American Journal of Infection Control 42 (2014) 7-11

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

Hospital-onset influenza hospitalizations—United States, 2010-2011

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Key Word:
Health care associated

Background: Seasonal influenza is responsible for more than 200,000 hospitalizations each year in the United States. Although hospital-onset (HO) influenza contributes to morbidity and mortality among these patients, little is known about its overall epidemiology.
Objective: We describe patients with HO influenza in the United States during the 2010-2011 influenza season and compare them with community-onset (CO) cases to better understand factors associated with illness.
Methods: We identified laboratory-confirmed, influenza-related hospitalizations using the Influenza Hospitalization Surveillance Network (FluSurv-NET), a network that conducts population-based surveillance in 16 states. CO cases had laboratory confirmation $\leq$ 3 days after hospital admission; HO cases had laboratory confirmation $>$ 3 days after admission.
Results: We identified 172 (2.8%) HO cases among a total of 6,171 influenza-positive hospitalizations. HO and CO cases did not differ by age ($P = .22$), sex ($P = .29$), or race ($P = .25$). Chronic medical conditions were more common in HO cases (89%) compared with CO cases (78%) ($P < .01$), and a greater proportion of HO cases (42%) than CO cases (17%) were admitted to the intensive care unit ($P < .01$). The median length of stay after influenza diagnosis of HO cases (7.5 days) was greater than that of CO cases (3 days) ($P < .01$).
Conclusion: HO cases had greater length of stay and were more likely to be admitted to the intensive care unit or die compared with CO cases. HO influenza may play a role in the clinical outcome of hospitalized patients, particularly among those with chronic medical conditions.

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A portion of the data included in this manuscript was presented at ID Week in October 2012, San Diego, CA.

Conflicts of interest: None to report.

The findings and conclusions in this presentation are those of the author and do not necessarily represent the views of the Centers for Disease Control and Prevention.

0196-6553/$00.00 - Published by Elsevier Inc. on behalf of the Association for Professionals in Infection Control and Epidemiology, Inc.
http://dx.doi.org/10.1016/j.ajic.2013.06.018

Seasonal influenza is responsible for more than 200,000 hospitalizations and between 3,000 and 49,000 deaths each year in the United States[1,2] and poses important infection control risks and challenges to both patients and health care personnel (HCP). Although hospital-onset (HO) influenza contributes to morbidity and mortality among hospitalized patients, little is known about its overall epidemiology. Most prior reports have described outbreaks in the acute care setting among selected populations at increased risk for infection, such as immunocompromised patients or neonates.[3-8] We describe characteristics of adults and children with HO influenza identified during the 2010-2011 influenza season in the United States and compare them with patients hospitalized with community-onset (CO) influenza.

METHODS

We used data from the 2010-2011 influenza season collected through the Influenza Hospitalization Surveillance Network (FluSurv-NET). FluSurv-NET is a collaborative surveillance network with participants from the Centers for Disease Control and Prevention (CDC), state and local health departments, and academic institutions that conducts population-based surveillance for laboratory-confirmed, influenza-related hospitalizations in children (persons younger than 18 years) and adults each year from October 1 to April 30. During the 2010-2011 season, FluSurv-NET covered over 80 counties in 16 states (CA, CO, CT, GA, ID, MD, MI, MN, NM, NY, OH, OK, OR, RI, TN, and UT) and included a surveillance population of approximately 7 million children and 22 million adults.[9]

FluSurv-NET defines a case as (1) a resident of a preidentified geographic area (ie, a surveillance catchment area), (2) admitted to a hospital where catchment area residents receive care, (3) with a positive influenza diagnostic test $\leq$ 14 calendar days prior to hospital admission or any time during the current hospitalization, and (4) a hospital admission date between October 1, 2010, and April 30, 2011. Diagnostic testing for influenza was conducted at the discretion of care providers and included testing by viral culture, immunofluorescence antibody staining, reverse-transcription polymerase chain reaction testing, and rapid influenza diagnostic testing. In FluSurv-NET, the date of laboratory confirmation of influenza refers to collection date of the specimen used to confirm influenza virus infection. We considered hospitalization to represent admission to an inpatient ward of a hospital; an overnight stay was not required. Emergency room visits, regardless of duration, were not considered hospitalizations.

