Clean Hospitals: More Than Just Clean Hands!

MRSA, VRE and Clostridium difficile can survive on environmental surfaces for weeks or months. Surfaces contaminated with these organisms can result in nosocomial infections by two mechanisms: 1) the hands or gloves of healthcare workers (HCWs) can become contaminated via inanimate (environmental) contact and thus lead to the indirect transmission of infection and 2) these organisms can be acquired by patients directly from the environment.

The extent to which contaminated hospital surfaces account for hospital-acquired infections has not been well established. In other words it is often impossible to prove how individual patients acquired their nosocomial infections. However, new evidence from recent research studies suggests that improved hospital cleaning and disinfection practices can reduce transmission of several hospital-acquired pathogens. This month’s newsletter critically examines this evidence; specifically whether improvements in hospital cleaning and disinfection can reduce hospital-acquired infections caused by three pathogens: MRSA, VRE and C. difficile.

MRSA

MRSA can remain viable for up to 14 days on surfaces and for up to nine weeks on cotton blanket material. Studies have demonstrated that a variety of surfaces in the rooms of colonized patients can become contaminated with MRSA. These surfaces include bed rails, blood pressure cuffs, television remote control devices, bedside tables, toilet seats, toilet rails, dressers, door handles and intravenous pumps. One published report describes an MRSA infection in an outpatient clinic healthcare worker who did not have direct contact with patients. The pulsed field gel electrophoresis (PFGE) profile of the infecting isolate was identical to that of isolates obtained from a computer keyboard, pulse oximeter, patient examination table and multiple patient chairs in the outpatient clinic, suggesting that the isolate was acquired by the healthcare worker directly from the environment. Other studies have demonstrated that MRSA can be transmitted from contaminated surfaces to the hands or gloves of healthcare workers. In one study, 42% of nurses contaminated their gloves by touching objects in the room of patients with MRSA without having touched the patient. Another study showed that 31% of volunteers who touched bedrails and over-bed tables contaminated their hands with S. aureus (35% MRSA). In contrast, only 7% of volunteers contaminated their hands with S. aureus following terminal cleaning.

Specific examples of environmental contamination with MRSA leading to outbreaks include contaminated ultrasonic nebulizers and ventilation grills. Resolution of these outbreaks occurred following appropriate cleaning of the contaminated equipment.
VRE

VRE can survive for up to two months on countertops, seven days on fabric chairs and up to three months or more on cloth, plastic and dry polyvinyl chloride surfaces\(^1\). Environmental contamination with VRE occurs commonly in the rooms of colonized patients. Diarrhea and bowel incontinence increase the risk of environmental contamination with VRE. For example, VRE was recovered from 46% of environmental cultures obtained from surfaces in the rooms of colonized patients with diarrhea compared to 15% of cultures obtained from the rooms of colonized patients without diarrhea in one study\(^10\). In another study, between 36% and 58% of chairs and couches used by VRE colonized patients in outpatient settings were contaminated with VRE\(^11\).

Transmission of VRE from environmental surfaces to the hands or gloves of healthcare workers has been well documented. Forty-six percent of healthcare workers who touched bedrails and bedside tables in rooms of colonized patients in turn contaminated their gloves with VRE in one study\(^6\). Another study demonstrated that gloves or hands contaminated through contact with contaminated environmental surfaces can transfer VRE to approximately 10% of uncontaminated surfaces that are subsequently touched by the healthcare worker\(^12\). Although difficult to prove, it is also likely that VRE in the environment can be the source of hand or glove transmission when environmentally contaminated gloves or hands touch subsequent patients—even if they previously did not directly touch a patient with VRE colonization or infection.

Direct transmission of VRE to patients from the environment has also been described. For example, several outbreaks caused by transmission of VRE from contaminated medical equipment have been reported. Implicated medical equipment included rectal thermometers, tympanic thermometers and contaminated EKG leads\(^13, 14, 15\). Environmental surfaces are also a potential source of VRE. Also a single retrospective case control study demonstrated that occupation of a room contaminated with VRE was an independent risk factor for VRE acquisition\(^16\). In view of the data discussed above, this is not at all surprising.

Removal of contaminated equipment and enhanced environmental cleaning have been associated with resolution of outbreaks and reduced transmission of VRE. A prospective quasi-experimental study showed that improved environmental cleaning significantly reduced the rate of VRE acquisition in a medical ICU\(^17\). This study was divided into four phases; a baseline period, a period including education to improve cleaning practices, a “washout” period and a period including a multimodal hand hygiene initiative. Patients were screened for VRE on admission to ICU and daily thereafter. Enhanced cleaning with a detergent-disinfectant was found to reduce environmental and hand contamination as well as VRE acquisition.

C. difficile

Because *Clostridium difficile* is a spore-forming organism, it is particularly stable in the environment. Studies have shown that environmental surfaces in rooms of patients placed on contact isolation because of known *C. difficile* infection are commonly contaminated with *C. difficile*\(^18\). These studies have shown that the following surfaces are routinely contaminated: bedpans, commodes, blood pressure cuffs, walls, floors, washbasins and furniture\(^19\).
Contamination has also been found on shoes and stethoscopes. Hospital floors, in particular, have been shown to remain contaminated with *C. difficile* for up to five months following contamination\textsuperscript{19}. Not surprisingly studies have also shown that the degree of environmental contamination in hospitals is roughly proportional to the prevalence of hand contamination among HCWs\textsuperscript{20}.

Many commonly used disinfectants do not eliminate *C. difficile* spores. Sporicidal disinfectants, including sodium hypochlorite (bleach) and vaporized hydrogen peroxide, are required to fully eradicate all forms of *C. difficile*. The former is the most practical cleaning agent in disinfecting rooms that are contaminated with *C. difficile*. One well designed study showed that disinfection with a 1:10 dilution of concentrated sodium hypochlorite was both effective in reducing environmental contamination of patient rooms and in reducing the rate of *C. difficile* associated diarrhea (CDAD)\textsuperscript{21}. Other quasi-experimental studies have demonstrated a similar significant reduction in the rate of CDAD with the use of hypochlorite compared to a quaternary ammonium based disinfectant as a cleaning agent\textsuperscript{22}.

**Discussion and summary**

We believe the evidence that environmental cleaning leads to a reduced incidence of hospital-acquired infection caused by *C. difficile* is plausible and reasonably conclusive. For other hospital-acquired pathogens, the evidence for similar benefits from environmental cleaning is not as well established. However, it is likely that by reducing bacterial contamination of the hospital environment, the incidence of nosocomial infections caused by organisms such as MRSA and VRE can also be reduced.

Educational programs directed at staff responsible for cleaning have been shown to be effective in reducing environmental contamination with VRE and *C. difficile*\textsuperscript{23}. This underscores the obvious fact that the effectiveness of cleaning depends on the thoroughness of cleaning, the frequency of cleaning and the cleaning agent used.

Most hospitals assess the adequacy of hospital cleaning by visual inspection. This system is impossible to standardize and may lead to poorly cleaned hospital rooms. Thus, we believe that other methods to assure the adequacy of hospital room cleaning are needed. For example, fluorescent dyes, microbiological standards, and feedback to cleaning staff are all potential interventions to improve hospital room cleaning.

In the coming months, the DICON team plans to produce and distribute an educational resource that discusses approaches to hospital cleaning and outlines possible ways that cleaning practices can be improved in member hospitals. The objective of this initiative is to improve and standardize hospital room cleaning and, thus, to help reduce nosocomial infections with organisms that have become increasingly resistant to treatment and persistent in the hospital environment.
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