



ELSEVIER

# Hand Hygiene Opportunities in Pediatric Extended Care Facilities<sup>1,2,3</sup>

Amanda Buet MPH<sup>a,\*</sup>, Bevin Cohen MPH<sup>a</sup>, Melissa Marine BS<sup>a</sup>, Fiona Scully<sup>a</sup>, Paul Alper BA<sup>b</sup>, Edwin Simpser MD<sup>c</sup>, Lisa Saiman MD, MPH<sup>d,e</sup>, Elaine Larson RN, PhD<sup>a</sup>

<sup>a</sup>Columbia University, School of Nursing, New York, NY

<sup>b</sup>Deb Worldwide Healthcare, Inc., Charlotte, NC

<sup>c</sup>St. Mary's Healthcare System for Children, Bayside, NY

<sup>d</sup>Department of Pediatrics, Columbia University, New York, NY

<sup>e</sup>Department of Infection Prevention & Control, NewYork-Presbyterian Hospital, New York, NY

## Key words:

Pediatric long term care;  
Infection control;  
Hand hygiene

**Introduction:** Children in extended care facilities (ECFs) are at risk of healthcare-associated infections, but little hand hygiene (HH) research has been conducted in this unique setting. **Methods:** Eight children across four pediatric ECFs were observed for a cumulative 128 hours, and all care giver HH opportunities were characterized by the World Health Organization's '5 Moments for HH'. Data were analyzed using Pearson's  $\chi^2$  test. **Results:** Observers documented 865 HH opportunities. Overall HH adherence was 43% and was significantly higher among clinical care givers than among non-clinical care givers (61% and 14%, respectively, ( $p < .01$ )). **Conclusions:** Hand hygiene adherence was low, suggesting multiple opportunities for transmission of infectious agents.

© 2013 Elsevier Inc. All rights reserved.

PEDIATRIC EXTENDED CARE facilities (ECFs) represent a unique healthcare environment, providing medical care as well as on-site social, academic, and therapeutic activities. Children remain in pediatric ECFs from months to years and have frequent and close contact with other children as well as with a wide variety of clinical and non-clinical care givers who often provide most, if not all, activities of daily living. The population in pediatric ECFs is increasingly complex, and such children are at high risk of healthcare-associated infections (HAIs) which are associated with

increased morbidity, mortality, resource use and cost (Burns et al., 2010; Feudtner et al., 2001; Lorenz, 2000). While the epidemiology of HAIs in pediatric ECFs has not been extensively studied, it is likely to be different from the epidemiology of HAIs described in pediatric acute care settings. Bacterial pathogens, including multidrug-resistant strains have been described in pediatric ECF (Furuno et al., 2008), but viral pathogens are perhaps more important and can cause endemic and epidemic infections (Harris, 2002; James et al., 2007; Pituch, 2009; von Renesse et al., 2009).

The Centers for Disease Control and Prevention (CDC) (Boyce & Pittet, 2002) and the World Health Organization (WHO) (World Health Organization, 2009a) have published evidence-based guidelines confirming the causal relationship between poor infection control practices, particularly hand hygiene (HH), and increased risk of HAIs. However, most HH research has been focused in adult long term care facilities and acute care settings and findings from such studies are unlikely to be applicable to HH in pediatric

<sup>1</sup> Funding Sources: Study was funded by Deb Worldwide Healthcare, Inc.

<sup>2</sup> Financial Disclosure: Paul Alper receives a salary from Deb Worldwide Healthcare, Inc. All other authors have no financial interests to disclose.

<sup>3</sup> Conflict of Interest: Authors have no conflicts of interest to disclose.

\* Corresponding author: Amanda Buet, MPH.

E-mail address: aeb2185@columbia.edu (A. Buet).

ECFs given the different care patterns, including the relative distribution of different devices. For example, central venous catheters and ventilators are more common in acute care settings, while tracheostomies and feeding tubes are more common in pediatric ECFs. The purpose of this observational study was to assess the frequency and type of HH opportunities initiated by clinical (e.g., physicians and nurses) and non-clinical (e.g., parents and teachers) care givers, as well as evaluate HH adherence using the WHO's '5 Moments for HH' observation tool (World Health Organization, 2009b).

## Methods

### Setting and Sample

From June-August 2011, four pediatric ECFs, which provide subacute, long term and residential care, rehabilitation, chronic disease management, and/or specialty care (Table 1), participated in this observational study. A convenience sample of two children from each site (N = 8) was observed. The leadership at each facility was asked by the study team to select two school-aged participants, one child from each facility who was completely dependent on staff for *all* activities of daily living, and one child who was dependent on staff for *most* activities of daily living. The mean age of the eight children was seven years (SD, 2.1; range, 3–9 years). One child had a feeding tube, central venous catheter, and tracheostomy tube, three children had both feeding tubes and tracheostomy tubes, one child had only a tracheostomy tube, one child had only a feeding tube, and two children had no invasive devices. All resided in shared bedrooms with three to five other children.

