Terminal room disinfection: how much BETR can it get?

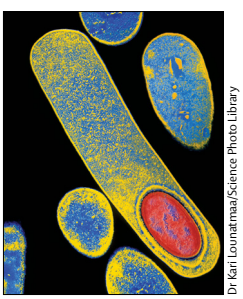
Multidrug-resistant organisms and *Clostridium difficile* infection are continued threats to human health.[1] Acquisition of these organisms through environmental exposure in the hospital has long been recognised as a primary source of infection.[2–4] Other methods of acquisition exist, including environmental sources outside health-care settings;[5] however, hospital acquisition remains the most important means of spread of these infections. Curbing environmental transmission of resistant pathogens in the hospital through modifiable factors that are not solely dependent on human efforts, such as hospital cleaning, is vital to maintaining the utility of antimicrobial treatment.

Terminal room disinfection (disinfection of a room between occupying patients) has a vital role in limiting the transfer of multidrug-resistant organisms and other nosocomial pathogens. The success of terminal room disinfection depends on human factors such as training and management of personnel, as well as accessibility of surfaces in the room. Quaternary ammonium and bleach are the most common products used in standard cleaning, but new technologies put the sole reliance on these agents in question.[6–10] The addition of contactless modalities such as UV light and hydrogen peroxide vapour for terminal cleaning could lead to more thorough disinfection of hospital room surfaces known to harbour important pathogens, and ultimately could decrease rates of health-care-associated infection. Previous studies of the use of UV light have shown decreases in hospital-acquired multidrug-resistant organisms[7] and incidence of *C difficile* infection.[8–10] These supplemental cleaning strategies could be a key step in halting the spread of health-care-associated pathogens.

In *The Lancet*, Deverick Anderson and colleagues[11] describe the Benefits of Enhanced Terminal Room (BETR) Disinfection study, an investigation of the effect of three enhanced terminal cleaning processes on decreasing acquisition of multidrug-resistant organisms (meticillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, and multidrug-resistant *Acinetobacter*) and *C difficile* infection through environmental (patient hospital room) exposure. The BETR disinfection study was a multicentre, cluster-randomised, crossover study done in nine US hospitals with four strategies for terminal hospital room cleaning in targeted rooms. Strategies included traditional disinfection with quaternary ammonium, except *C difficile* rooms in which bleach was used, along with three enhanced strategies: bleach; quaternary ammonium with disinfecting UV device, except *C difficile* rooms in which bleach and UV device was used; and bleach with UV device.

Among 21 395 patients included in the intention-to-treat analysis, the addition of UV light to the reference disinfection strategy reduced the incidence of target organisms by 30% (n=76; 33·9 cases of infection per 10 000 exposure-days; relative risk [RR] 0·70, 95% CI 0·50–0·98; p=0·036). Conversely, there was no statistically significant difference with either bleach alone (n=101; 41·6 cases per 10 000 exposure-days; RR 0·85, 95% CI 0·69–1·04; p=0·116) or bleach with UV light (n=131; 45·6 cases per 10 000 exposure-days; RR 0·91, 95% CI 0·76–1·09; p=0·303). The study was further strengthened by the inclusion of a microbiological analysis of 92 seed rooms after terminal cleaning, demonstrating that all enhanced strategies reduced the bioburden of target organisms compared with the reference cleaning strategy, with the largest decrease in the UV group. This analysis adds biological plausibility to the clinical results.

The incidence of *C difficile* infection was no different with the addition of UV light to bleach disinfection versus bleach alone (n=38 *vs* 36; 30·4 cases *vs* 31·6 cases per 10 000 exposure-days; RR 1·0, 95% CI 0·57–1·75; p=0·997). In a post-hoc analysis with the removal of *C difficile* infection seed rooms from the composite primary outcome of target organism incidence, the decrease in multidrug-resistant organisms was strengthened in the UV group and a significant decrease occurred in the bleach with UV group. Anderson and colleagues propose that the use of bleach in the reference group, high cleaning compliance (roughly 90%), and location of the UV device outside of bathrooms for the single-stage cycle, are possible reasons for the lack of effect of UV on incidence of target organisms. The requirement to only turn on the UV device, not necessarily complete the cycle, might also



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Clostridium difficile

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have affected these findings. UV device manufacturers recommend that multiple cycles be done, including one in the bathroom (potentially the area of the room most contaminated with *C difficile*). Furthermore, other entry points for transmission of *C difficile* must be considered.[12]

Another promising finding was a lack of substantial delays in emergency department waiting times or increases in hospital time on diversion. Time from admission decisions to departure from the emergency department were delayed by only 10–20 min for all enhanced strategies. But considering that institutions that implement UV strategies are likely to complete multiple UV cycles per room, the delays reported are probably not representative of a non-trial setting. Cost–benefit analyses for the use of UV light, including capital and maintenance costs (eg, replacement bulbs), would be beneficial. These costs would be greater for larger institutions, because they would require multiple UV disinfection devices in order to fully implement their use in terminal cleaning. Additionally, increased staffing might be needed to implement UV light protocols since it is unlikely that these operations can be taken on by current staff at most institutions.

The study provides provocative results, namely a reduction in the incidence of subsequent infection caused by meticillin-resistant *S aureus* or vacomycin-resistant enterococci following seed room exposure. These results are welcome at a time of crucial action in combatting resistant microbes. While meticillin-resistant *S aureus* and vacomycin-resistant enterococci are of great importance among nosocomial pathogens, the full effect of enhanced terminal cleaning strategies is not yet realised. If viewed as surrogates for overall disinfection of other vegetative pathogens such as *Pseudomonas aeruginosa* (among others), the potential of enhanced terminal cleaning strategies can be appreciated. Measuring the full effect of terminal disinfection might be beyond the scope of any single investigation and could be better understood through epidemiological tracking within hospitals, health-systems, and geographical regions. A dampener on these positive results is that no substantial decrease in *C difficile* infection incidence was recorded with enhanced terminal room cleaning. Further investigation of the role of UV light in preventing *C difficile* infection, including multiple cycles and bathroom disinfection, is warranted to decipher the lack of clinical effect for this key pathogen.

Hospital environmental exposure has long been recognised as a key component in the transmission of multidrug-resistant organisms and *C difficile* infection. Halting the spread of these organisms is a difficult task that involves changing a complex system across the vast landscape of health care. Efforts to prevent infection in conjunction with antimicrobial stewardship and reduced non-human antibiotic use are needed to preserve life-saving antimicrobial agents. Enhanced terminal cleaning using UV light holds great promise in making the hospital an end rather than a starting point in the complex cycle of resistance transmission.

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