Clostridium Difficile

Reducing infections using an evidence-based practice initiative

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BACKGROUND: Nosocomial *Clostridium difficile* (*C. difficile*) infections are adverse incidents that affect immunocompromised hospitalized patients. High-touch surface areas within the patient's environment are frequently overlooked and are a source of microscopic bacterial transmission.

OBJECTIVES: This article examines whether the use of a standardized protocol for cleaning high-touch surface areas would reduce the incidence of hospital-acquired *C. difficile* infection.

METHODS: Based on a review of the literature, the initiative targeted five high-touch surfaces, and nurses were educated about these findings. Baseline data on the *C. difficile* infection rate was collected from four specialty medical-surgical oncology units. A pilot period of the Five by Five initiative evaluated *C. difficile* infection rates after staff cleaning of these high-touch surfaces.

FINDINGS: This initiative accounted for a statistically significant reduction in *C. difficile* infections. The use of a standardized cleaning initiative was effective in reducing *C. difficile* infections. Nursing staff perceived that the education was easy to remember and supported efficient implementation.

KEYWORDS
nosocomial; *Clostridium difficile*; high-touch areas; evidence-based practice

EACH YEAR, ABOUT 500,000 AMERICANS DEVELOP a *Clostridium difficile* (*C. difficile*) infection, with 29,000 of these infections resulting in death within 30 days of diagnosis (Centers for Disease Control and Prevention [CDC], 2015). The CDC (2015) report that *C. difficile* infections are preventable. However, in the hospital setting, even with isolation precautions, high-touch surfaces around the patient can transmit bacteria to him or her (Louh et al., 2017; Sattar & Maillard, 2013). A preventive approach used by nursing and hospital staff is the frequent cleaning of highly contaminated hard surfaces. This cleaning, in addition to excellent hand hygiene, has been shown to be an effective intervention for reducing bacterial transmission (CDC, 2015).

Preventing nosocomial *C. difficile* infection in immunocompromised populations, including patients with cancer and patients undergoing transplantation, is a significant safety concern for nurses in clinical practice. Infection prevention is of particular interest in the cleaning of the occupied room of the immunocompromised patient. Immunosuppression from cancer treatment increases the risk of infection in patients, and *C. difficile* infection is a particularly serious risk for these patients. *C. difficile* can cause severe pain, dehydration, reduced nutrition, isolation, and increased hospital length of stay and costs (Bhandari et al., 2018; CDC, 2015; Ran-Castillo et al., 2019; Talbot et al., 2019).

At the authors' institution, Loma Linda University Medical Center in California, a nurse-led shared governance council consisting of acute care nurses from four inpatient specialty medical-surgical oncology units formed an evidence-based practice (EBP) team to explore an increase in hospital-acquired *C. difficile* infections during the first three quarters of 2017. The objectives of the EBP team were (a) to determine and implement best practices that would reduce the incidence of *C. difficile* infections on the four inpatient units (the units had an average of seven new *C. difficile* infections per year) and (b) to reinforce environmental service staff education regarding the impact of cleaning patient rooms and to review the seven-step daily patient room cleaning process, which includes cleaning of the patient bedside table, bed rails, telephone, and patient television/nurse call remote.

Methods

A literature review was undertaken using Academic Search Premier, CINAHL®, and PubMed® to determine best practices in the prevention of

C. difficile infections. Keywords used included the following: *high-touch*, *surface bioburden*, *wiping surfaces*, C. difficile *prevention*, and *hospital-acquired infections prevention*.