The study team informed the staff at each facility about study. The ethics boards of all four facilities as well as the Columbia University Medical Center Institutional Review Board approved the study. Parents of selected children provided written informed consent for their respective child to participate.

## Procedures

Four observers participated in two hours of didactic training and two hours of monitored practice observations at one of the four study sites to ensure consistent documentation and interpretation of observations. Observers learned how to accurately record HH opportunities and HH adherence using the WHO '5 Moments for HH' data acquisition tool, discussed below. Throughout the study, regular debriefings were also held to review and discuss data recording.

Decision rules for recording sequential care activities were developed as the study team did not think it was feasible for facility staff to perform multiple episodes of HH during episodes of bundled care. The highest indication of care was recorded during any such episode. For example, multiple episodes of HH may not be feasible if a staff member changes a toddler's diaper and clothing, brushes his/her teeth, and adjusts the tracheostomy tube. Thus, the indication for HH following the highest level of care was noted (e.g., after body fluid exposure/risk while changing a diaper), along with the care giver's HH action. A trained observer conducted observations of HH for each of the eight children during two 8-hour shifts on different days.

Hand hygiene adherence was defined as either a hand wash or application of alcohol-based sanitizer. Clinical care givers included physicians, nurses, nurse aides and respiratory, physical or occupational therapists. Non-clinical care givers included teachers, teachers' aides, recreational support staff, environmental service workers, social workers, volunteers and adult visitors.

## Observation Tool

The World Health Organization (2009a) '5 Moments for HH' define points of contact when healthcare workers should perform HH: 'before touching a patient', 'before clean/aseptic procedures', 'after body fluid exposure/risk', 'after touching a patient', and 'after touching patient surroundings'. Observers recorded HH opportunities on a study-specific observation form adapted from the WHO

**Table 1** Characteristics of Study Sites \*

	Site A	Site B	Site C	Site D
Number of beds	97	44	92	135
Mean length of stay (range)	0.3 yr (0.2 yr– 0.3 yr)	2.8 yr (7 d– 8 yr)	0.2 yr (14 d– 0.8 yr)	1.5 yr (7 d– 21 yr)
Residents Age (range)	14 d– 20 yr	0.5 yr– 20 yr	0.1 yr– 20 yr	7 d– 21 yr
Residents with devices (%)				
Tracheostomy	29%	30%	33%	51%
Central venous catheter	6%	2%	10%	0%
Feeding tubes	78%	77%	42%	85%
Residents hospitalized at acute care facilities per year	25%	25%	20%	U

Notes: Abbreviations used in table: d: day; yr: year; U: unknown.

\* All facilities had schools on site licensed by the New York State Board of Education.

(Sax et al., 2009; World Health Organization, 2009b). Observers noted type of care giver, location in which the child was being observed, indication of contact as categorized by the '5 Moments for HH', adherence to HH and the type of product used (soap or alcohol-based hand sanitizer). For example, one recorded HH opportunity could show that a nurse, in the patient's room, performed a hand wash with soap before touching the patient.

## Statistical Analyses

Data analyses were descriptive. Comparisons of categorical data were performed using Pearson's  $\chi^2$  test.

## Results

### Hand Hygiene Opportunities

During approximately 128 hours of observation, 865 HH opportunities were observed. Overall HH opportunities ranged from 133 to 269 per site (mean, 216; SD, 59). During the 16-hour observation period for each child, care givers had an average of 108 (SD, 48; range, 54 – 169) HH opportunities. As shown in Table 2, nurses and nurse aides had the highest number of opportunities and were associated with 50% of all HH opportunities. In contrast, far fewer HH opportunities were associated with other types of care givers including visitors (22%), occupational, physical, and respiratory therapists (9%), school staff (9%), other staff (i.e.,

recreational support staff, environmental service workers and volunteers) (8%), and physicians (1%). As seen in Figure 1, the most common indication for HH was 'before touching a patient' (25%) and the least common indication was 'before clean/aseptic procedure' (1%).