We defined a CO case as any FluSurv-NET case with laboratory confirmation of influenza $\leq$ 3 calendar days after hospital admission. We defined a HO case as (1) any patient admitted for a nonrespiratory illness who subsequently developed fever or respiratory illness and had laboratory confirmation of influenza $>$ 3 calendar days after hospital admission (Fig 1) or (2) any FluSurv-NET case designated by the site surveillance officer as HO, with accompanying narrative justification. HO cases eligible under criterion (2) were reviewed individually to determine final case status. For patients transferred from another hospital, we used the first hospital admission date to determine case status. We defined an indeterminate case as any FluSurv-NET case not fitting one of the above criteria for exposure setting or patients for whom the exposure setting could not be determined because of lack of available data.

Surveillance officers at each FluSurv-NET site abstracted information from patient medical records to complete a standard case report form for all cases as part of regular surveillance activities. We compared HO cases to CO cases using the Wilcoxon rank sum test for continuous variables and the χ^2 or Fisher exact test for categorical variables; $\alpha = .05$ for all comparisons. We maintained case data on a secure server at CDC and performed all analyses using Microsoft Excel (Microsoft Corp, Redmond, WA) and SAS v 9.2 (SAS Institute, Cary, NC). This activity was determined by CDC to be part of routine public health practice and was not subject to Institutional Review Board approval for human research protections.

RESULTS

We identified 172 (2.8%) HO, 5,912 (96%) CO, and 87 (1.4%) indeterminate cases among a total of 6,171 FluSurv-NET cases during the 2010-2011 influenza season (Fig 1). The median age of HO cases was 55 years, and 84% were aged 18 years or older. The majority (90%) of HO cases had at least 1 chronic medical condition, including cardiovascular disease (40%), asthma or other chronic lung disease (40%), and metabolic disease (39%). Significantly fewer CO cases (78%) had 1 or more chronic medical conditions (Table 1). Four (2%) HO cases were newborns that had laboratory confirmation of influenza before being discharged from the maternity ward. Seventeen FluSurv-NET cases were designated by site surveillance officers as HO but had insufficient accompanying information to confirm case status; these cases were categorized as indeterminate.

Among HO cases, the median date of influenza confirmation by diagnostic test was hospital day 7 (range, 4-101). The median hospital length of stay (LOS) after influenza diagnosis for HO cases (7.5 days) was significantly longer than that of CO cases (3 days). Of 72 (42%) HO cases admitted to the intensive care unit during their hospitalization, 46 (27%) required mechanical ventilation; both proportions were significantly greater than those observed among CO cases (Table 2). Among cases for which information was available, a significantly greater proportion of HO cases either died during hospitalization (16%), compared with CO cases (2.9%), or were discharged to a long-term care facility (LTCF) (35%) compared with CO cases (16%). Significantly more HO cases (7.6%) were transferred from another hospital compared with CO cases (2.1%). Significantly fewer HO cases (64%) received treatment with influenza antiviral medications during hospitalization than did CO cases (72%) (Table 2).

HO cases were identified in 15 of 16 FluSurv-NET sites and ranged from 0% to 7% of all influenza-associated hospitalizations at each site. Connecticut reported 30 HO cases, the largest number among all sites, representing 17% of all HO cases identified, whereas Idaho reported the fewest number (1), excluding Oklahoma, which did not identify an HO case during the surveillance period (Fig 2). Overall, 140 (81%) HO and 4,008 (68%) CO cases were identified using a reverse-transcription polymerase chain reaction diagnostic test, respectively ($P < .01$).

Thirty-five of 49 (71%) HO cases discharged to a LTCF after hospitalization were not LTCF residents prior to hospitalization. This is significantly higher than the proportion of CO cases (334/874, 38%) discharged to an LCTF who were not LTCF residents prior to hospitalization ($P < .01$). Among patients with influenza A virus infection, significantly more HO cases were hospitalized with influenza A (H3N2) virus than influenza A (H1N1) virus compared with CO cases (Table 1).

DISCUSSION

We used data from a multicenter, national surveillance system in the United States to describe the prevalence of laboratory-confirmed HO influenza during an influenza season. We found 2.8% of all patients hospitalized with influenza in FluSurv-NET during the 2010-2011 season to be HO cases. This result falls within the range of previous surveillance studies of health care-associated influenza that reported rates from 2.0% to 7.0% among adult or all hospitalized patients with influenza.[10,11] Influenza virus