Improving hospital staff compliance with environmental cleaning behavior

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Reducing the incidence of healthcare-associated infections requires proper environmental cleanliness of frequently touched objects within the hospital environment. An intervention was launched in June 2012 and repeated in February 2013 and August 2013 to increase hospital room cleanliness with repeated education and training of nursing and environmental services staff to reduce healthcare-associated infections at Cook Children's Medical Center. Random rooms were tested, staff were trained about proper cleaning, rooms were retested for surface cleanliness, and preintervention and postintervention values were compared. The percentage of cleaned surfaces improved incrementally between the three trials—with values of 20%, 49%, and 82%—showing that repeat training favorably changed behavior in the staff ($P = 0.007$). During the study period, during which other infection control interventions were also introduced, there was a decline from 0.27 to 0.21 per 1000 patient days for *Clostridium difficile* infection, 0.43 to 0.21 per 1000 patient days for ventilator-associated infections, 1.8% to 1.2% for surgical site infections, and 1.2 to 0.7 per 1000 central venous line days for central line–associated bloodstream infections.

The Centers for Disease Control and Prevention (CDC) estimated that in 2002, healthcare-associated infections (HAIs) contributed to 1.7 million infections and 99,000 deaths; 33,269 infections were in high-risk newborns, 19,059 in well-baby nurseries, 417,946 among adults and children in intensive care units, and 1,266,851 in adults and children outside of intensive care units. The overall annual direct medical costs of HAIs to US hospitals ranges from a low of $28.4 billion to a high of $45 billion (after adjusting to 2007 dollars using the Consumer Price Index for inpatient hospital services) (1–4). Prevention of HAIs could save an estimated $5.7 to a high of $31.5 billion in inpatient hospital services. For this reason, HAIs have been identified by the US Department of Health and Human Services as a top priority for cost reduction. Over 11,500 healthcare facilities in all 50 states use the CDC's National Healthcare Safety Network to track HAIs. Thirty states and the District of Columbia require reporting of HAIs using this network (1).

The CDC has documented that HAIs are caused by many pathogenic organisms present on floors, bedding, mops, and furniture in the hospital environment (1, 2, 5–8)—what the CDC has called "high-touch points/objects" (HTOs). Through clinicians' hands and the environment, patients may be exposed to pathogenic bacteria such as methicillin-resistant *Staphylococcus aureus* (MRSA) and enterococcus (6, 7, 9, 10). Several studies have documented the importance of cleaning and disinfecting and its impact in preventing transmission of pathogens from the environment to providers and patients in a broad range of US healthcare settings (2). This study evaluated whether training interventions would be effective in changing the behavior in nurses and environmental services (EVS) staff in cleaning patient rooms after discharge. Baseline results suggested that several interventions were needed. The ultimate goal was to decrease the rate of HAIs.

METHODS

This research was considered a quality improvement project and so was exempt from review by the institutional review board at Cook Children's Hospital. After patients were discharged from their rooms, a public health student entered random rooms on the medical and surgical floors and lightly swabbed HTOs with clear Glo Germ gel before EVS staff or nurses performed routine cleaning duties in each room. The staff was blinded with respect to which rooms were going to be sampled for inclusion in the study. HTOs were marked with a fluorescent marking gel (invisible to the naked eye) evaluated with ultraviolet blue light and then interpreted with Ecolab Recording software after the patients were discharged from the rooms and before the staff came to clean. After the cleaning, the HTOs were evaluated with blue light. If the gel mark was completely wiped off, then the cleaning was recorded as pass. If any surface gel was still present, then the cleaning was recoded as fail. For trial 1, 747 random HTOs were sampled; for trial 2, 1322; and for trial 3, 2188. The percentage of clean surfaces was calculated. This procedure was completed in June 2012,

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February 2013, and August 2013, following training for nurses and EVS staff on infection control principles, HTOs, and methods for environmental cleaning and disinfecting.

