Infection Control & Hospital Epidemiology (2019), **40**, 362–364
doi:10.1017/ice.2018.337

Concise Communication

Prevention of hospital-acquired respiratory viral infections: Assessment of a multimodal intervention program

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Abstract

A multimodal program focused on preventing nosocomial respiratory viral infections. Definite cases per 1,000 discharges increased 1.3-fold in hospital units screening visitors for respiratory viral symptoms during the 2017–2018 respiratory virus season but not during the 2016–2017 season. Definite cases per 1,000 discharges increased 3.1-fold in hospital units that did not screen visitors either season.

(Received 10 September 2018; accepted 27 November 2018)

Hospital-acquired respiratory viral infections (RVIs) are transmitted to patients from infected visitors, staff, and roommates,[1] and they are a cause of morbidity and mortality.[2]

Methods

We developed a multimodal program focused on the prevention of hospital-acquired RVIs with staged interventions over 8 years at Rhode Island Hospital, an academic center licensed for 719 beds that includes Hasbro Children's Hospital (Table 1). We defined a *definite* case as a patient admitted without clinical signs or symptoms of a respiratory infection and whose number of days from hospital admission to symptom onset exceeded the upper range for the incubation period of the identified virus.[2] We also included any patient who, when the duration of a patient's hospital stay was within an incubation period for the identified virus, was discharged and readmitted but the duration of time out of hospital was less than the lower range of the incubation period. We defined a *possible* hospital-acquired respiratory virus infection as a patient admitted without clinical signs or symptoms of a respiratory infection and in whom the number of days from hospital admission to symptom onset was within the range of the incubation period for the identified virus. We also included any patient who was without clinical signs or symptoms of a respiratory infection during hospitalization, was discharged and readmitted with new respiratory symptoms, and the lower range of the incubation period for the identified virus covered both the time of the patient's last hospital admission and the time the patient was out of the hospital before readmission. Community-acquired RVIs were cases with positive respiratory virus testing on hospital admission or when symptoms began after admission but before the lower range of the incubation period for the identified virus. Interventions occurred during the respiratory virus season (October through April).

Nasopharyngeal swabs were used to diagnose RVIs. The respiratory virus panel assay (RVP; Luminex, Austin, TX) included adenovirus; coronavirus; influenza A H1, and H3, and nontypeable; influenza B; human metapneumovirus; parainfluenza virus 1, 2, 3, and 4; respiratory syncytial virus A and B; and human rhinovirus/enterovirus. The respiratory pathogen panel assay (RPP; Genmarkdx, Carlsbad, CA) included adenovirus; coronavirus 229E; HKU1; NL63; OC43; human metapneumovirus; human rhinovirus/enterovirus; influenza A H1, 2009 H1N1, and H3; influenza B; parainfluenza 1, 2, 3, and 4; and respiratory syncytial virus A. The panels did not differentiate rhinovirus and enterovirus. Rapid influenza testing (Xpert; Cepheid, Sunnyvale, CA) and rapid respiratory syncytial virus testing (Xpert; Cepheid) were also used.

Unit secretaries and/or nursing staff screened visitors for respiratory viral infection signs and symptoms using a standardized form (Supplement Fig. 1 online). Those who screened positive were prohibited from visiting patients. Exceptions were made on a case-by-case basis; such ill visitors were instructed to mask, to perform hand hygiene, and to remain in the room of the patient they were visiting. Hasbro Children's Hospital nursing staff and visitors were polled May 2017 to assess attitudes regarding our visitor screening policy.

Logistic regression was used (SAS software, SAS Institute, Cary, NC) to compare the change in incidence of hospital-acquired RVIs during the last 2 respiratory virus seasons in patient care units that did not screen visitors during either season to those units that did not screen visitors during the 2016–2017 season but began screening visitors during the 2017–2018 season.

