# Fighting an Invisible Enemy

Kasey Panetta, Managing Editor, ECN

*How UV robots are clearing the way for germ-free hospitals*

Though medical devices are always moving towards less invasive, more effective technology, they face a constant, persistent and ever-evolving enemy in deadly bacteria and infections. Healthcare-associated infections (HAIs) can be caused by any infectious agent and result in 99,000 deaths per year, according to the Centers for Disease Control and Prevention. According to the U.S. Department of Health & Human Services, at any given time, one in 20 hospital patients has an infection related to hospital care.

Setting aside the challenge of battling an unseen enemy that is quickly becoming immune to treatment, part of the issue is logistical. Traditionally, hospital rooms are manually disinfected using bleach (or a similar product) by staff members. Unfortunately, the method depends on the thoroughness of a busy individual, and multiple studies have shown that oftentimes more than half of the surfaces remain

untouched. Hospitals can also use hydrogen peroxide vapor (HPV) systems, but that involves sealing off a room, pumping in gas, and then removing the gas. This option is very expensive and can take several hours, and a busy hospital can't spare time or money.

"Think about the equipment in a traditional patient room – the poles, monitors, tray table, remote controls, keyboards – there is no way even the very best worker can thoroughly clean every surface in that room in the time allotted to them," says Dr. Mark Stibich, Chief Scientific Officer, Xenex Disinfection Services, a company that specializes in robotic cleaning services.

Alarmingly, something as simple as not cleaning the underside of a remote control can have deadly consequences. As the diseases, which include Methicillin-resistant Staphylococcus aureus (MRSA) infection, Vancomycin-resistant enterococci (VRE), Acinetobacter, and Clostridium difficile (C. diff), become resistant to antibiotics and treatment (and even to some cleaning supplies) it has become apparent that hospitals need to explore more effective cleaning technology.

**Look to the Light**

The solution, it seems, may be in a modified version of an idea that water treatment plants, food manufacturers and air-purifiers have been using for years: using UV light to eliminate bacteria and germs. The UV rays come in the form of lamps and "robots," and there are several versions on the market today.

Most people are familiar with high intensity ultraviolet A light (UV-A) and UV-B, which are naturally found wavelengths in sunlight. However, these cleaning devices use UV-C, which cannot penetrate glass, plastic, clothing or skin and does not exist naturally on earth, according to Stibich, whose company created a robot called Xenex. Because it doesn't exist naturally, the microorganisms have no defense against it.

“UV-C penetrates the cell walls of microorganisms including bacteria, viruses, mold, fungus and spores. Their DNA is instantly fused so that they are unable to reproduce or mutate—they are, technically, ‘deactivated’—effectively killing them on surfaces and in the air without contact or chemicals, says Stibich.

**A Unique Technique**

Each of these systems works using the same basic principle of UV-C, but the unique technology of each system offers pros and cons.

The Xenex works by delivering a millisecond, high voltage charge to a xenon flash lamp, which then pulses 1.5 times per second eliminating dangerous microorganisms. The system, now used in 100 U.S. hospitals uses four techniques: photohydration, causing functional damage by inserting water into cellular structures; photosplitting, splitting the phosphate backbone of the DNA; photo crosslinking, creating bonds among protein molecules that lead to structural damage; and photodimerization, the bonding of the elements of DNA and RNA. Because the pulsed xenon powers the light, it produces a very powerful UV-C without mercury. The entire process takes between five and 10 minutes though different rooms (patient versus operating rooms) have different protocols. Main features include the Xenon UV lamp, a UV Focus system using reflectors and movement to focus the light on “high touch” surfaces, on-board database logs for analysis, a visible light filter and safety features (timer, emergency stop button, auto shutdown and a motion detection system.) The company recommends that the system be used twice in each room from specific focal points.

A 140-bed acute care community hospital, which used the Xenex for three seven-minute sessions per room after the traditional Clorox wipe-down, reported a 53 percent reduction in hospital-acquired C.diff. A second study using Xenex (combined with screening and hand hygiene) found a 56 percent reduction in MRSA.

Both studies were published in the American Journal of Infection

control.

**Self-Calculating Systems**

Another system, called the Tru-D Smart UVC, made by Lumalier, uses what the company calls a Sensor360 to calculate the UV dose needed for each specific room given the size, shape, position of other equipment, windows, and doors. The Sensor360 measures the reflected UV-C emissions to calculate the pathogen-lethal UV dose for the specific environment. The light sensors are specifically dialed in to see only the germicidal UV-C range at 253 nm, according to Chuck Dunn, president of Lumalier. Depending on the analysis of the machine, the hospital operator will be remotely notified about how long the process will take.

It’s a 15 to 50-minute process—improved in one study by using a special reflective coding—which can be done from one area of the room. The system emits light at a wavelength of 254 nm and measures the reflected dose of light using eight sensors, according to a study published in, Infection Control and Hospital Epidemiology. One study, using the TRU-D Smart UVC, resulted in a 98 percent reduction of Acinetobacteria and a 97.9 percent reduction for VRE.

Interestingly, Tru-D will soon integrate an iPad into the process. The product, called iTRU-D, will provide a web portal access to allow hospitals to track infection control efforts. The iPad mini, which comes standard with the program, will control both the operation of the robot as well as tracking disinfection data.

More and more of these bots will hit the medical hallways in the coming years. With improving technology, they might be able to eradicate a problem that continues to plague hospitals and medical facilities. Both of the aforementioned robots are being used in some capacity across the country, proving the UV-C is the key to saving lives and fighting infections.

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