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Best practices in disinfection of noncritical surfaces in the health care setting: Creating a bundle for success

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Because increasing evidence suggests that the environment plays a role in transmission of health care-associated infections, more attention is focusing on environmental cleaning and improving its efficacy. Creating and sustaining a successful cleaning and disinfection program should include several key components using a bundle approach and requires ongoing commitment within the institution.

Because there is a growing body of evidence that the environment plays a role in the transmission of health care-associated infections (HAIs),[1-5] more attention is being focused on environmental cleaning and ways of improving the efficacy of the cleaning process to decrease the spread of HAIs in the health care setting.[6,7] Several studies have shown that there is increased risk of acquiring a HAI for patients placed in rooms where the previous occupant was colonized or infected with a pathogenic organism.[7-10] Current guidelines recommend that health care facilities clean noncritical surfaces on a regular basis, when spills occur, and when these surfaces are visibly soiled.[11,12] However, because several studies have reported that cleaning practices are often suboptimal,[13,14] it is now recognized by the Centers for Disease Control and Prevention and professional societies that there is a need for a system for monitoring adherence to recommended cleaning practices to ensure consistent cleaning and disinfection of surfaces in patient rooms.[15] Several studies have shown that monitoring and providing feedback to the housekeeping staff can show significant improvement in their cleaning practices,[13,14] but others have demonstrated that the improvement is not always sustainable.[16] Administrative leadership and interdepartmental involvement are necessary to achieve success, and sustainability requires an ongoing commitment within the institution.

CREATING A BUNDLE FOR SUCCESS

Similar to the Institutes for Healthcare Improvement bundle models for central lines and ventilators to prevent HAIs, an evidence-based care bundle is also needed for a successful environmental cleaning and disinfection program. Key components of this bundle should include the following: policies and procedures to delineate cleaning responsibilities among staff; selection of appropriate cleaning products; determining the method of application for the products; and to educate, monitor, and give feedback to the staff. All of these elements are required to create a bundle for a successful cleaning and disinfection program.

Creating policies and procedures

The first step in creating a successful environmental cleaning program is to form a multidisciplinary task force as described by Dumigan et al.[17] The team should comprise members from administration, nursing, environmental services, infection prevention (hospital epidemiologist, infection preventionist), materials management, biomedical engineering, pharmacy, and epidemiology laboratory personnel. Every discipline that has any role in the cleaning process needs to be represented so that policies and procedures can be effectively defined. The policies need to clearly define the cleaning task, the responsible service to perform the task, the cleaning frequency, and the products to be used. Figure 1 is an example of a grid that defines these items in a cleaning policy.

Following the Spaulding definitions, which categorize levels of disinfection based on the object's intended use and risk for infection in the use of that item, noncritical surfaces in the health care setting are those that only touch intact skin, and these require

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TYPE OF CLEANING	RESPONSIBLE SERVICE	ITEMS TO BE CLEANED	PRODUCTS USED TO CLEAN	COMMENTS
COMPUTERS (excluding terminals in patients rooms)	All users NEW	1. wipe down computer keyboard and mouse	1. EPA/ICC hosp quat* or bleach wipe**	Clean after use
ROUTINE DAILY CLEANING OF PATIENT ROOM	Environmental Services	1. dust window ledge 1.spot clean furniture (chairs) 2.wipe down over-bed table 3.wipe down side rails 4.wipe down TV control 5.wipe down bathroom fixtures (faucets, grab bar, shelf, etc.) 6.clean sink and toilet 7.wipe down door handles (room and bathroom) 8.mop bathroom and patient floor 9.remove trash	1. – 9. EPA/ICC hosp quat* or 1. - 8. EPA/ICC hosp bleach wipe** for Contact CD and Enteric Precautions 9. EPA/ICC hosp quat*	10 Step daily cleaning process
TRANSFER/ DISCHARGE CLEANING OF PATIENT ROOM, AND ANY PATIENT ROOM AT NURSE'S REQUEST (WHEN ROOM IS EMPTY)	Environmental Services NEW	1. strip bed of all linen, clean bed frame, side rails, mattress NOTE: after nursing has removed all patient belongings (i.e. clothing in closets, hearing aids in bedside table or over-bed table) and nursing equipment (i.e. halter monitors, blood glucose meters, pulse oximeters) 1. clean bedside table, over bed table, phone, call bell, TV control 2. wipe down flow meters 3. wipe down regulators 4. dust/clean lighting fixtures 5. clean outside canister (clean) of suction container 6. clean and wipe down IV poles and pumps that need to remain on the unit, apply sani-strip ⌘¶ 7. wipe down furniture 8. dust all ledges 9. clean around sharps containers and glove boxes 10. wipe down step stools 11. wipe down walkers 12. wipe down canes 13. clean bedside commode, (once emptied by nursing) apply sani-strip⌘ 14. clean bathroom fixtures, sink, shower, and toilet apply sani-strip ⌘ 15. mop bathroom and patient floor 16. pull trash 17. change out privacy curtains if soiled or on request	1. - 16. EPA/ICC hosp quat* or 1-15. EPA/ICC hosp bleach wipe** for Contact CD and Enteric Precautions 16. EPA/ICC hosp quat* ¶ see cleaning instructions provided by Clinical Engineering, below ⌘ apply sani-strip, see notes below	10 Step Discharge cleaning process