### Hand Hygiene Adherence

Overall HH adherence was 43% and ranged from 27% to 65% among the sites. Adherence by type of care giver and location of HH opportunity varied (Table 2). Hand hygiene adherence among clinical care givers was significantly higher than adherence among non-clinical care givers (61% vs. 14%, respectively;  $\chi^2$  (1,  $N = 865$ ) = 176.62,  $p < .001$ ). The highest frequency of HH adherence occurred among nurses and nurse aides and the lowest occurred among visitors (Table 2).

Adherence to the WHO '5 Moments for HH' varied (Figure 1) and was highest 'after body fluid exposure/risk' (66%;  $n = 78$ ) and 'before clean/aseptic procedure' (54%;  $n = 7$ ) and lowest 'before touching a patient' (36%;  $n = 120$ ). Hand hygiene adherence 'after touching a patient' and 'after touching patient surroundings' was 41% ( $n = 88$ ) and 42% ( $n = 77$ ), respectively. The frequency of HH adherence significantly varied by indication ( $\chi^2$  (4,  $N = 865$ ) = 34.27,  $p < .001$ ). Two children were on Contact Precautions (Siegel, Rhinehart, Jackson, Chiarello, & the Healthcare Infection Control Practices Advisory Committee, 2007) as they harbored potentially transmittable pathogens during the second 8-hour observation period. Hand hygiene adherence was significantly reduced during

**Table 2** Number of Episodes of Adherence (n) per Number of Opportunities (N)

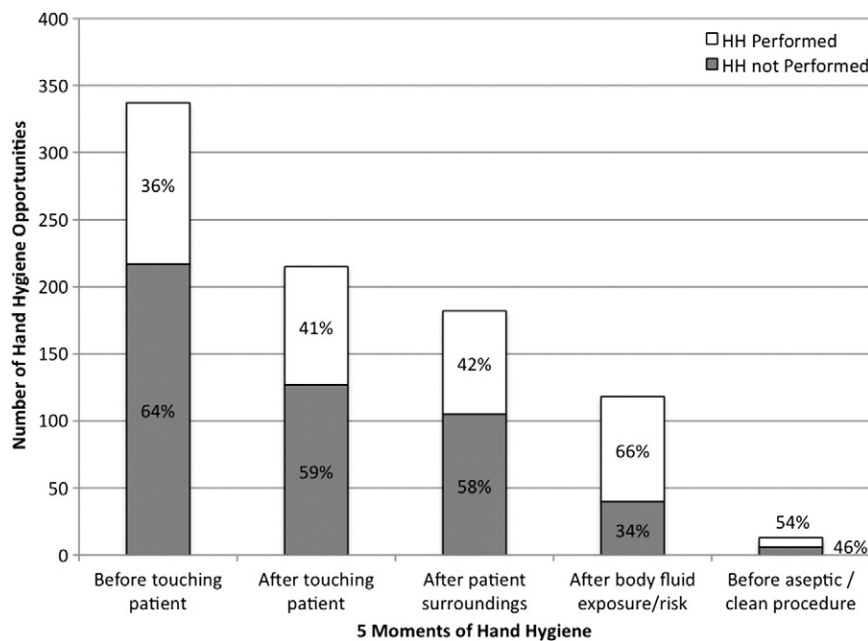
	n/N (%)				
	Site A	Site B	Site C	Site D	Total
Overall adherence	77/243 (32)	77/133 (58)	73/269 (27)	143/220 (65)	370/865 (43)
<i>By type of care giver*</i>					
<i>Clinical</i>					
Nurse/nurse aide	68/129 (53)	71/109 (65)	50/83 (60)	88/114 (77)	277/435 (64)
Physician	-	1/2 (50)	-	1/4 (25)	2/6 (33)
Therapist <sup>†</sup>	9/15 (60)	2/4 (50)	6/24 (25)	22/37 (59)	39/80 (49)
<i>Non-Clinical</i>					
Visitors	0/93 (0)	-	13/92 (14)	6/9 (67)	19/194 (10)
School Personnel	-	2/12 (17)	0/32 (0)	15/36 (42)	17/80 (21)
Housekeeping	0/3 (0)	1/5 (20)	-	0/2 (0)	1/10 (10)
Other <sup>‡</sup>	0/3 (0)	0/1 (0)	4/38 (11)	11/18 (61)	15/60 (25)
<i>By observation location</i>					
Bedroom	65/220 (30)	67/104 (64)	70/167 (42)	118/168 (70)	320/659 (49)
Dining room	2/7 (29)	-	-	6/12 (50)	8/19 (42)
School	-	6/19 (32)	0/42 (0)	15/27 (56)	21/88 (24)
Other <sup>§</sup>	10/16 (63)	4/10 (40)	3/60 (5)	4/13 (31)	21/99 (21)

\*  $p < .001$ .

