37 HOI cases out of 382 inpatients (9.7%) with influenza were detected in a tertiary care hospital. HOI and community-onset influenza cases peaked simultaneously, and employee absenteeism was delayed by 1 month. A HOI to community-onset influenza case-comparison revealed associations with placement in rehabilitation, leukocytosis, health care–associated infections, and elevated mortality rates. Interventions should be selected based on the epidemiology of influenza occurrence.

Seasonal influenza epidemics affect millions of people each year. In the United States alone an estimated 48.8 million people were affected during the 2017-2018 season, leading to 959,000 hospitalizations and 79,400 deaths from influenza.[1] Health care–associated outbreaks have been described in neonatal, oncology, and geriatric units.[2-5] However, little is known about how influenza spreads throughout a hospital during a regular season and who is mostly affected.[6]

METHODS

Wake Forest Baptist Medical Center is an 885-bed tertiary care teaching hospital. During the 2017-2018 influenza season (October 2017 to May 2018), 26,126 patients were admitted (mean age = 53.3 years; 46.5% female; white = 71%, black = 21%, others = 8%; and mean length of stay = 6.39 days). The hospital provides single bed inpatient rooms. Probable health care–onset influenza (HOI) was defined as[1] being newly diagnosed with influenza (Influenza-RVP [FilmArray, BioFire; BioMerieux Inc, Durham, NC], rapid Influenza test [BD Veritor System Influenza A+ B; BD Diagnostics, Franklin Lakes, NJ]),[2] being admitted as an inpatient at least 96 hours before respiratory sample collection, and[3] not displaying respiratory symptoms at admission such as fever, runny nose, sneezing, or coughing. Suspected or confirmed cases were automatically placed on droplet isolation. Influenza vaccination was mandatory for health care providers (>95% coverage). Visitor restrictions (all visitors ≤12 years of age) were implemented from January 12, 2018, to March 16, 2018. Staff adherence to hand hygiene and isolation precautions assessed by direct observations was 89% (84%-91%) and 91% (85%-95%), respectively. Patient characteristics were collected in a retrospective chart review. Health care provider absenteeism due to influenza-like-illness (ILI) was assessed through the Employee Health Call-In records. Case-comparison studies with a case-control ratio of 1:2 were performed using SAS statistical package (version 9.4; SAS Institute Inc, Cary, NC). The X^2 and independent sample Student t tests were used to assess group differences in categorical and continuous variables, respectively, using a 2-sided P value of .05. The Institutional Review Board approved the study.

RESULTS

During the 2017-2018 season, a total of 382 (1.5% of total admissions) influenza cases were confirmed, with 37 (9.69%) meeting the criteria for HOI (Fig 1). A total of 1,083 employees called out due to

* Address correspondence to Werner Bischoff, MD, PhD, FSHEA, Department of Internal Medicine, Section on Infectious Diseases, Infection Prevention and Health System Epidemiology, Wake Forest Baptist Medical Center, Medical Center Blvd, Winston-Salem, NC 27157.
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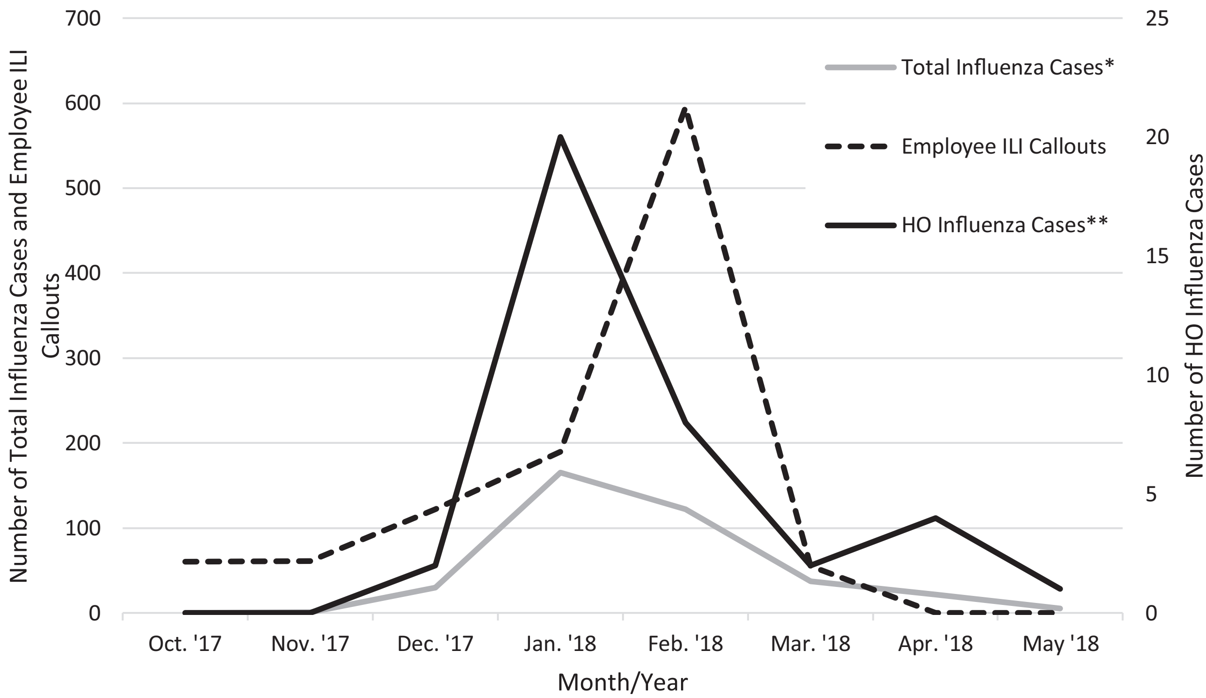