Team members used the Johns Hopkins Nursing EBP Model (Dang & Dearholt, 2017) to evaluate the level of evidence and quality of the articles used to answer the EBP question, which was as follows: In the hospitalized adult immunocompromised patient population, will more frequent cleaning of the high-touch surfaces reduce new *C. difficile* infections compared to once-daily room cleaning? The literature search yielded 18 articles. After adding the criteria of peer-reviewed articles published from 2013 to 2017, eight articles were eliminated. Three additional articles were rejected because of low levels of evidence. Seven articles were selected for this review (Adams, Smith, Watson, Robertson, & Dancer, 2017; CDC, 2015; Cheng et al., 2015; Donskey, 2013; Han et al., 2015; Sattar & Maillard, 2013; Zelikoff, Dellit, Lynch, McNamara, & Makarewicz, 2016).

Literature Review

Han et al. (2015) and Zelikoff et al. (2016) examined the cleaning of high-touch surfaces in hospital rooms. Both found that the cleaning of these surfaces is critical for reducing healthcare-associated infections. Han et al. (2015) included in their review studies examining surface contamination, colonization, and infection with *C. difficile*, methicillin-resistant *Staphylococcus aureus*, and vancomycin-resistant enterococci. They identified 80 studies (76 primary studies and 4 systematic reviews); of these, 49 examined cleaning methods, 14 evaluated monitoring strategies, and 17 addressed challenges or facilitators to implementation. However, only five studies were randomized controlled trials where surface contamination was the assessed outcome. Han et al. (2015) identified that challenges include identifying high-touch surfaces that confer the greatest risk for pathogen transmission and developing standard thresholds for defining cleanliness. Zelikoff et al. (2016) focused on the actual cleaning of patient rooms (isolation and standard) in a quality improvement project, identifying that a key first step is to accurately assess current processes to identify weaknesses and inconsistencies in cleaning practices. Although Zelikoff et al. (2016) did not find statistically significant differences between the cleaning of standard rooms and isolation rooms, they were able to identify areas where there was reduced cleaning because of isolation precautions.

In a review of 54 research studies published between 2000 and 2013, Donskey (2013) found that more frequent cleaning of high-touch areas resulted in a reduction of hospital-acquired infections; more specifically, strict terminal cleaning of isolation rooms after discharge, along with daily room cleaning with disinfectants, reduced transmission risks. However, Donskey (2013) also identified other interventions that yielded a more significant reduction in contamination, particularly in occupied beds (e.g., daily disinfecting of high-touch surfaces and portable equipment, improved cleaning of non-isolation rooms). Disinfectants used in the studies examined by Donskey (2013) all contained hypochlorite, which provides the best disinfection, particularly for *C. difficile* isolation rooms (Donskey, 2013).

"Protecting the immunocompromised patient with cancer from preventable infection is the job of every healthcare professional."

Sattar and Maillard (2013) examined 44 studies from 2005 to 2013 that evaluated the ability of different types of disposable towelettes to hold and release disinfectant onto surfaces, as well as their capacity to pick up, carry, and remove soil and microbes. The authors found that the towelettes reduced pathogens through chemical methods (disinfectants kill germs) and mechanical methods (individuals physically wipe germs from a surface and transfer them to the trash) (Sattar & Maillard, 2013). In addition, the disinfectant dwell time (the length of time the disinfectant must remain in contact with the surface and be wet to achieve the advertised rate) and the cleaned area's surface integrity (the intactness of the surface) were factors in reducing the bioburden, or the amount of pathogens on the high-touch surface (Sattar & Maillard, 2013).

Adams et al. (2017) and Cheng et al. (2015) further explored the cleaning of high-touch sites, which consist of both bed rails, the bed table, the patient's body, the bed linen, the curtain, the bed frame, the control panels of the IV infusion pump, and the blood pressure cuff (Adams et al., 2017; Cheng et al., 2015). Adams et al. (2017) identified a direct statistically significant correlation ($p = 0.005$) between hand-touch frequency and gross contamination of the high-touch areas. This finding reinforced the concept that areas of the patient environment that nurses frequently touch are also areas of high contamination. Frequent contact with these areas can lead to cross-contamination of items or other areas if proper cleaning does not occur. Cheng et al. (2015) determined that nursing staff performed about 75% of the high-touch contacts and reported their surprise at the higher-than-expected contributions of family and visitors, who contributed about 10% of the high-touch contacts.