Fig 1. Example of an environmental cleaning grid.

low-level disinfection. Some examples of noncritical items includes noncritical surfaces that may have contact with patients or health care providers (bedside rails, toilet, sink, overbed tables, and others), noncritical surfaces that do not have contact with patients or health care staff (ceilings, walls, window sills, and others), and medical devices (blood pressure cuffs, monitors, and others). All require low-level disinfection, and the frequency may vary. For example, noncritical surfaces need cleaning only when visibly soiled and periodically; noncritical surfaces that contact patients or health care providers should be cleaned and disinfected daily (or more frequently) and at terminal cleaning; and equipment should be disinfected between patients if shared or at least daily and at terminal cleaning.

By definition, a low-level disinfect is an agent that destroys all vegetative bacteria (except tubercule bacilli) lipid viruses, some nonlipid viruses, and some fungi but not bacterial spores on inanimate objects. There are many factors that affect the efficacy of the disinfectant including: prior cleaning of the item, whether there is any organic or inorganic substances present, the type and level of microbial contamination, the concentration and contact time of the disinfectant, the physical nature of the item, whether or not there is the presence of a biofilm, and also the temperature and pH of the environment.[12] One inconsistency in the Spaulding classification system and the definition of a low-level disinfectant is when it comes to *Clostridium difficile* (CD). One of our biggest challenges in cleaning and disinfecting the environment is to remove CD spores to prevent the transmission of this organism to other patients. In the case of CD, it is necessary for the CD spores to be physically removed from surfaces or inactivated by the use of a sporicidal germicide.

Table 1
Desired disinfectant characteristics

Function	Safety
Broad-spectrum antimicrobial efficacy	Low toxicity to humans
Short contact time	Nonallergenic and nonsensitizing
Good cleaner	Nonhormone disrupting
Compatible with materials	Environmentally sound
Noncorrosive	Low volatile organic compounds
Long shelf life	Safe to transport
	Safe and easy to store

Selection of cleaning products

Selection of the cleaning products should include a review of the current cleaning agents and disinfectants used within your institution. Guidelines have outlined environmental disinfection protocols that include routine cleaning and disinfection of environmental surfaces with a US Environmental Protection Agency-registered, hospital-grade disinfectant.[11,12] Common products include quaternary ammonium compounds, sodium hypochlorite, phenolics, and hydrogen peroxide. All products have pros and cons for use, but it is of utmost importance to use the product following manufacturer's recommendations for use on certain surfaces and for the correct use dilution. Some characteristics to consider when choosing the appropriate disinfectant are listed in Table 1.

Table 2
Advantages and disadvantages for methods for accessing cleaning practices

Method	Advantages	Disadvantages
Visual inspection	Simple Inexpensive	Not reliable measure of cleanliness
Aerobic colony counts	Relatively simple Can detect presence of pathogens	More expensive Results not available for 48 hrs later Requires the use of a microbiology lab
Fluorescent marker system	Inexpensive Minimal equipment needed Can improve practices	Must covertly mark surfaces before cleaning and check them after cleaning with a UV light
ATP bioluminescence assay systems	Provides quantitative measure of cleanliness Quick results Can improve practices	More expensive Requires purchase of a luminometer Requires purchase of swabs

Determining method of application

After determining the products to be used and developing guidelines for when to use various agents, the method of application needs to be defined. These products can be applied with cotton cloths, microfiber cloths, or disposable wipes. The disinfectant may be sprayed, wiped, or applied with a saturated cloth. The application process may be determined by a facility's capability of laundering within the facility or contracting with an outside vendor or by budget constraints. Regardless of the method of application to be used, the most important factor is that the disinfectant be applied liberally enough to achieve sufficient wetness to ensure that the correct disinfectant contact time is being achieved.

