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Concise Communication

Respiratory viral surveillance of healthcare personnel and patients at an adult long-term care facility

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Abstract

We conducted active surveillance of acute respiratory viral infections (ARIs) among residents and healthcare personnel (HCP) at a long-term care facility during the 2015–2016 respiratory illness season. ARIs were observed among both HCP and patients, highlighting the importance of including HCP in surveillance programs.

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Respiratory viruses can cause significant morbidity and mortality in long-term care facilities (LTCFs), whose residents risk significant health impacts from these infections.[1,2] LTCF residents are at risk for respiratory infections from living in congregate settings,[3] and healthcare personnel (HCP) can play a role in the transmission of respiratory viruses in LTCFs.

The objective of this study was to conduct active surveillance for respiratory viral infections among both residents and HCP at 1 LTCF during the 2015–2016 winter respiratory illness season, using sensitive and broad diagnostic techniques to identify respiratory infections.

Methods

This study was conducted at a 120-bed suburban LTCF providing both long-term and short-term skilled nursing and rehabilitation care. The facility has a mandatory influenza vaccination policy for staff (97% vaccination rate for the 2014–2015 respiratory illness season), and all patients are offered influenza vaccination.

All HCP who worked at the facility at any time during the study period (n = 247) and all patients age ≥18 years with an anticipated stay of ≥7 days (n = 350) were eligible for participation. We included long-term residents already living at the facility at the start of surveillance, as well as new long- and short-term patients admitted during the surveillance period. Upon enrollment, a mid-turbinate nasal swab, a throat swab, and a serum specimen were collected from all study participants. Demographic and clinical data were collected through interviews, medical record review, and from facility records.

Active surveillance was conducted between December 2, 2015, and April 30, 2016. During this period, enrolled HCP and patients were monitored for acute respiratory illness (ARI) symptoms. Participants who reported ≥2 of the following symptoms during the previous 7 days were identified as having an ARI: fever ≥ 37.3°C (99.1°F), headache, sore throat, shortness of breath, chills, muscle and/or joint pain, coughing, wheezing, fatigue, congestion or runny nose, or change of mental status or confusion. This broad, symptom-based definition was designed to maximize identification of potential respiratory infections. For patients with a medical condition that might cause chronic respiratory symptoms, symptoms were only recorded if they had worsened over the previous 7 days.

Participants with a study-defined ARI had additional nasal and throat swabs collected at the time of the symptom report and then weekly for 4 weeks. Serum specimens were collected when an ARI was identified and at the fourth or final follow-up visit. Information about symptoms, medical interventions, contact with sick individuals, and sick days (staff only) were recorded during these visits.

At the end of the surveillance period, patient discharge or end of staff employment (whichever came first), final nasal, throat, and serum specimens were collected, and participants were asked about respiratory symptoms not previously reported to the study team. Staff were also asked to report any sick days taken for respiratory illness.

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All study specimens were tested using a commercial multiplex real-time reverse-transcriptase polymerase chain reaction (rRT-PCR) assay kit (FTD Respiratory Pathogens 21, cat. No. FTD-2-64, Fast-Track Diagnostics, Luxembourg) to detect common human respiratory viruses.[4] Specimens were also tested using broadly reactive pan virus group (family, subfamily, or genus) PCRs designed for identification of known, variant, and potentially novel viruses in a virus group.[5] Indirect enzyme immunoassays (EIAs) for IgG antibodies were performed on serum specimens following the CDC in-house standard protocols.[6]

Study data were managed using REDCap electronic data capture tools hosted at Washington University.[7] Data were analyzed using SPSS Statistics for Windows, version 23.0 software (IBM, Armonk, NY). Basic enrollment and demographic statistics were calculated for patients and HCP. The proportion with respiratory illnesses was calculated using results of the respiratory symptom assessments and laboratory testing. Reported symptoms were compared for participants who had positive versus negative study specimens. The incidence of respiratory illnesses, defined either as ARI by symptom assessment and/or a study specimen from any time point that was positive by PCR or serum analysis, was evaluated to identify potential transmission events.

The study protocol was reviewed and approved by the Washington University Human Research Protection Office (HRPO) and the CDC Institutional Review Board. Informed consent for study participation was obtained from all enrolled participants or a legally authorized representative.

