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Major Article

Is hand hygiene frequency associated with the onset of outbreaks in pediatric long-term care?



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Background: Studies in adult long-term care facilities (LTCFs) have shown a correlation between hand hygiene (HH) and viral outbreak reduction, but no such studies have been conducted in pediatric LTCFs where the epidemiology of viral pathogens is different.

Methods: We compared electronically monitored facility-wide HH frequency in the weeks immediately prior to outbreaks of acute respiratory or gastrointestinal infections versus control weeks in a 137-bed pediatric LTCF from October 2012–August 2015. Control weeks were the 8–14 day (control 1) and 15–21 day (control 2) periods prior to the onset of each outbreak.

Results: There was no difference in HH frequency in the weeks leading up to the outbreaks versus control weeks (odds ratio [OR], 1.0; 95% confidence interval CI, 1.00–1.001 using control 1 and OR, 1.0; 95% CI, 1.00–1.001 using control 2).

Conclusions: Our findings differed from those in adult LTCFs, possibly because of the greater contact between residents and staff in the pediatric setting, increased susceptibility to viral pathogens because of immunologic immaturity, or differences in the types of pathogens prevalent in each setting. Although HH may be important for limiting the number of residents infected during outbreaks, we found no association between HH frequency and subsequent outbreak onset.

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Hand hygiene is the primary recommendation for preventing infections in health care settings.¹ A recent review identified several studies conducted in acute care which have demonstrated a correlation between improved hand hygiene compliance and reductions in infections from bacterial organisms commonly spread via direct or indirect contact, such as *Staphylococcus aureus* and *Clostridium difficile*.² Research in adult long-term care has also shown a correlation between improved hand hygiene and reduction in viral respiratory outbreaks, which are transmitted by contact or droplet

routes and therefore difficult to control in residential health care settings.³

Pediatric long-term care facilities face unique challenges with regard to outbreak prevention. Children in such facilities have increased risk of developing infections. They rely on facility staff for assistance with all activities of daily living and require frequent hands-on contact from a variety of caregivers, thereby providing many opportunities for exposure to transmissible pathogens.⁴ In addition, children in pediatric long-term care facilities have chronic medical conditions necessitating the use of indwelling devices, such as tracheostomy and feeding tubes, which place them at greater risk of infection.⁵ Many pediatric long-term care residents are young and therefore have immature immune systems placing them at increased risk of infections. Finally, the home-like environment and focus on group therapy complicates adherence to hand hygiene protocols and other infection prevention efforts because staff members often work with multiple children at once and engage in activities in which educational toys and props are shared.⁶

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Conflicts of Interest: None to report.

Because of the specialized nature of pediatric long-term care and high burden of infections among residents, we sought to determine whether hand hygiene frequency was associated with subsequent outbreaks of acute respiratory or gastrointestinal infections in a pediatric-long term care facility.

METHODS

Sample and setting

This study was conducted in a 137-bed pediatric long-term care facility which provides residential care to children aged 0–21 years old who have chronic, complex medical conditions, including genetic, neurologic, pulmonary, and cardiac disorders. The facility provides a wide range of services in addition to medical and nursing care, including physical, occupational, speech and language, creative arts, child life, recreational therapies, and education in an on-site school. Length of stay ranges from 1 day to 21 years, with an average of 4 years. Because of the long-term nature of care at this facility and high demand for pediatric skilled nursing care in this region, the census and acuity remained stable over time. Most children (>95%) had cognitive impairment throughout the study. Prevalence of common devices assessed at the beginning and end of the study included feeding tubes (85% and 82%, respectively), tracheostomies (51% and 44%, respectively), and mechanical ventilation (12% and 20%, respectively).

All facility personnel are educated on the World Health Organization My 5 Moments for Hand Hygiene and expected to perform hand hygiene before touching residents, before aseptic procedures, after contact with body fluids, after touching residents, and after touching residents' belongings or surroundings. Electronic wall-mounted alcohol hand sanitizer dispensers are located throughout the entire facility, and sinks with electronic wall-mounted soap dispensers are located in all patient rooms, classrooms, bathrooms, break rooms, and kitchen areas.

Data collection

Hand hygiene frequency was captured electronically by a commercially available group monitoring system (DebMed GMS; Deb Group, Charlotte, NC) which recorded, with date and time stamp,

each time a wall-mounted alcohol hand sanitizer or soap dispenser in the facility was used. The number of daily hand hygiene events throughout the facility was collected retrospectively from the system for the period of October 1, 2012–August 31, 2015.

Data on all outbreaks of gastroenteritis or acute respiratory infections occurring at the facility from October 1, 2012–August 31, 2015, were collected retrospectively from the New York State Department of Health Nosocomial Outbreak Reporting Application, an electronic repository for mandated reports of infectious disease outbreaks. Reporting for gastroenteritis and upper respiratory infections is required whenever there is a significant increase in infection rates above baseline.⁷ Reports include the number of laboratory-confirmed cases with identified pathogen(s), the number of suspected cases based on clinical presentation, and the number of cases resulting in acute care hospitalization.

