UV-C Light Used to Help Combat C. diff, Boost Environmental Hygiene
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By Elizabeth Srejic

Room decontamination by a portable device that emits ultraviolet C (UV-C) light is setting a new industry standard in reducing healthcare-associated infections (HAIs) – even those caused by antibiotic-resistant superbugs and deadly viruses such as Ebola. The technology is so effective, in fact, that an infection preventionist believes it could be a boon to standard infection control protocols in any healthcare facility.

At any given time, 1 in 25 hospital patients has at least one healthcare-associated infection (HAI). At the same time, the use of antibiotics and the number of bacteria resistant to them have increased in the past decade. As such, infection preventionists overseeing infection control practices in healthcare facilities are continually searching for the latest, most efficacious ways to fight today’s life-threatening pathogens.

Area decontamination by short-wavelength ultraviolet C radiation (UV-C) immersion is a newer disinfection practice gaining ground due to its efficacy, ease of use, and long-term financial and human payoffs. Using germicidal light, UV-C disinfection “robots” are used in conjunction with standard room cleaning regimens to kill pathogens living on surfaces in healthcare facilities. These 5-foot 5-inch, remotely-operated robots, the TRU-D SmartUVC™ (nicknamed “Trudi”) created by Lumalier Corporation, are reportedly talented at killing common and even deadly pathogens. Reports also indicate the units are safe and easy to use as well as a good investment over the long term, to the benefit of patients, healthcare workers, administration, visitors and other stakeholders.

Suzanne Cirulli, RN, BSN, CIC, director of infection prevention and control at O’Connor Hospital, a 358-bed facility in San Jose, Calif., recently spearheaded a campaign to add ultraviolet room disinfection to the existing cleaning regimen at her facility. One TRU-D unit was implemented beginning in 2013, and Cirulli reports the results have been encouraging.

TRU-D is a portable area disinfection device that delivers a lethal dose of UVC light in one cycle from a single, central location in the room. By precisely measuring reflected UVC emissions with Sensor360™, the system calculates the dose of UV light needed to successfully disinfect a specific room by assessing variables such as room size and geometry, surface reflectivity and the amount and location of equipment, according to the manufacturer, whereas UVC disinfection devices without built-in technology to measure and calculate proper disinfection times either under or overestimate the necessary dose of UV-C light. This technology allows TRU-D to produce three to four log-10 reductions in microbes on all surfaces, including those not in the direct line of UVC light exposure, the company states.
including pathogens commonly responsible for HAIs and even antibiotic-resistant superbugs such as Clostridium difficile (C. diff), methicillin-resistant Staphylococcus aureus (MRSA) and carbapenem-resistant Enterobacteriaceae (CRE). Lumalier also markets the system for easy use among hospital staff and applicability to a range of environments including patient rooms, intensive care units, operating rooms, emergency rooms and public areas.

Research on the efficacy of UV-C area decontamination has been encouraging. Lumalier asserts that TRU-D has been the device most often used in existing and ongoing studies on the topic. One such study, an ongoing Centers for Disease Control (CDC) study funded by the Epicenter Program at Duke University, the University of North Carolina and eight other hospitals in that region has shown that TRU-D significantly reduces resident pathogens without manual cleaning following patient discharge from contaminated hospital rooms.  

Seven infectious disease specialists and authorities in epidemiology collaborated with the CDC’s Division of Healthcare Quality Program to evaluate using automated UVC emitters as a progressive method for disease prevention. After patient discharge, hospital rooms that tested positive for the presence of vancomycin-resistant enterococci (VRE), MRSA, C. diff and Acinetobacter spp. were treated with a complete disinfection cycle of UVC light using TRU-D. The researchers concluded that TRU-D demonstrated the significant effect UVC light-emitting devices have in decreasing the bioburden of deadly pathogens in hospital rooms.

A similar study published in Infection Control and Hospital Epidemiology also found the UV-C-emitting device was effective in eliminating nosocomial pathogens found in contaminated hospital rooms. According to the authors of the University of North Carolina, Chapel Hill, study, the device successfully killed MRSA and VRE as demonstrated by a reduction in these bacteria within patient rooms before and after patient occupation. Specifically, the device destroyed vegetative bacteria on contaminated surfaces both in direct sight as well as behind objects.

The TRU-D device has been shown to be particularly beneficial against C. diff, which is responsible for an estimated 165,000 cases, $1.3 billion in excess costs, and a 9,000 per year death rate that continues to rise. In a study published in Infection Control and Hospital Epidemiology, veteran’s administration researchers of infectious diseases and geriatric health studied the effectiveness of UVC light in disinfecting hospital rooms that had been occupied by patients with C. diff by using TRU-D to disinfect a patient room shared by two patients who contracted C. diff during their hospital stay. Prior to using the device, multiple colonies were found on surfaces throughout the room and bathroom. Five weeks after administering a full UVC dose from TRU-D to the patient’s room, neither patient tested positive for C. diff TRU-D was also shown to significantly reduce bacterial contamination and C. diff spore counts in an independent study conducted by researchers from Yale University School of Medicine, in which three researchers used TRU-D in both one- and two-stage procedures conducted inside a patient room and bathroom by measuring the size of aerobic colony and C. diff spore counts before and after use of the device. The data collected from both parts of the study showed that treatment with TRU-D’s UVC light significantly reduced bacterial contamination and C. diff spore counts on contaminated surfaces in patient rooms.
As at many other healthcare sites, C. diff was a persistent threat in Cirulli’s healthcare facilities. She said she lobbied for implementation of TRU-D to help depress the population of the dangerous pathogen.