Results

Greater colonization pressure was associated with RVIs during the 2017–2018 respiratory virus season (2,244 hospital-admitted cases of community-acquired RVIs) than with the 2016–2017 season

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Cite this article: Mermel LA, *et al.* (2019). Prevention of hospital-acquired respiratory viral infections: Assessment of a multimodal intervention program. *Infection Control & Hospital Epidemiology*, 40: 362–364, https://doi.org/10.1017/ice.2018.337

Table 1. Multimodal Intervention Program

Hospital-wide Interventions Rhode Island Hospital/Hasbro Children's Hospital	Start Dates
At time of hospital admission, screen patients with signs/symptoms suggestive of respiratory viral infection using nasopharyngeal swabs; if necessary, cohort patients in same room that have the same respiratory virus	RVP October 2009–July 2017 Mean turnaround, 26.6 h; median, 25.6 h[a] RPP September 2017–present Mean turnaround, 3.2 h; median, 3.0 h[a]
Kiosks at hospital entry sites with: cough etiquette poster; alcohol-based hand hygiene dispenser; facial tissues; masks during respiratory virus season (October–April)	September 2010
Influenza vaccination of staff required by November 30 (unless a valid medical exemption certification is presented); unvaccinated staff wear masks for patient contact when influenza at CDC-defined widespread level in Rhode Island	October 2012
Contact and droplet isolation for all patients with suspected or confirmed respiratory viral infection	November 2015
Disallow Hasbro Children's Hospital visitors < 12 years of age during respiratory virus season (October–April)	January 2017
Patient care unit–specific interventions	
Screen visitors on selected patient care units during respiratory virus season (October–April)	Hasbro Children's Hospital - PICU January 2017 - All other children's hospital units October 2017 Adult hospital - hematology/oncology and solid-organ transplant units November 2017 - Cardiothoracic ICU January 2018 - Respiratory ICU June 2018 - Medical ICU March 2018

Note. RVP, respiratory virus panel; RPP, respiratory pathogen panel (see Methods section for viruses included in both panels).
[a]Turnaround times (ie, time from NP swab of patient to time results reported in electronic medical record) were measured January 1–10, 2017 and 2018 for RVP and RPP, respectively.

Table 2. Impact of Visitor Screening on Incidence of Hospital-Acquired Respiratory Viral Infections

	Hospital-Acquired Respiratory Viral Infections per 1,000 Patient Care Unit Discharges			
Cases	Oct 2016–Apr 2017[a,b]	Oct 2017–Apr 2018[c]	Rate Ratio	*P* Value
Total cases				
Visitor screening was not done on patient care unit during 2017–2018 respiratory virus season	0.9[d]	2.6[e]	2.9	
Visitor screening was done on patient care unit during 2017–2018 respiratory virus season	3.2[f]	5.3[g]	1.7	.67
Definite cases				
Visitor screening was not done on patient care unit during 2017–2018 respiratory virus season	0.7	2.2	3.1	
Visitor screening was done on patient care unit during 2017–2018 respiratory virus season	2.4	3.1	1.3	.11
Possible cases				
Visitor screening was not done on patient care unit during 2017–2018 respiratory virus season	0.2	0.4	2.0	
Visitor screening was done on patient care unit during 2017–2018 respiratory virus season	0.7	2.2	3.1	.26

[a]Visitor screening was *not* done during the October 2016–April 2017 respiratory virus season.
[b]Hand hygiene compliance in patient care units with no visitor screening and with visitor screening was 82% and 91% respectively ($P = .001$); compliance with isolation precautions was 72% and 60%, respectively ($P = .60$).
[c]Hand hygiene compliance in patient care units with no visitor screening and with visitor screening was 87% and 96% respectively ($P < .002$); compliance rates with isolation precautions were 89% and 90%, respectively ($P = 1.0$).
[d]5 coronavirus, 4 influenza, 2 RSV, 2 metapneumovirus, 2 parainfluenza, and 2 rhinovirus/enterovirus.
[e]19 influenza, 10 rhinovirus/enterovirus, 5 metapneumovirus, 4 RSV, 4 viral coinfection, 2 adenovirus, 1 coronavirus, and 2 parainfluenza.
[f]5 RSV, 4 influenza, 2 coronavirus, and 2 enterovirus/rhinovirus.
[g]5 enterovirus/rhinovirus, 5 viral co-infection, 4 RSV, 4 influenza, 1 parainfluenza, 1 metapneumovirus, 1 coronavirus, and 1 adenovirus.

https://doi.org/10.1017/ice.2018.337 Published online by Cambridge University Press

(1,198 hospital-admitted cases). We compared hospital-acquired RVIs per 1,000 discharges in patient care units that did not screen visitors during the 2016–2017 and 2017–2018 respiratory virus seasons to those units that went from no visitor screening during the 2016–2017 season to visitor screening during the 2017–2018 season. Comparing 2016–2017 to 2017–2018, the rate ratio for total and definite cases of hospital-acquired RVIs was greater in units that did not screen visitors during either season compared to those that did screen visitors during the 2017–2018 season; however, the difference was not statistically significant (Table 2).