Initiative

After assessing current organizational practices, policies, and infection rates, as well as findings from the literature review, the EBP team determined that a practice change was needed to reduce the risk of *C. difficile* for immunocompromised patients (Han et al., 2015). Consequently, EBP team members created the Five by Five initiative.

Procedure

Prior to the Five by Five initiative, environmental services staff would clean each patient's room once in a 24-hour period using a seven-step process:

- Empty all waste and linen containers.
- Dust all fixtures, ledges, and surfaces in the room and in the bathroom. Begin at the door and work clockwise around the room.
- Using a two-step clean-and-disinfect process, first remove any adhesive, then damp dust all high-touch surfaces, horizontal surfaces, spots on walls, and cabinets.
- Dust mop room.
- Clean bathroom.
- Damp mop room.
- Inspect room for cleanliness, and restock dispensers.

Staff also were responsible for cleaning four of the five high-touch areas in the patient's environment: the bedside table, bed rails, telephone, and patient television/nurse call remote. Because of institutional restrictions on the type of equipment that environmental services staff can clean, clinical staff were responsible for cleaning the stationary physiologic monitor and cords, as well as the IV pump and poles in each patient room. The EBP team identified variability in depth of daily room cleaning; the initial cleaning assessment noted mixed understanding of the daily cleaning requirements. As a result, some environmental services staff were only cleaning the bathroom and floors and removing trash and linens instead of cleaning the high-touch areas.

For the Five by Five initiative, the EBP team chose to limit the fields to be cleaned to the five most frequently hand-touched surfaces: the bedside table, bed rails, telephone, patient television/nurse call remote, and IV pump and pole. The name of the initiative represents wiping down the five high-touch areas by 5 am or 5 pm (day shift versus night shift). Once a staff member completed this cleaning, he or she was to sign a documentation sheet on the door. The sheets also were intended to serve as a reminder to nursing staff to perform the cleaning during each shift. Each sign-off sheet included an image of a red hand with the five high-touch areas listed on the fingers as an additional reminder.

Before initiating staff education, preimplementation data were obtained. This involved invisibly and temporarily marking the five high-touch areas on each unit (five to six rooms) using an ultraviolet pen, then assessing these markings with a black light 24 hours later to determine if cleaning had taken place. Initial data showed that almost all of the markings were still present the next day with no visible cleaning.

The EBP team and the institution's nurse epidemiologist determined that using multichemical disinfectant or accelerated hydrogen peroxide towelettes with a wet time of one minute would provide the decontamination needed for bioburden reduction of *C. difficile* and other bacteria (Han et al., 2015). The use of sodium hypochlorite, or bleach, towelettes to decontaminate glucometers and other removable items from *C. difficile* isolation rooms is required, but the staff members were not to use the bleach towelettes on an occupied bed because the odor can cause respiratory distress in the patient (Zelikoff et al., 2016).

In addition to reducing the bioburden, the Five by Five initiative was intended to include patient and visitor education about hand hygiene. Included in this education was patient hand hygiene, performed before touching the mouth, eating, taking oral medications, and brushing the teeth and after using the restroom (Association of California Nurse Leaders, 2017). Hand hygiene consisted of washing with soap and water or using a hand sanitizer gel or foam (Cheng et al., 2015). Staff provided gel hand sanitizer to oriented patients (patients who know who they are, where they are, the time, the date, and why they are in the hospital) to keep on the bedside table for easy access. All visitors were encouraged to perform hand hygiene before entering and while leaving the patient's room. Cheng et al. (2015) found that instructing the family in proper hand hygiene reduced the transmission of bacteria to and from other surfaces throughout the hospital.

Staff provided an education sheet to visitors of isolated patients, which listed steps to stop the spread of germs including *C. difficile*. Although hand sanitizer is acceptable for standard precautions, hand washing with soap and water is required for confirmed *C. difficile* rooms.