Data analysis

A matched case-control design was used to determine whether hand hygiene frequency was lower in the week immediately preceding an outbreak versus in control weeks. For case weeks, the total frequency of hand hygiene events in the 7 days prior to the onset of an outbreak (ie, the day of diagnosis for the first recognized case) was calculated. Total hand hygiene frequency was also calculated for 2 control weeks: the 8–14 day (control 1) and 15–21 day (control 2) periods prior to the onset of each outbreak. Conditional logistic regression was used to model the odds of an outbreak occurring in case versus control weeks. The percent difference in hand hygiene frequency between case and control weeks was also modeled against the odds of an outbreak.

RESULTS

Twenty-one outbreaks occurred during the study period (Table 1). The mean number of facility-wide hand hygiene events was 22,025 in the weeks leading up to outbreaks, 21,760 in the 8–14 day periods prior to outbreaks (control 1), and 21,759 in the 15–21 day periods prior to outbreaks (control 2). There was no difference in hand hygiene frequency in the week leading up to an outbreak versus control weeks (odds ratio [OR], 1.0; 95% confidence interval [CI], 1.00–1.001 using control 1 and OR, 1.0; 95% CI, 1.00–1.001 using control

Table 1
Outbreaks of acute respiratory and gastrointestinal infections in a pediatric long-term care facility

Date of symptom onset for first case	Etiology	No. of affected residents (no. of labs confirmed)	No. of affected staff (no. of labs confirmed)	Resident hospitalizations
January 18, 2013	Influenza A	7 (1)	3 (1)	1
February 15, 2013	Influenza B	7 (1)	1 (0)	0
March 1, 2013	Human metapneumovirus	9 (4)	0 (0)	3
April 23, 2013	<i>Clostridium difficile</i>	16 (1)	5 (0)	0
November 22, 2013	Norovirus-calicivirus (1 coinfecting with <i>C difficile</i>)	21 (3)	29 (0)	0
December 20, 2013	Respiratory syncytial virus	4 (4)	1 (0)	4
December 28, 2013	Influenza A (H1N1)	12 (3)	1 (0)	1
January 7, 2014	<i>C difficile</i>	3 (3)	0 (0)	0
January 18, 2014	Respiratory syncytial virus	6 (3)	0 (0)	0
February 13, 2014	Influenza B	1 (1)	0 (0)	1
February 22, 2014	Coronavirus NL63	2 (2)	0 (0)	2
April 4, 2014	Norovirus-calicivirus	3 (3)	0 (0)	1
April 7, 2014	Influenza A	3 (2)	2 (1)	1
August 6, 2014	Parainfluenza	7 (1)	0 (0)	0
September 8, 2014	Rhinovirus-enterovirus	11 (3)	2 (0)	1
November 23, 2014	Rhinovirus-enterovirus, parainfluenza, coronavirus	14 (6)	0 (0)	4
March 14, 2015	<i>C difficile</i> , rotavirus	6 (2)	0 (0)	0
May 1, 2015	Rhinovirus-enterovirus	5 (3)	0 (0)	2
May 24, 2015	Parainfluenza	2 (2)	0 (0)	1
June 30, 2015	Parainfluenza	3 (2)	0 (0)	1
July 27, 2015	Rhinovirus-enterovirus	3 (2)	0 (0)	1

2). There was also no association with the percent difference in hand hygiene frequency between case and control weeks and the odds of an outbreak: a 5% difference in hand hygiene frequency produced ORs of 1.5 (95% CI, 0.67-3.49) for control 1 and 1.2 (95% CI, 0.74-1.90) for control 2.

DISCUSSION

Contrary to other studies,^{2,3} we found no association between hand hygiene and outbreak onset in a long-term care setting. One reason for the disparate results may be differing methods of ascertaining hand hygiene compliance. We measured electronically monitored frequency of hand hygiene, whereas previous studies assessed adherence to hand hygiene protocols using direct observation of hand hygiene opportunities. Because timing and appropriateness of hand hygiene may be more critical for infection prevention than overall frequency, our results may be biased toward the null. Another reason for the difference in findings may be the study population. Children in pediatric long-term care likely have more frequent contact with a greater number and variety of staff members compared with residents in adult long-term care, which would make transmission events more likely.^{4,6} Children also may be more susceptible to gastrointestinal and acute respiratory infections because of their age and immunologic immaturity.⁵ Furthermore, viral pathogens that are more common among children (eg, rhinovirus) may be more likely to be spread via the droplet route and therefore less preventable through hand hygiene.⁸ Finally, our study may have lacked sufficient power to detect associations between hand hygiene frequency and the occurrence of outbreaks, particularly if the magnitude of association were small.

Despite possible limitations of power and methodology of hand hygiene assessment, this study has several important strengths. Hand hygiene was captured electronically and anonymously on an ongoing basis, therefore avoiding observer biases and other measurement biases, such as the Hawthorne effect.⁹ To ensure reliability and validity of the electronic monitoring system, we randomly selected dispensers at several points throughout the study and compared observed hand hygiene events with those captured by the system

and found no discrepancies. It is possible that some hand hygiene events were not recorded by the system, for example if they were performed using personal bottles of hand sanitizer. However, this practice was discouraged and unlikely to have varied over time. In addition, structured state-level mandatory reporting allowed for systematic and consistent ascertainment of outbreaks throughout the study period.

Although we did not find a correlation between hand hygiene frequency and subsequent outbreak onset in this pediatric long-term care setting, hand hygiene may still play an important role in limiting the number of staff and residents affected when outbreaks do occur.

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