Fig 1. Timeline of health care–onset influenza cases, community-onset influenza cases, and employee absenteeism due to influenza-like illness over the 2017-2018 influenza season. *Total influenza cases (n = 382; influenza A/H3N2, n = 184 [48.2%]; influenza A/2009 H1N1, n = 36 [9.4%], influenza A nontypable, n = 59 [15.4%]; influenza B, n =85 [22.3%]; undetermined, n = 18 [4.7%]). ** HOI cases (n = 37; influenza types: A/H3N2, n = 21 [56.8%]; A/2009 H1N1, n = 4 [10.8%]; A nontypable, n = 6 [16.2%]; and B, n = 6 [16.2%]) to COI cases (n = 74; influenza types: A/H3N2, n = 41 [55.4%], A/2009 H1N1, n = 2 [2.7%]; A nontypable, n = 14 [18.9%], and B, n = 17 [23.0%]). *HO*, health care onset.

ILI. Table 1 summarizes the results of the case-comparison of HOI. Mortality was higher in the HOI group (n = 4; 10.8%; age range, 15-97; mean age, 62.0) versus the COI group (n = 3; 4.1%; age range, 2-96; mean age, 60.4), although this difference was not significant (P = .167). An HOI cluster of 12 cases (January 12, 2018 to January 28, 2018) was detected in a rehabilitation center on 3 units with 4 cases each (influenza types: A/H3N2, n = 9; A/2009 H1N1, n = 1; and A nontypable, n = 2).

DISCUSSION

Influenza is a highly transmissible viral disease that causes seasonal epidemics and sporadic pandemics. The spread of influenza in health care settings poses a major threat to all hospitalized patients and is associated with high morbidity and mortality.[3-5] Although reports of nosocomial outbreaks exist in specific locations, little is known about the overall dynamics of influenza transmission inside of an entire hospital throughout a regular influenza season.

Around 10% of all influenza cases met the definition of a probable nosocomial infection in our patient population. In the study reported by Taylor et al,[7] this falls within the lower range of HOI rates (6.6% up to 33.1%) for the 2006-2007 to 2011-2012 seasons. A small cluster of cases was detected in a rehabilitation center within our hospital. Most HOI, however, occurred as solitary events, with no apparent associations to other cases. The limited transmission of influenza may be explained by use of single-patient rooms, high adherence to hand hygiene and isolation, and the mandatory employee vaccination campaign.

COI and HOI cases peaked at the same time, however, employee absenteeism due to ILI was delayed by 1 month. Admission of community cases most likely drove the HOI increase, whereas employee illness appeared to play a less important role. Further study is necessary to determine the impact of presenteeism on nosocomial influenza transmission.[6,8] Another potential exposure source are visitors affected by influenza. Restriction of visitors was introduced mid-January at the peak of COI and HOI cases and discontinued mid-March at the end of the HOI peak. However, no data are available regarding adherence to this measure. Although the coincidence of COI, HOI, and intervention is remarkable, it remains unclear if or how much visitor restrictions contributed to the decline in HOI cases.

Overall, both HOI and COI patients were older than inpatients not affected by the virus. Comparing HOI with COI cases no differences in patient demographics were detected. However, HOI displayed higher white blood cell counts, indicating potential underlying conditions initially that led to hospitalization. No specific conditions in HOI were identified. In contrast, Taylor et al[7] reported several chronic comorbidities in HOI cases, although based on a much larger sample. Of note, in our study HOI cases were more often associated with health care–associated infections such as central line–associated bloodstream infection, health care–associated pneumonia, and *Clostridioides difficile* laboratory identification events requiring further study. Mortality in the HOI group, although not significant, nearly doubled compared with the COI group, matching the significant findings by Taylor et al.[7]

Our study has limitations. The external validity is limited by the inclusion of only 1 center during a single influenza season. Transmission of specific influenza strains could not be confirmed due to lack of phylogenetic analysis. However, the mostly intermittent emergence of cases and varied influenza types do not suggest widespread transmission of a single strain. Employee self-reported ILI were not