“We chose C. diff reduction as a system-wide infection prevention initiative as our hospital onset C. diff infection (HO-CDI) rates in each of our hospitals were higher than the California average (7.657/10,000 patient days) according to data published by the California Public Health Department,” she says. “We developed a nursing protocol to isolate any patient having diarrhea and to send a specimen for PCR testing, enhanced our cleaning methods and implemented bleach cleaning of C. diff patient rooms, communicated rates and ensured that a robust antimicrobial stewardship program was in place. We also focused on reducing the use of proton pump inhibitors (PPIs), as 95 percent of our HO-CDI patients were on a PPI. The 2013 first quarter HO-CDI rate at O’Connor Hospital was 14.47/10,000 patient days. Throughout that year as we implemented different processes our rate decreased but remained 11.13/10,000 patient days by the end of September 2013.”

At that point, Cirulli says she asked upper administration if the facility could incorporate TRU-D into its cleaning regimen to see if it would help to lower the facility’s levels of C. diff.

“After seeing no true progress with reducing our HO-CDI rate which was a concern for our hospital leadership, I made a proposal to our Quality and Patient Safety Board to purchase the TRU-D,” she says. “I had seen it at the national APIC convention in 2012 and liked the technology. It seemed to be an easy and sure method to kill C. diff spores. I did an informal test of the TRU-D and cultured environmental surfaces before environmental services (EVS) personnel cleaned a patient room, after EVS cleaned the same room and then again after the use of TRU-D. The results were impressive and the decision was made to purchase the TRU-D.”

After speaking with hospital administration, the most significant drawback of purchasing the TRU-D unit was identified as the cost of acquiring the unit. “I was charged by our CEO with the task of proving that TRU-D worked as it is a costly item,” Cirulli says. The cost also worried staff initially: “They were a little leery at first because they knew ‘Trudi’ was expensive.”

However, according to Cirulli, the unit ultimately proved its worth through its efficacy and ease of use. “We trialed the TRU-D for a month beginning in October 2013 and immediately I felt we were seeing less HO-CDI,” she says. “It impacted our overall quarterly rate and by the end of December our rate had dropped to 7.27/10,000 patient days. Our patients received the benefit of us using the TRU-D for one month well into the new year and by the end of the first quarter of 2014 our rate had decreased even more to 4.85/10,000 patient days. We purchased our own TRU-D in February and began using it regularly in March. By June, our rate had dropped to 2.18/10,000 patient days.”

Furthermore, the learning curve among staff was negligible. “The TRU-D is so easy to use,” Cirulli says. “Basically you just perform the terminal cleaning of an isolation room, roll TRU-D into the corner of the room, close and secure the door, and turn on the unit remotely with an iPad. The TRU-D tells you when ‘she is done’ which depends on the size
of the room and other variables. The unit even kills the bacteria in the restroom if you leave the door opened.”

As such, Cirulli says, the robust results produced by using the UVC-emitting robot justify the initial investment. “If you build a business case and plug your numbers in, it is worth the initial financial impact to the hospital. Our dropping community HO-CDI rate in turn contributed to our decreased numbers of readmissions within 30 days which also financially impacted the hospital with Medicare reimbursement.”

Cirulli also says that the facility tries to boost the cost-effectiveness of the unit by decontaminating multiple pieces of equipment at the same time. “For example, we roll several IV poles and pumps into a room and disinfect them all at once,” she explains.

In addition to its efficacy, efficiency, and value as a sound investment, the TRU-D unit scores high in safety. According to the Centers for Disease Control and Prevention (CDC), the type of ultraviolet irradiation produced by the device is not considered harmful. Unlike ultraviolet A (UVA) which penetrates relatively deeply beneath the top layer of human skin and is associated with increased risk of developing skin cancer and ultraviolet B (UVB) which penetrates less deeply into skin but can still cause some forms of skin cancer, ultraviolet C (UV-C) rays as emitted by TRU-D are regarded as benign because UV-C is absorbed by the earth’s atmosphere. Furthermore, according to Lumalier, TRU-D is safe to use in rooms with glass windows and doors as UV-C is not transmitted through glass.

The unit’s beneficial characteristics could make it a good choice for outbreak situations such as the Ebola crisis, according to Cirulli. “We are considering using ultraviolet light or hydrogen peroxide vapor to decontaminate any rooms used in our hospital should we receive an Ebola patient before we even go in to clean,” she says.

In fact, reports state that TRU-D is currently being used to combat the Ebola virus at JFK and ELWA Hospitals in Monrovia, Republic of Liberia, where Ebola patients are being treated, in an effort to eradicate the virus at the source. In Liberia the first unit was deployed on Aug. 20, 2014.

Although regular manual disinfection and cleaning remain the staple practices in healthcare for room disinfection, Cirulli says that UV-C area disinfection in her experience should be considered by other infection preventionists as a valuable addition to any infection control regimen. “No matter how good your EVS staff is, no one can clean every single square inch of surfaces in a patient room,” she said. A review authored by two leading infection preventionists agrees with her assessment, citing almost 30 studies in the discussion of decontamination units concluded that use of UVC light to disinfect hospital environments is a recommended weapon against potentially lethal nosocomial pathogens.(11)
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“Our patients need to feel safe when they come into healthcare facilities and shouldn’t have to worry whether or not they are going to get an infection or whether their room is clean,” says Cirulli. “I feel so fortunate to have this technology available at our facility for our patients and knowing that they are at less risk for acquiring C. diff while at our hospital. I am certain that this technology was what truly made the difference as we had tried everything else.”

References