



Elimination of clostridium difficile by illumination? Surface disinfection by ultraviolet light treatment

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Background

Clostridium difficile (*C.difficile*) is recognized as a primary pathogen causing healthcare associated infections (HAI) because of increased incidence and associated morbidity and mortality. *C.difficile* spores can survive for months on environmental surfaces making it difficult to eradicate in the healthcare setting. Rooms previously occupied by a person with *C.difficile* increase the risk of subsequent acquisition.

For more than 50 years laboratory studies have demonstrated the effectiveness of ultraviolet light (UVGI) against a variety of microorganisms including *C.difficile*. Most recently both Boyce and Rutala have studied an automated portable UVGI device which employs mirrors to reflect UV-C around a patient's room in an attempt to disinfect all surfaces. Each study showed a significant log reduction of *C.difficile* on most surfaces challenged. There remains a lack of definitive epidemiologic data demonstrating that this technology actually prevents HAI. However in an outbreak setting our working hypothesis was that this novel intervention could play an adjunct role in the prevention and control of subsequent cases.

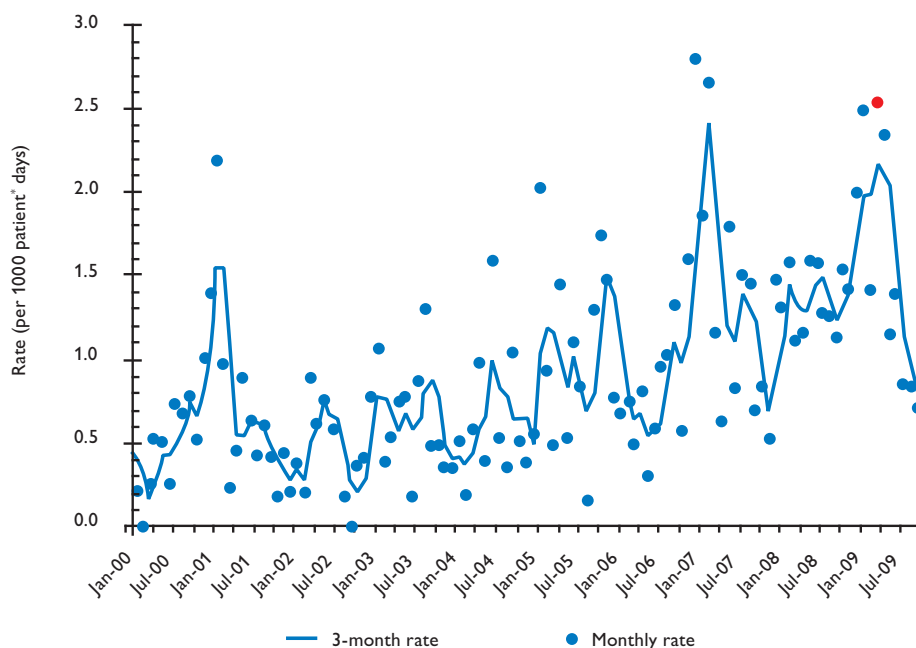
Issues

- Highland Hospital is a 260 bed community teaching facility.
- Our Infection Prevention program has been documenting both nosocomial and community acquired *C.difficile* cases for over 18 years, therefore we have extensive data, as well as experience, in dealing with periods of increased incidence and preventative strategies.
- During the first quarter of 2009, we experienced our highest rate of nosocomial CDI in many years (2.2 per 1000 patient days vs. 1.4). The associated morbidity and mortality had also escalated (42 cases with 3 deaths).
- At this time all SHEA Compendium prevention strategies had already been implemented and compliance was assessed to be fairly consistent.
- We subsequently added a novel intervention, total room UV disinfection, with the same portable device studied by Rutala and Boyce.
- The device is fully automated, self-calibrated and is activated by a handheld remote control device.
- Our experience with this technology is described.

Project

- The unit with the highest incidence (11 cases vs. expected of 3 and 2 deaths) was closed to new admissions.
- Each room was terminally cleaned with bleach, which had been the previous practice on all units.
- Cleaning was followed by treatment of the room with high energy UV radiation at a level previously documented to kill spores.
- The machine was initially procured on a 1 month free trial basis.
- Nursing and Admitting were instrumental in freeing up each room for treatment since the patient could not be present during treatment. This was accomplished by creating a "swing room". We referred to this as a "clean sweep" process since the entire unit was treated and this was accomplished on the first unit in 3 days.
- The machine was then moved to sequential units based upon their incidence of CDI. Each UVC room treatment lasted for 45–60 minutes depending on the size and configuration of the room.
- Although the target unit was completed in 3 days, subsequent units took longer due to the fact that they were not closed to new admissions.