Education

The next step in the process is to educate the environmental services personnel. There is an enormous amount of information that they must be given to perform their tasks effectively. They must be educated on the items that they are required to clean, the frequency of which they are to be cleaned, the order in which to clean the items, the products to be used, the concentration of the products, and the correct contact time to achieve cleaning. Boyce et al[18] describe the variations in cleaning practices, such as the time spent cleaning surfaces, the order in which items were cleaned, and how many disposable wipes were used per room when a standardized policy is not defined. Housekeepers also need to be aware of the personal protection equipment required to protect themselves from the chemicals they are using and the role of the environment in disease transmission. It is also important to emphasize that they are part of a team and that their role is crucial in a successful cleaning and disinfection program.

A study by Guerrero et al[19] demonstrated the effect that managers have in achieving adequate cleaning with various levels of interaction with their staff. They cultured 3 items for CD that included the tables, bedrails, and drawer handles after housekeeping cleaning was performed with bleach, while the housekeeper was either unobserved, observed, or supervised. They demonstrated that the percentage of cultures that were positive for CD significantly decreased when the housekeepers were being observed versus unobserved and even more so when they were being supervised, thus confirming that sustainability requires an ongoing commitment within the institution.

Monitoring

It is now recommended by the Centers for Disease Control and Prevention, Society for Healthcare Epidemiology of America, Infectious Disease Society of America, Association for Professionals in Infection Control and Epidemiology, Inc, and other professional associations that facilities monitor their cleaning practices to ensure the adequacy of their cleaning practices.[12] Four current methods available to monitor cleaning practices include visual inspection, aerobic colony counts, fluorescent marker systems, and adenosine triphosphate (ATP) bioluminescence assays. Although visual inspection is still the most widely used, it has been shown to be an inaccurate assessment of cleaning efficacy when compared with other methods.[20,21] Aerobic colony counts can provide the level of bacterial contamination and can identify pathogens if necessary, although results are not available for 48 to 72 hours and require the use of a microbiology laboratory. Fluorescent markers systems provide an inexpensive means of monitoring whether certain surfaces have been wiped by the housekeepers. This method provides a qualitative result and requires the surface to be marked before cleaning and observed with ultraviolet light (UVL) after cleaning has been performed. ATP provides a quantitative measurement of organic substances present on the surfaces sampled, and results are expressed as relative light units (RLUs). This system requires the purchase of a luminometer and swabs, but results are available within seconds to allow immediate feedback to environmental services personnel (Table 2).

Providing feedback

After monitoring of cleaning practices, providing feedback to the staff is an essential element in a successful cleaning program and has been shown to significantly improve cleaning practices. Boyce et al[14] showed significant improvement in daily cleaning practices with the use of ATP, in a 2 phase, prospective interventional study. In phase I, 5 high-touch surfaces were sampled before and after daily cleaning in 20 patient rooms without the housekeeper being notified. Feedback and reeducation was provided on their cleaning practices at the completion of phase I. In phase II, the same 5 high-touch surface in 105 patient rooms were sampled, before and after cleaning, and this time the housekeepers were notified that sampling the rooms would occur immediately after they were finished cleaning. Surfaces sampled were significantly cleaner after daily cleaning in phase II than in phase I, except for the toilets, which were adequately cleaned in phase I (Fig 2). This clearly demonstrates the positive effect of the feedback given to the staff after phase I, which led to significant improvement of the cleaning practices of the staff.

Similarly, Carling et al[22] demonstrated significant improvement in cleaning practices after providing feedback of results using a fluorescent marker system in a prospective quasiexperimental, before-after study, in 36 acute care hospitals. Of 20,646 standardized environmental surfaces that included 14 types of objects, only 9,910 (48%) were cleaned at baseline. After interventions and performance feedback to the environmental services staff, 7,287 (77%) of 9,464 standardized environmental surfaces were cleaned ($P < .001$).