Table 1
Results of the case control study of health care–onset influenza (HOI) versus community-onset influenza (COI) cases

Patient characteristics	HOI cases (n = 37)	COI controls (n = 74)	*P* value
Demographics and time variables			
Sex			
Male, n (%)	23 (62.1%)	35 (47.3%)	.139
Age, y (SD)	62.0 (20.4)	60.4 (23.4)	.729
Race, n (%)			.898
White	22 (59.5%)	46 (62.2%)	—
Black	12 (32.4%)	21 (29.4%)	—
Other	3 (8.1%)	7 (9.5%)	—
Total length of stay, d (SD)	20.8 (18.4)	8.8 (13.5)	<.001
Sample collection unit length of stay, d (SD)	12.5 (7.7)	3.1 (2.7)	<.001
Time admitted before sample collection, d (SD)	12.4 (17.6)	0.6 (2.7)	<.001
Service line			.007
Cardiology	4 (10.8%)	6 (8.1%)	.639
Pediatrics	1 (2.7%)	8 (10.8%)	.14
Medicine	17 (46.0%)	51 (68.9%)	.019
Rehab	12 (32.4%)	6 (8.1%)	.001
Surgery	3 (8.1%)	3 (4.1%)	.373
Vitals			
Body mass index, kg/m^2 (SD)	29.8 (8.7)	27.4 (8.5)	.217
Min systolic blood pressure, mm Hg (SD)*	108.5 (17.9)	106.9 (19.4)	.673
Min diastolic blood pressure, mm Hg (SD)*	64.0 (11.9)	64.9 (13.7)	.736
Max creatinine, unit (SD)†	1.8 (1.8)	2.1 (2.3)	.495
Max white blood cell count, 10^3/mL (SD)†	16.5 (11.3)	11.0 (5.8)	.007
Max temperature, °F (SD)†	101.6 (1.6)	101.2 (1.7)	.304
Underlying conditions, treatment, and outcome			
Chronic obstructive pulmonary disease, n (%)	5 (13.9%)	16 (21.6%)	.333
Asthma, n (%)	2 (5.6%)	6 (8.1%)	.629
HIV, n (%)	1 (2.8%)	1 (1.4%)	.599
Diabetes mellitus, n (%)	15 (41.7%)	26 (35.1%)	.506
Immunosuppressants, n (%)	9 (24.3%)	14 (19.2%)	.531
Active malignancy, n (%)	3 (8.3%)	4 (5.4%)	.555
Heart disease, n (%)	16 (44.4%)	31 (41.9%)	.78
Intubated on admission, n (%)	5 (13.5%)	11 (14.9%)	.849
Extracorporeal membrane oxygenation, n (%)	0 (0.0%)	0 (0.0%)	1
Diagnosis of pneumonia, n (%)	10 (27.0%)	30 (40.5%)	.162
Pressors, n (%)	6 (16.2%)	6 (8.1%)	.195
Antiviral exposure, n (%)	33 (89.2%)	69 (93.2%)	.461
Deceased, n (%)	4 (10.8%)	3 (4.1%)	.167
Influenza tests and coinfections, n (%)			
Respiratory viral panel	35 (94.6%)	68 (91.9%)	—
Rapid influenza antigen test	2 (5.4%)	6 (8.1%)	—
Influenza tests combined			.604
Coinfections based on respiratory viral panel	1 (2.8%)	2 (2.9%)	.962
Bacterial respiratory culture	9 (24.3%)	23 (31.5%)	.433
Positive blood culture	5 (13.5%)	4 (5.4%)	.157
Positive wound culture	2 (5.4%)	1 (1.4%)	.257
Catheter-associated urinary tract infection‡	0 (0%)	0 (0%)	—
Central line–associated bloodstream infection‡	3 (87.1%)	0 (0.0%)	.035
Surgical site infection‡	1 (2.7%)	0 (0%)	.333
Health care–associated pneumonia‡	4 (10.8%)	0 (0%)	.011
Community-associated pneumonia‡	0 (0%)	0 (0%)	—
Ventilator-associated event‡	1 (2.7%)	0 (0%)	.333
Clostridioides difficile LabID event‡	3 (87.1%)	0 (0.0%)	.035

LabID, laboratory identification.
*Minimum values on day of testing positive for influenza.
†Maximum value during hospitalization.
‡HAIs based on the definitions of the National Healthcare Safety Network.

confirmed by testing and may have been caused by respiratory viruses other than influenza.

The transmission dynamics of influenza within a health care setting are complex and depend on a wide range of factors.[6,9,10] Our study demonstrated intermittent occurrence of HOI over an influenza season primarily driven by the burden of influenza emerging in the community. Employee presenteeism did not appear to alter HOI rates. HOI were more often associated with specific HAIs and led to higher mortality rates. The epidemiology of influenza should drive the selection of interventions with targeted activities for localized outbreaks or broad approaches for system-wide events.

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