Monthly rate of hospital-associated *Clostridium difficile* infections



Results

- In the quarter following implementation of UV-C the CDI rate was 1.6 per 1000 patient days. In the next quarter it dropped further to 0.8. This was the lowest rate documented in over 10 prior quarters.
- 14 hospital onset cases occurred in the 2 months prior to UV-C compared to 8 cases occurring in the 2 months after implementing UV-C.
- Based on a reduction in CDI, Administration supported the purchase of the machine once the free trial was over. The machine continues to be used in a “clean sweep” fashion, treating an entire unit in one time frame.

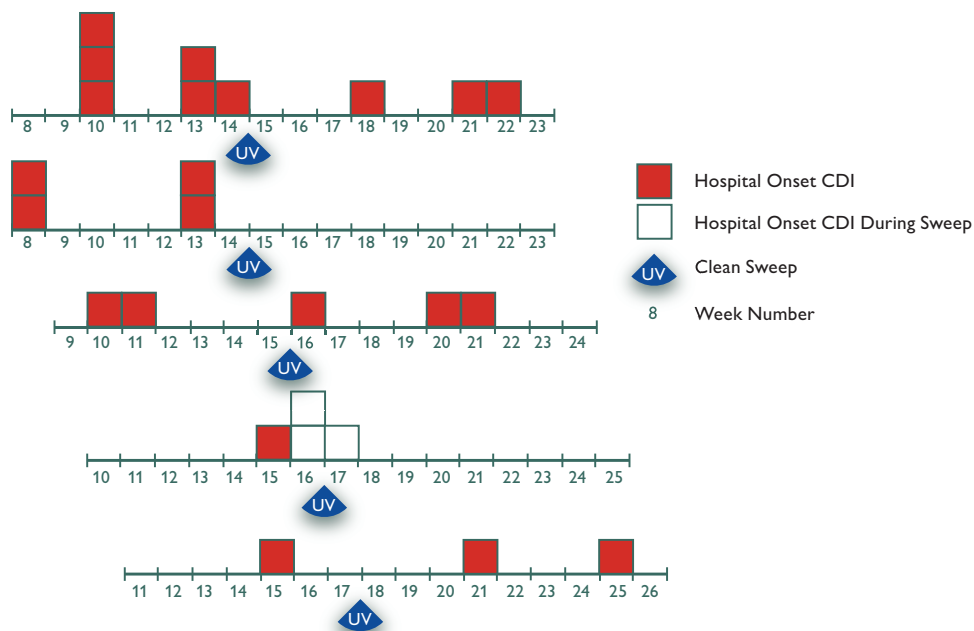
Lessons learned

- Successful implementation requires intense coordination between Nursing, Environmental Services (ES) and Admitting.
- Education of patients, families and HCW regarding the benefits and safety is crucial, especially given the ozone-like odor generated upon completion.
- When census is high it is a challenge to procure empty rooms to treat.
- It is advantageous to have more than one machine but the current cost makes this a difficult “sell”.
- The UV replacement light bulbs are low cost but the intensity decreases with age and hours used, therefore they must periodically be replaced. They must also be cleaned frequently to ensure that the intensity is sufficiently germicidal.
- Given the capital investment, the machine should be utilized as frequently as possible which may require additional ES staffing. It can be used to disinfect equipment such as IV poles, commodes, wheelchairs, etc. if these items can be gathered in an appropriate space for treatment.

Conclusions

- Environmental contamination contributes to the acquisition of C.difficile.
- Prior to light treatment, it is imperative that thorough cleaning be done since studies have shown that UVGI had no impact on bioburden without cleaning.
- UV-C is a non-corrosive, non-invasive disinfection strategy, which should be considered for use, if despite the implementation of evidence based interventions, rates remain high. Capital investment is currently considerable for this technology.
- UV radiation has been associated with skin cancer and cataracts therefore stringent safety measures must be in place to protect both patients and HCWs from inadvertently entering the room during treatment. This machine automatically shuts off if the door is opened.
- Well designed studies must be funded and conducted to determine if the use of UVC room disinfection effectively and consistently results in reduction of CDI incidence in clinical settings.
- Portable UV light is not meant to be a stand alone intervention to prevent C.difficile but rather another tool in our “prevention tool belt”.

Epicurve of hospital-onset CDI 8 weeks before and after clean sweep with bleach and UV-C



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