Education

Staff education commenced in October 2017 and initially was offered during start-of-shift huddles and via online education. The EBP team provided this education to coworkers via a one-page informational sheet that described the reasons why this intervention was necessary; also noted was how the Five by Five initiative would make a difference to patients and demonstrate caring.

Peer-to-peer communication was found to be most effective in educating staff. EBP team members provided education at nursing staff meetings; this included a report on findings of monthly infection rates and staff documentation of cleaning, as well as clarification concerning the five high-touch areas, the disinfectant towelettes to use, and why the sodium hypochlorite towelettes should not be used on an occupied bed.

TABLE 1.
MONTHLY ADHERENCE TO FIVE BY FIVE INITIATIVE

MONTH/YEAR	UNIT A (%)	UNIT B (%)	UNIT C (%)	UNIT D (%)
11/2017	35	92	43	47
12/2017	43	88	45	59
1/2018	60	84	42	62
2/2018	63	74	46	52
3/2018	65	77	49	56
4/2018	59	69	44	44
5/2018	53	67	43	50
6/2018	61	65	31	44
7/2018	58	67	42	60
8/2018	59	64	42	67
9/2018	45	65	36	44
10/2018	42	69	46	51

Note. Adherence is documention of the completed Five by Five initiative and was measured by manually counting the number of staff (nurses and patient care assistants) signatures on the sign-off sheets posted on patients' doors. Each sign-off sheet contained a month's worth of documentation. The number of signatures per shift, per patient, per month was tracked. Participating units were one 15-bed surgical transplantation unit (unit A) and three 26-bed medical-surgical oncology units (units B, C, and D); all units provided care to immunocompromised patients.

Implementation

The Five by Five initiative began on November 1, 2017, and involved one 15-bed surgical transplantation unit (unit A) and three 26-bed medical-surgical oncology units (units B, C, and D). All units provide care for immunocompromised patients. Nurses and patient care assistants performed the Five by Five initiative and documented their efforts using the sign-off sheet posted on each patient's door; each sheet contained a month's worth of documentation.

Markings via ultraviolet pen were done and assessed monthly, with staff feedback and education based on these findings occurring at start-of-shift huddles. This cleaning efficacy assessment combined with the sign-off sheet information and the *C. difficile* rate provided the outcome data. Data were collected from November 2017 to October 2018. Data collected during initiative implementation were compared to data collected preimplementation, from September 2016 to October 2017. The pilot period was from November 2017 to July 2018. The post-pilot period was from August to October 2018; this period was included so that data would span one year. Using IBM SPSS Statistics, version 24.0, paired t tests and analysis of variance were used to analyze unit *C. difficile* infection rates before and after initiative implementation.

Results

The data showed a reduction in *C. difficile* infections. Units varied in adherence efforts as well as in outcomes, but all units reflected a decline in *C. difficile* rates. The EBP team chose not to monitor the efficacy of patient and visitor education regarding hand hygiene.

The reduction in *C. difficile* infections for unit A and unit D, both with immunocompromised populations, was found to be statistically significant ($p < 0.025$). The reductions in *C. difficile* infections for the three medical-surgical oncology units and for all four units were also found to be statistically significant ($p < 0.02$ and $p < 0.006$, respectively).

Overall, the night shift data showed the highest rate of documentation of surface cleaning (60% for the night shift compared to 39% for the day shift). Unit C had lower adherence to the Five by Five initiative than the other three units. The nursing assistants on unit B completed the Five by Five initiative for both shifts on every bed; as a result, unit B consistently had the highest average adherence to surface cleaning (73%) during the 12-month study period, which shows how engagement makes a difference (see Table 1).