Results

In total, 76 HCP (31%) were enrolled, including 21 nurses (28%); 10 administrative staff (13%); 9 patient care technicians (12%); 8 food service staff (11%); 8 physical therapists (11%); 7 environmental services staff (9%); 4 occupational therapists (5%); 3 social workers (4%); 2 recreation therapists (3%); 2 facilities staff (3%); one dietician (1%); and one speech pathologist (1%). One hundred and five patients (30%) were enrolled, including 88 (84%) post-acute care patients and 17 (16%) long-term care patients. Patient and HCP demographics are described in Table 1.

Thirteen patients (12%) and 24 HCP (32%) reported any respiratory symptoms during the surveillance period, and 4 symptom reports from patients (31%) and 18 from HCP (75%) met the study definition for ARI. One HCP had 2 ARIs during surveillance. None of the patients with ARIs reported contact with a sick visitor during the previous 5 days; however, 44% of HCP with ARIs reported a sick household member prior to illness. Of the 18 HCP with an ARI, 5 HCP (28%) reported having taken sick days and 16 (89%) reported working while ill, including 4 HCP who had also used sick days.

In total, 19 participants (8 patients and 11 HCP, 10%,) had a positive specimen collected at any point during the study: 18 had a swab specimen positive by PCR and 1 had a positive serum analysis. Rhinovirus was the most commonly identified pathogen (Table 1). Of the 18 participants with a positive swab specimen, 9 (50%, 5 patients and 4 HCP) never reported respiratory symptoms and were only identified through laboratory testing. One patient with a positive swab specimen reported symptoms that did not meet the case definition for ARI. For all 4 HCP that had positive swab specimens but no reported symptoms, the positive sample was collected at enrollment, prior to the start of the surveillance period, before symptom assessments were being conducted.

Table 1. Patient and Healthcare Personnel (HCP) Demographics

Characteristic	Patients (N = 105), No. (%)	HCP (N = 76) (%)
Age, y		
Mean (SD)	67.6 (11)	43.0 (12)
Median (range)	67 (40–96)	42 (18–65)
Female	66 (63)	60 (79)
Race		
White	50 (48)	36 (47)
Black	54 (51)	35 (46)
Hispanic	0	1 (1)
Other/not specified	1 (1)	3 (4)
Received flu vaccination 2015–2016	91 (87)	70 (92)[a]
Smoking status		
Never smoker	52 (50)	49 (65)
Past smoker	48 (46)	19 (25)
Current smoker	5 (5)	6 (8)
Any medical condition(s) with high risk for respiratory illness or complications[b]	100 (95)	17 (22)
Any contact with children	45 (43)	49 (65)
Positive study specimens[c]	8 (8)	11 (15)
Rhinovirus	3 (3)[d]	7 (9)
Influenza A H1N1	2 (2)	1 (1)
Coronavirus	1 (1)	1 (1)
Parainfluenza	0	1 (1)
RSV	2 (2)	0
Adenovirus	0	1 (1)[e]
Acute respiratory illnesses[f]	4 (4)	18 (24)
Rhinovirus	1 (1)	3 (4)
Influenza A H1N1	0[g]	1 (1)
Coronavirus	0	1 (1)
Parainfluenza	0	1 (1)[h]
RSV	1 (1)	0
Adenovirus	0	0
No virus identified	2 (2)	12 (16)

Note. SD, standard deviation; RSV, respiratory syncytial virus; rRT-PCR, real-time reverse-transcriptase polymerase chain reaction.

[a]2 HCP were not vaccinated. One received a medical exemption and the other had an unknown exemption. Vaccination data were not available for 4 HCP.

[b]Includes asthma, chronic obstructive pulmonary disease (COPD), congestive heart failure, other cardiovascular diseases, diabetes, kidney/renal disease, liver disease, neuromuscular/neurologic condition, cancer with treatment in the last year, immunosuppressive condition, pregnancy, dementia, and obesity.

[c]Based on study specimen testing using rRT-PCR, pan virus group PCR, and serum analysis.

[d]An additional patient had a positive clinical specimen collected 1 day after a negative acute illness study specimen.