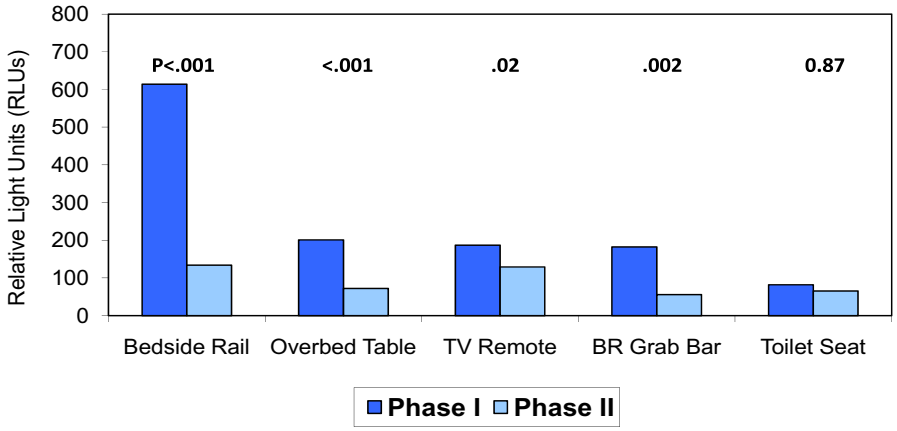

Fig 2. Median relative light units (RLUs) for 5 sites for phase I and phase II.

Not only should you be monitoring the cleaning practices of your environmental services personnel, but you also need to be monitoring items that have been designated to be cleaned by nursing services. Such examples include rolling mobile vital signs carts and glucometers. Havill et al[23] used ATP to access the cleanliness of all rolling vital signs carts, which are used to take patients' vital signs and are rolled from one patient bed to the next. The policy states that these should be cleaned by the nursing staff in between each use. In this study, 5 distinct surfaces were sampled on all devices from all of the medical and surgical wards in the institution. Surfaces sampled included the control buttons on the front of the device, the electronic thermometer, the blood pressure cuff, the top of the machine handle, and the pulse oximeter. The median ATP RLU values for each of the 5 sites was calculated, and only the control buttons had a median result that was less than a proposed "clean" cut-off value of 250 RLUs[24] (Table 3). The thermometer, the blood pressure cuff, and the machine handle all had medians that fell between 250 and 500 RLUs, but the pulse oximeter had a median result of close to 1,200 RLUs, which is more than 4 times greater than the "clean" standard of 250 RLUs. As pulse oximeters are placed on the patient's finger, any contamination on that finger is then being transferred directly onto pulse oximeter and again directly transferred to the finger of the next patient. It becomes clear how important it is to ensure that this equipment is being cleaned between each patient use. It must be emphasized that the cut-off of <250 RLUs has not been validated because there has not been a study that demonstrated <250 RLUs is associated with a reduction in HAIs; thus, it is unclear whether we should use a lower or higher cut-off value. Regardless of the actual cut-off value used, it is clear that, in this case of these mobile vital signs carts, feedback and education to the nursing staff are warranted.

No-touch room decontamination

Additionally, no-touch room decontamination devices such as hydrogen peroxide vapor (HPV) or ultraviolet light (UVL) are available to supplement cleaning practices. The fact that several investigators have shown that cleaning practices are often suboptimal[13,14] and that improvements made through education and feedback are often not sustainable[16] has led us to these new technologies. Their advantage is they eliminate human factors such as relying on an operator to ensure that all surfaces are disinfected adequately. It has been demonstrated that surfaces cleaned multiple times with bleach still may not sufficiently remove all of the contamination.[25,26] Several studies have demonstrated the effectiveness of UVL on surface microbial contamination.[27,28] Boyce et al[29] demonstrated the effectiveness of HPV on surface microbial contamination but also showed a reduction in the transmission of CD after the introduction of HPV room decontamination. Multiple studies have proven the efficacy of these no-touch room decontamination systems and that they may be more reliable in reducing transmission and acquisition of pathogens, and therefore these technologies should be considered for use in the health care setting.

Table 3
Adenosine triphosphate readings from 5 sites sampled from 101 portable medical units and the percentage of readings <250 RLU

Site sampled	Median RLU value (range)	Percent < 250 RLU value
Control buttons (n = 58)	86 (14-1,532)	76
Thermometer (n = 44)	346 (23-5,340)	39
Blood pressure cuff (n = 79)	477 (42-31,877)	24
Machine handle (n = 54)	480 (42-31,877)	24
Pulse oximeter (n = 65)	1,208 (59-27,297)	22

RLU, Relative light unit.

CONCLUSION

There is compelling evidence that the environment plays a role in transmission of HAIs, and therefore more attention is being focused on environmental cleaning and improving the efficacy of cleaning practices. Key components using a bundle approach to create and sustain a successful cleaning and disinfection program should include written policies and procedures, selecting the appropriate cleaners and disinfectants, selecting the method of application of the products, education of the staff, monitoring cleaning practices, and providing feedback to the environmental service personnel. Sustaining a successful cleaning and disinfection program requires ongoing commitment within the institution to effectively decrease the spread of HAIs from environmental contamination.

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