Discussion

Respiratory viruses are spread by multiple potential routes.[3] Use of contact and droplet precautions for all RVIs reduces risk of hospital-acquired RVIs.[4] Multimodal infection prevention programs, including both contact and droplet precautions as well as visitor screening, have dramatically reduced risk of nosocomial RSV infections in immunocompromised patients.[5,6] We developed a multimodal respiratory virus prevention program over 8 years. It is difficult to determine the impact of individual elements of the program during that time, and our analysis is limited to the last 2 respiratory virus seasons when our intervention focused on visitor screening. The major finding of our study is that a multimodal program, which includes visitor screening, is associated with a reduced risk of such infections in patients hospitalized in a large, academic medical center that includes a pediatric hospital within a hospital.

Although the incidence density of hospital-acquired RVIs in the 2017–2018 season was greater on patient care units that screened visitors compared to those that did not, we believe this reflects the facts that visitor screening included our pediatric units where there is a greater risk of RVIs compared to our adult units[2] and that adult units that screened visitors were high risk units such as our transplant and hematology/oncology units.

We informally polled nursing staff regarding use of contact and droplet precautions for all respiratory viral infections and found that this was preferred and easier to follow than our prior use of virus-specific precautions. Additionally, we more formally polled our children's hospital nursing staff and visitors regarding visitor screening. The vast majority of responses were positive from both groups. Additionally, after we started screening visitors in some of our adult hospital units, unit directors of other hospital units made requests to initiate such screening on their units.

Regarding limitations, we did not closely monitor the incidence of hospital-acquired RVIs prior to the 2016–2017 season, so we are unable to compare the impact of our interventions with previous years. Also, we did not measure compliance with visitor screening. Our study may have been underpowered to show a significant difference in rate ratios on units that did and did not screen visitors. Because hand hygiene was significantly better in the units with visitor screening, it is difficult to know how much of the reduction in hospital-acquired respiratory viral infections was associated with this infection control intervention. Lastly, visitor screening during the 2017–2018 season in predominantly high-risk patient care units may have magnified the impact of this intervention.

In conclusion, a multimodal program focused on reducing risk of RVIs among hospitalized patients can be effectively implemented in a large adult and pediatric teaching hospital with associated culture change. Although twice as many hospital admissions with RVIs occurred during the 2017–2018 season than during the 2016–2017 season, there was only a 1.3-fold increase in definite cases per 1,000 discharges in units that screened visitors during 2017–2018, compared with a 3.1-fold increase in unit that did not screen visitors. As such, screening visitors for respiratory viral infection signs and symptoms appears to reduce risk of transmission to hospitalized patients. Moving forward, we hope that our hospital will review our sick leave policy in an effort to further limit, in a nonpunitive fashion, our hospital staff from coming to work if they have signs and symptoms suggestive of a RVI.[7]

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2018.337

Acknowledgements. Our hospital nursing and physician staff provided crucial assistance in successfully implementing our multimodal program. We specifically thank Lisa Paolino, RN, for her generous assistance in trialing our first unit-based visitor screening program. Our Rhode Island Hospital Department of Epidemiology and Infection Control assisted in initiating and maintaining our multimodal program. We thank YJ Choe, MD, PhD, for assistance with organizing the data and Jason T. Machon, PhD, who kindly assisted in performing the logistic regression analysis. The Seattle Cancer Care Alliance generously allowed an on-site assessment of their respiratory virus management plan (by J.J.) and kindly supplied us with copies of materials used in their visitor screening program. The hospital administration and microbiology laboratory transitioned to our current nucleic acid amplification testing modality, which allowed for expeditious identification of patients with respiratory viral infections. Finally, our operational excellence team led a failure modes and effects analysis regarding cases of nosocomial respiratory viral infections.

Financial support. No financial support was provided relevant to this article.

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

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