Overall, each unit showed a decrease in *C. difficile* rates (see Table 2). Units A and B demonstrated the highest reductions in rates during the pilot period (86% and 100%, respectively, compared to 50% for unit C and 67% for unit D). Although Unit A, with an adherence rate of 54%, did achieve an 86% reduction in *C. difficile* infections, Unit B, with an adherence rate of 95%, had the steepest decline of *C. difficile* infections, with no infections reported. Even in unit C, where the adherence rate was 42%, the *C. difficile* rate dropped by 50%.

Discussion

In September 2018, after the pilot period had concluded, staff members were re-educated because of new occurrences of

TABLE 2.
CLOSTRIDIUM DIFFICILE INFECTION CASES

	TIME POINT		
HOSPITAL UNIT	PRE	PILOT	YEAR TOTAL
Unit A	7	1	4
Unit B	8	–	1
Unit C	10	5	6
Unit D	9	3	5

pre—preimplementation
Note. Preimplementation was September 2016 to October 2017. The pilot period was November 2017 to July 2018. The year total signifies November 1, 2017, to October 31, 2018, from implementation to postimplementation.

infection. Adherence monitoring via documentation of cleaning has continued and has brought *C. difficile* occurrences back to zero for the four units as of November 2018.

The Five by Five initiative was performed on only four units. The institution's *C. difficile* rate was 91 occurrences between November 2017 and October 2018. Since institution-wide rollout of the initiative, a significant reduction in *C. difficile* infection rates can be observed when compared to the same time period of the previous year (54 cases from November 2017 to May 2018 versus 35 cases from November 2018 to May 2019).

Protecting the immunocompromised patient with cancer from preventable infection is the job of every healthcare professional. Additional wiping of high-touch patient areas is critical to the inpatient population's health because it reduces the risk of infection (Donskey, 2013). Culture change, along with creativity and persistence, is necessary for implementing changes and overcoming staff engagement barriers. These barriers include current cleaning habits, availability of supplies, education of staff, and individual nurse beliefs. At a time when there are many demands on the oncology nurse's time, adding one more task may be a barrier for some.

Limitations

There were a few limitations to the Five by Five initiative. One limitation was the small test size of four units with a total of 93 beds at a single institution. Another was the intermittent availability of disinfectant towelettes; supplies were backordered, which resulted in staff not performing the intervention. In addition, at the beginning of the initiative, it was necessary to assess the equipment need (towelette holders), determine placement of the equipment, purchase the equipment, and install the equipment in each patient room for easy availability. Without the needed towelettes, staff would not have been able to perform the Five by Five initiative. The time required to look for supplies, if not readily available, could be a significant barrier to achieving the task. Also, some patients refused the cleaning that made up the Five by Five initiative because they disliked the smell of the disinfectants; because of patient refusal, daily cleaning of the high-touch areas did not take place. Another limitation was the increased use of outside staff due to a high patient census on the units; these staff members were unaware of the initiative and, therefore, did not execute the initiative during the worked shift.

Conclusion

Developing and implementing interventions to reduce and prevent *C. difficile* infection rates exemplify the nursing process of putting current evidence-based practice into action to provide excellent nursing care. Results from the Five by Five initiative show that best practice cleaning procedures can reduce the bioburden and risk of *C. difficile* infection for immunocompromised patients.

IMPLICATIONS FOR PRACTICE

- Realize that *Clostridium difficile* (*C. difficile*) infection is detrimental to patients' health and can lead to poor outcomes, particularly in immunocompromised patients.
- Frequently clean high-touch areas around the patient to reduce bioburden.
- Acknowledge that nurses make a difference in the health of patients, particularly those who are immunocompromised, by preventing *C. difficile* infections.

Use of the ultraviolet markers and black light provided a concrete method to assess cleanliness of the high-touch areas. This offered the opportunity for evaluation, intervention with feedback, and real-time education; these were key to improving patient outcomes. The awareness of the high-touch areas within the patient room environment gave insights into nursing workflow and opportunities for improvement related to increased understanding of the composition of different surfaces and the cleaning requirements of each.

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