[e]Identified by serum analysis only.

[f]Includes participants with either a positive study specimen or a positive symptom assessment.

[g]Neither of the 2 patients with influenza positive specimens had symptom assessment completed because they were known to have been infected prior to study enrollment. For 1 patient, both the enrollment specimen (collected 11 days after most recent positive clinical specimen) and the end-of-study specimen (collected 20 days after the enrollment specimen) were positive for influenza.

[h]One HCP had 2 ARIs: 1 with PIV and 1 with negative specimens.

Table 2. Reported Symptoms for Patients and Healthcare Personnel (HCP) who had ARIs With Any Positive Versus All Negative Study Specimens[a]

Reported Symptoms	ARI Episodes With a Positive Study Specimen (N=8), No. (%)	Ari Episodes With Negative Study Specimens (N=14), No. (%)
Congestion/runny nose	8 (100)	12 (85.7)
Cough	6 (75.0)	11 (78.6)
Sore throat	7 (87.5)	9 (64.3)
Headache	5 (62.5)	7 (50.0)
Fever (≥37.3°C/99.1°F)	2 (25.0)	6 (42.9)
Fatigue	3 (37.5)	9 (64.3)
Muscle or joint pain	3 (37.5)	6 (42.9)
Chills	3 (37.5)	5 (35.7)
Wheezing	2 (25.0)	2 (14.3)
Shortness of breath	3 (37.5)	3 (21.4)
Change in mental status	0	1 (7.1)
Mean age (SD), y[b]	48.1 (16.7)	46.2 (13.4)

Note. ARI, acute respiratory infection; SD, standard deviation; rRT-PCR, real-time reverse-transcriptase polymerase chain reaction.
[a]rRT-PCR, pan virus group PCR, or serum positive at any point during study enrollment.
[b]2 HCP with ARIs were missing age data.