Data were collected before and after the intervention for each of the three evaluation periods. Statistical analysis was performed offsite using an independent sample *t* test to compare the pre- and postintervention means of surfaces cleaned. Pearson's chi-square test was used to determine if there was a relationship between the cleaning and training for each HTO object individually. The overall percentage of cleaned surfaces was compared among the three evaluation periods, and the overall percentage of cleaned surfaces was compared by buildings and floor levels. The goal was to evaluate the relationship between interventions and cleaning behavior from trial to trial. The significance level was set at $P = 0.05$.

RESULTS

The *Table* and *Figure* show the proportion of surfaces cleaned before and after the intervention for each of the three periods. Overall, the proportion of surfaces cleaned increased incrementally from 20% in June 2012 to 49% in February 2013 and 81% in August 2013 ($P = 0.007$, df 25). In the third trial in August 2013, when some preintervention values were already improved based on prior and ongoing training, there were still significant improvements for three HTOs—the toilet seat, flush handle, and bedpan ($P = 0.03$, 0.003, and 0.027, respectively).

DISCUSSION

An important component to reducing the incidence of HAIs is getting buy-in from the staff to address the importance of labor-intensive cleaning of HTOs (9–12). This study shows that ongoing training followed by blinded monitoring with transparent reporting of the results in a positive, engaging manner will motivate staff to improve cleaning behavior. Intense strategies to reduce HAIs were ongoing in the hospital during the period from June 2012 to August 2013; therefore, it is not surprising that the overall rate of HAIs decreased substantially. During the study period, there was a decline from 0.27 to 0.21 per 1000 patient days for *Clostridium difficile* infection, 0.43 to 0.21 per 1000 patient days for ventilator-associated infections, 1.8% to 1.2% for surgical site infections, and 1.2 to 0.7 per 1000 central venous line days for central line–associated bloodstream infections. Other strategies to reduce HAIs were implemented during the same time period to increase healthcare providers' awareness of hand washing during procedures and to supply them with better kits for line-changing procedures. What portion of the

Table. Percentage of high-touch objects cleaned before and after three training interventions

	June 2012			February 2013			August 2013		
High-touch room surfaces	Surfaces tested (n)	Surfaces cleaned (n)	Surfaces cleaned (%)	Surfaces tested (n)	Surfaces cleaned (n)	Surfaces cleaned (%)	Surfaces tested (n)	Surfaces cleaned (n)	Surfaces cleaned (%)
Bed rail	44	18	41.0	43	21	49	132*	83	63
TV control	22	1	4.5	20	15	75	71	50	70
Tray table	24	21	88	24	15	63	99	92	93
IV pole (grab area)	19	2	11	19	10	53	99	70	71
Nurse call button	28	5	18	20	12	60	120*	83	69
Bed angle button	28	4	14	28	14	50	39	27	70
Telephone	23	16	70	23	19	83	108	67	62
Bedside table handle	26	3	12	26	10	38	83	58	70
Game controller side	42	10	24	40	22	55	143	100	70
Cubby handle	48	5	10	48	23	58	131*	92	71
Chair arm	82	17	21	78	42	54	176	100	57
Chair headrest	39	5	13	32	9	28	99	58	59
Diaper scale top	15	5	33	15	5	33	91	78	86
Diaper scale button	21	3	14	19	10	53	246*	192	78
Light switch	58	3	5	58	21	36	119	75	63
Door knob	47	2	4	42	17	40	104*	75	72
Computer mouse	25	1	4	25	14	56	37	28	75
Computer table	25	7	28	25	13	52	32	30	93
Computer keyboard	24	2	8	24	8	33	56	50	90
Computer pull-out tray	18	0	0	18	8	44	34	27	80
Total	658	130	20%	627	308	49%	1900	1435	76%