<sup>†</sup> Includes occupational, physical and respiratory therapists.

<sup>‡</sup> Includes volunteers, technicians, and 'others', which includes recreational support staff.

<sup>§</sup> Includes play room, other shared spaces, and during transport.



**Figure 1** Hand Hygiene (HH) Adherence among Care Givers in Pediatric Extended Care Facilities. The total number of HH opportunities ( $n = 865$ ) as defined by the WHO '5 Moments for HH' is shown. Opportunities with adherence to HH are shown in white and those in which HH was not performed are shown in grey.

Contact Precautions, although this decrease was associated with a visiting parent.

## Discussion

To our knowledge, this is the first study to report HH opportunities and HH adherence in pediatric ECFs using the WHO '5 Moments for HH' methodology. As predicted, HH opportunities were associated with a wide variety of clinical and non-clinical care givers. Adherence to HH was low, especially by non-clinical individuals.

Comparison of this study to data derived from various acute care settings reported by Steed et al. revealed that pediatric ECFs had more HH opportunities occurring 'before touching a patient' and fewer occurring 'after touching patient surroundings' or 'before an aseptic/clean procedure' (Steed et al., 2011). These differences emphasize that patients in pediatric ECFs are less acutely ill; fewer aseptic procedures are performed and residents are generally touched more. As observed in this study and as described by Schweon and Kirk (Schweon & Kirk, 2011), multiple contacts between care givers and children take place in the home-like setting of ECFs.

In addition, the community of care givers appears to be very different in pediatric ECFs than in acute care settings or in adult facilities. For example, non-clinical care givers such as visitors, volunteers, and school personnel are common in ECFs for children. Half of the HH opportunities in this study were associated with nurses and physicians, while in acute care settings for adult patients, the majority of HH

opportunities (82-86%) have been associated with nurses and physicians (Steed, et al.).

Hand hygiene adherence in this study was comparable or even superior to HH adherence in the acute care setting. In the acute care setting, overall HH adherence by physicians and nurses before touching a patient is generally low, sometimes as low as 28-35% (Cheng et al., 2011; Eveillard et al., 2010; Saint et al., 2009). These results highlight a significant need to continue to educate healthcare professionals and non-clinical care givers about HH. These findings also suggest that poor adherence to HH may be a risk factor for HAIs in pediatric ECFs. The children's behaviors and care needs, the large number of care providers, frequent group activities including school, meals and recreation, and the relative crowding can provide numerous opportunities for transmission of potential pathogens by direct patient contact or contact with patients' surroundings.

There are limitations to this study. First, it is possible that there was some difference in interpretation of the '5 Moments for HH' among the four observers. Second, despite the significant number of observations, the sample size was small and limited to four sites. Third, direct observations of HH adherence may have influenced behavior leading to an over-estimate of daily HH practice (Eckmanns, Bessert, Behnke, Gastmeier, & Ruden, 2006). Fourth, our decision rules for identifying HH opportunities and HH adherence during bundled care practices have not been validated. Fifth, we studied a heterogeneous mix of ECFs, which may have varying rates of HAIs (Abdolahi, Fisher, Aquino, & Beydoun, 2011) and distinct differences in patient population and care practices.

In summary, this study quantified HH opportunities and HH adherence in four pediatric ECFs. These findings indicate a different pattern of HH opportunities in such facilities when compared with adult acute care facilities consistent with the different care needs and care givers in pediatric ECFs. Adherence to HH was generally low, particularly among non-clinical care givers. Future studies should assess methodologies to improve HH and infection control practices in pediatric ECFs and assess the impact on HAIs. Measurement of inter-rater reliability and validation of HH notation during bundled care episodes should also be considered.

## Acknowledgments

We gratefully acknowledge the contributions of the leadership and staff at all four participating facilities and the funding provided by Deb Worldwide Healthcare, Inc.