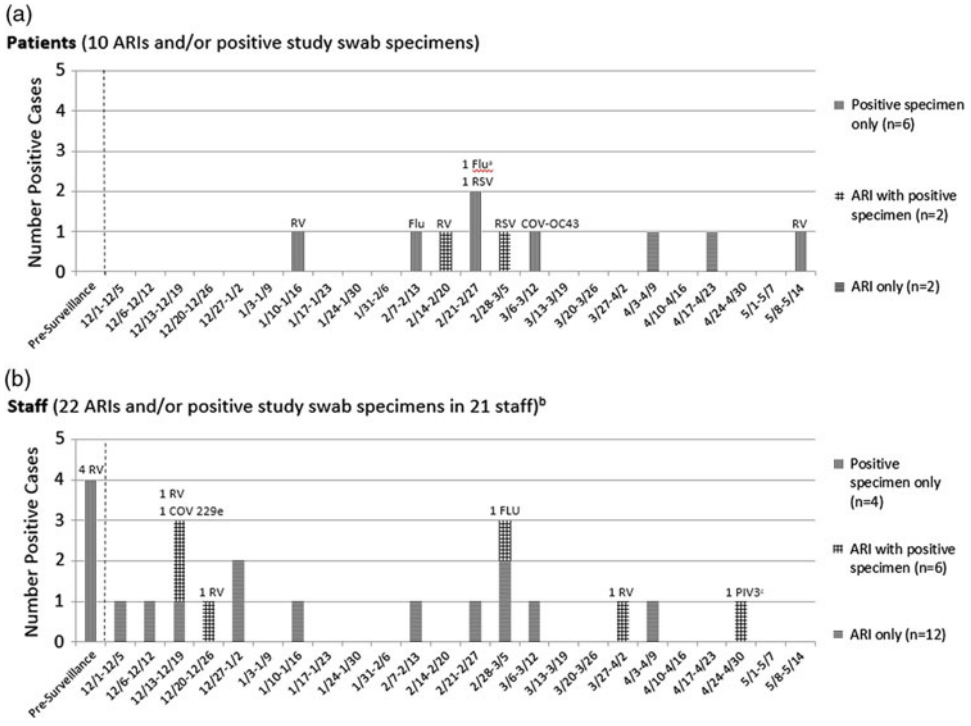

Fig. 1. Patients and HCP with acute respiratory illnesses (ARIs), positive study swab specimens, or both by study week. Results of positive swabs are noted above each week. Note. RV, rhinovirus; RSV, respiratory syncytial virus; Flu, influenza A H1N1; COV, coronavirus (229e for HCP; OC43 for patients); PIV, parainfluenza 3; Adv, adenovirus. [a]In this patient, the enrollment specimen (collected 11 days after most recent positive clinical specimen) and the end of study specimen (collected 20 days after the enrollment specimen) were both positive for influenza. Only the enrollment specimen is shown here. [b]One HCP who had a rise in serum titers for adenovirus is not included in this figure because the timing of the infection cannot be determined. [c]This HCP had an ARI but negative study specimens on April 29. A follow-up study specimen collected on May 11 was positive for parainfluenza virus 3.

Among participants who had an ARI, a greater proportion of individuals with positive versus negative study specimens reported sore throat (88% vs 64%; $P < .05$), while a smaller proportion reported fever (25% vs 43%; $P = .57$) (Table 2).

Illnesses that occurred during the surveillance period showed no clear pattern or clustering (Fig. 1). Although respiratory illnesses increased from about mid-February to mid-March, multiple pathogens were detected (Fig. 1). The timing of this increase in infections roughly corresponded with the peak in respiratory illnesses in the community (data not shown). Investigation into the dates, room placement, and specific viruses identified showed little overlap and a low likelihood of contact between sick HCP and patients.

Discussion

We conducted active surveillance for respiratory illnesses among patients and HCP at a single LTCF during the 2015–2016 respiratory illness season, using rigorous symptom assessments and specimens collected at multiple time points. Multiple techniques (ie, PCR, serology, and broadly reactive pan viral group PCR) were used to identify viral pathogens in study specimens, which

increased our ability to detect organisms that might be causing respiratory illness. Using these sensitive and broad diagnostic methods, we found fewer infections than anticipated, which might be related to high influenza vaccination rates at the facility, to good infection control practices, or to a mild respiratory illness season.

Infection prevention is paramount in healthcare settings to reduce the risk of infection among individuals.[8] In this study population, ARIs and viral detections were less frequent among patients than among HCP, many of whom had sick contacts outside of work. Although there was no evidence for ARI transmission among study participants, the greater incidence of illnesses among HCP suggests that paradigms of patient-centered infection prevention programs should expand to include all persons living and working in an LTCF. In addition, most HCP who had an ARI worked at the facility while ill, despite a facility policy for ill HCP to stay home, which is consistent with prior research.[9] This finding suggests that facilities should consider strengthening communication and enforcement of work restriction policies and should ensure that they are feasible.

Many participants who had a positive study swab collected during the surveillance period did not report respiratory symptoms. Symptom based criteria have been found to be insensitive for identifying viral infections in hospitalized or older adults.[10] The limited number of symptom reports among patients with positive specimens may also reflect subclinical or asymptomatic presentations, asymptomatic viral shedding, or a failure to report symptoms to the study team. HCP may have been particularly reluctant to report respiratory symptoms if they had come to work while ill.

This study had several limitations. First, significant staff turnover occurred following a change in facility management during the surveillance period and a wing of the facility was closed to patients, which decreased the population eligible for study enrollment. Second, some respiratory infections may not have been detected due to difficulties obtaining paired serology specimens from early patient discharges, staff turnover, and participants refusing blood collection. Third, this facility population was a mix of nursing home residents and shorter-stay posthospital patients, which may affect generalizability to facilities with a different patient or resident mix. Finally, this HCP population was highly vaccinated due to the mandatory influenza vaccination policy, which likely reduced influenza illness during the 2015–2016 respiratory illness season, a relatively mild one in St Louis. Therefore, the results may not be generalizable to LTCFs without a mandatory influenza vaccination policy or with lower HCP vaccination rates. Indeed, a previous study by Ursic et al[11] reported higher rates of ARI and viral detections at a nursing home with lower HCP and patient vaccination rates.[11]

Despite these limitations, this study demonstrates that active ARI surveillance can be implemented among both patients and HCP in an adult LTCF, and that HCP represent a potential source of ARI transmission in this setting.

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Conflicts of interest. All authors report no conflicts of interest relevant to this article.

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