*Grouped data

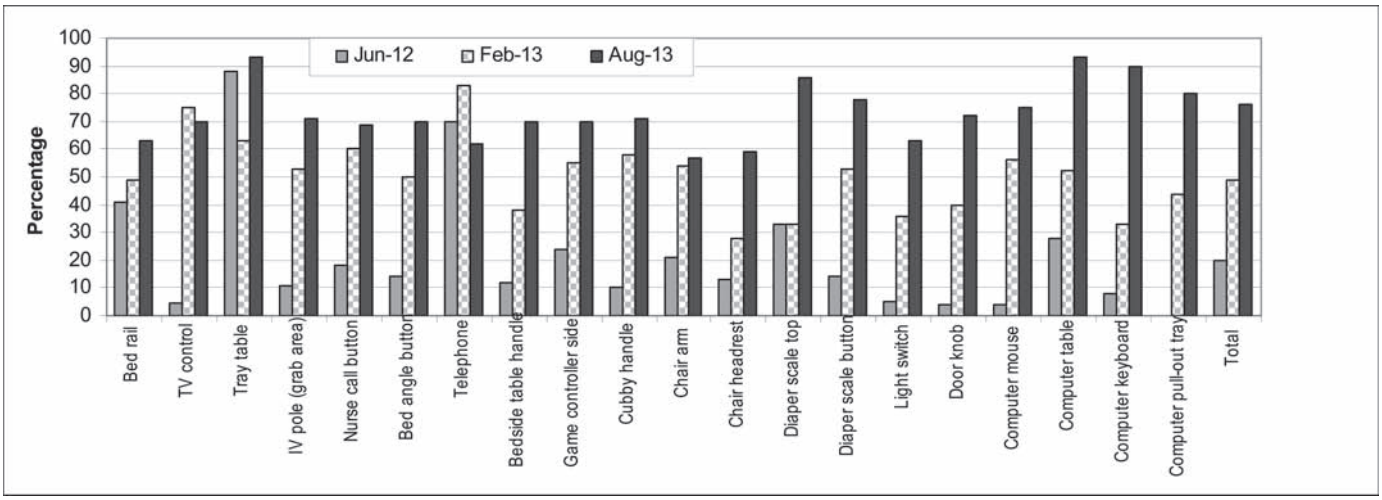

Figure. Percentage of high-touch objects cleaned after a training intervention for the three trial periods.

decrease in HAIs was due to environmental cleaning is difficult to calculate; however, decreasing the contribution of pathogens from the environment surely had an impact, as established by the CDC and various studies. Current accomplishments in HAI eradication have been encouraging, but much more needs to be done to promote the elimination of HAIs due to environmental contamination (13–24).

Other studies have also shown that targeted efforts to reduce HAIs, including environmental cleaning, can have significant results. The Jewish Hospital (Mercy Health) in Cincinnati, Ohio, formed a multidisciplinary task force that included physicians, nurses, pharmacists, experts, administrators, and EVS staff. The group concentrated on standardization of clinical care, broad-spectrum antibiotic use, and environmental cleaning to reduce the rate of *C. difficile* (primarily in the older population) from 25.27 per 10,000 to 3.08 per 10,000 in less than 2 years. The emphasis on environmental cleaning had an instant effect on *C. difficile* rates. The EVS staff changed curtains during cleaning of rooms, cleaned bathrooms twice daily, used bleach, used soap and water for handwashing instead of alcohol gel products, and used laundry sanitizer to kill bacteria on microfiber mop strips and clothes. They also used a real-time adenosine triphosphate to detect any residual left behind after the room was cleaned, which provided quick feedback that helped with effectively cleaning HTOs after patient discharge (25).

Commonly, the focus of infection control is to prevent provider or patient-to-patient transmission of infectious microorganisms. A presentation at the annual meeting of the Association of Operative Registered Nurses reported on a study conducted in 79 operating rooms across five hospitals showing that best practices, accurate products and tools, an unbiased environmental monitoring tool, and timely staff feedback advance the value of disinfection cleaning (24). Successful strategies to control HAIs have been used in Colorado, Florida, Wisconsin, Oregon, and Minnesota to reduce infections with carbapenem-resistant Enterobacteriaceae with increased surveillance, increased antibiotic stewardship, and isolation precautions. Tennessee and Colorado have reduced infections in central line–associated bloodstream infections through increased training and guidance, improved data collection, improved communication during transfer of patients between facilities, and improved tracking. Massachusetts, New York, and Illinois have reduced the rate of infections with *C. difficile* by having statewide full-day regional workshops and using uniform measurement and reporting tools. Improvements are patient focused, and sampling of the environment is rarely mentioned (1). The participation of the entire hospital staff and the use of constructive methods to approach staff are critical for the success of these public health achievements (1, 8, 14, 15, 19–22, 26).

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