## References

- Abdollahi, A., Fisher, S. G., Aquino, C., & Beydoun, H. A. (2011). Nosocomial infections in a pediatric residential care facility. *American Journal of Infection Control*, Nov 2011 [Epub ahead of print].
- Boyce, J. M., & Pittet, D. (2002). Guideline for hand hygiene in health-care settings recommendations of the healthcare infection control practices advisory committee and the HIPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. *American Journal of Infection Control*, 30, S1–S46. S0196655302002559 [pii].
- Burns, K. H., Casey, P. H., Lyle, R. E., Bird, T. M., Fussell, J. J., & Robbins, J. M. (2010). Increasing prevalence of medically complex children in US hospitals. *Pediatrics*, 126, 638–646. peds.2009-1658 [pii] 10.1542/peds.2009-1658.
- Cheng, V. C., Tai, J. W., Ho, S. K., Chan, J. F., Hung, K. N., Ho, P. L., et al. (2011). Introduction of an electronic monitoring system for monitoring compliance with Moments 1 and 4 of the WHO "My 5 Moments for Hand Hygiene" methodology. *BMC Infectious Diseases*, 11, 151.
- Eckmanns, T., Bessert, J., Behnke, M., Gastmeier, P., & Ruden, H. (2006). Compliance with antiseptic hand rub use in intensive care units: the Hawthorne effect. *Infection Control and Hospital Epidemiology*, 27, 931–934.
- Eveillard, M., Rabjeau, A., Pradelle, M. T., Raymond, F., Joly-Guillou, M. L., & Brunel, P. (2010). Rates of adherence to hand hygiene and gloving practices in 2 French rehabilitation hospitals by differentiation between single contacts and series of successive contacts with patients or the environment. *Infection Control and Hospital Epidemiology*, 31, 878–879.
- Feudtner, C., Hays, R. M., Haynes, G., Geyer, J. R., Neff, J. M., & Koepsell, T. D. (2001). Deaths attributed to pediatric complex chronic conditions: national trends and implications for supportive care services. *Pediatrics*, 107, E99.
- Furuno, J. P., Hebden, J. N., Standiford, H. C., Perencevich, E. N., Miller, R. R., Moore, A. C., et al. (2008). Prevalence of methicillin-resistant *Staphylococcus aureus* and *Acinetobacter baumannii* in a long-term acute care facility. *American Journal of Infection Control*, 36, 468–471.
- Harris, J. S. (2002). Infection control programs in pediatric extended care facilities. Paper presented at the 12th Annual Meeting of the Society for Healthcare Epidemiology of America, Salt Lake City, UT.
- James, L., Vernon, M. O., Jones, R. C., Stewart, A., Lu, X., Zollar, L. M., et al. (2007). Outbreak of human adenovirus type 3 infection in a pediatric long-term care facility—Illinois, 2005. *Clinical Infectious Diseases*, 45, 416–420.
- Lorenz, J. M. (2000). Survival of the extremely preterm infant in North America in the 1990s. *Clinics in Perinatology*, 27, 255–262. [pii]: S0095-5108(05)70020-8.
- Pituch, H. (2009). *Clostridium difficile* is no longer just a nosocomial infection or an infection of adults. *International Journal of Antimicrobial Agents*, 33(Suppl. 1), S42–S45.
- Saint, S., Bartoloni, A., Virgili, G., Mannelli, F., Fumagalli, S., di Martino, P., et al. (2009). Marked variability in adherence to hand hygiene: a 5-unit observational study in Tuscany. *American Journal of Infection Control*, 37, 306–310.
- Sax, H., Allegranzi, B., Chraiti, M. N., Boyce, J., Larson, E., & Pittet, D. (2009). The World Health Organization hand hygiene observation method. *American Journal of Infection Control*, 37, 827–834.
- Schweon, S. J., & Kirk, J. (2011). A realistic approach towards hand hygiene for long-term care residents and health care personnel. *American Journal of Infection Control*, 39, 336–338.
- Siegel, J. D., Rhinehart, E., Jackson, M., & Chiarello, L., & the Healthcare Infection Control Practices Advisory Committee. (2007). Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings, from <http://www.cdc.gov/ncidod/dhqp/pdf/isolation2007.pdf>.
- Steed, C., Kelly, J. W., Blackhurst, D., Boeker, S., Diller, T., Alper, P., et al. (2011). Hospital hand hygiene opportunities: where and when (HOW2)? The HOW2 Benchmark Study. *American Journal of Infection Control*, 39, 19–26.
- von Renesse, A., Schildgen, O., Klinkenberg, D., Muller, A., von Moers, A., & Simon, A. (2009). Respiratory syncytial virus infection in children admitted to hospital but ventilated mechanically for other reasons. *Journal of Medical Virology*, 81, 160–166.
- World Health Organization (2009a). Guidelines for Hand Hygiene in Health Care. Retrieved from [http://whqlibdoc.who.int/publications/2009/9789241597906\\_eng.pdf](http://whqlibdoc.who.int/publications/2009/9789241597906_eng.pdf).
- World Health Organization (2009b). Clean care is safer care. Tools for evaluation and feedback: Observation Form (revised August 2009). Retrieved August 24, 2011, from [http://www.who.int/gpsc/5may/tools/evaluation\\_feedback/en/index.html](http://www.who.int/gpsc/5may/tools/evaluation_feedback/en/index.html).