Disinfecting robots help prevent superbug infections at Hopkins

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Even as epidemiologists worry about a shrinking arsenal of antibiotics to fight potentially deadly drug-resistant bacteria, researchers at Johns Hopkins Hospital are betting on another weapon to prevent infections: robots.

It sounds more futuristic than it looks: The hospital uses "robot" devices resembling portable air-conditioning units to saturate the air in sealed rooms with hydrogen peroxide, disinfecting all surfaces before converting the potent mist into water vapor. The technology has been used at the hospital more than 4,000 times over the past five years, with promising results.

Research published Monday in Oxford University's Clinical Infectious Diseases journal explains that patients admitted to rooms disinfected by the robots were nearly two-thirds less likely to pick up drug-resistant bacteria while in the hospital. The finding builds on a growing understanding of the ways the so-called "superbug" bacteria spread through hospital environments and how to prevent infections.

Overuse of antibiotics has caused some strains of bacteria to develop immunity to common treatments, prompting doctors to turn to more powerful antibiotics or older ones that bacteria haven't faced in decades. Meanwhile, public health experts are using other methods to prevent the bacteria from spreading and to stop infections, particularly those acquired in hospitals and other health care settings.

The focus has been on health care workers themselves, ensuring they don't carry bacteria into operating rooms and intensive-care units. But the Hopkins study, like other types of technology being tested at hospitals around the country, targets bacteria that survive on surfaces, waiting to be transferred to sterile dressings, instruments, and, ultimately, patients.

"If you had talked to me maybe seven or eight years ago, we would have discounted the role of the environment as important in transmission," said Dr. Trish Perl, senior epidemiologist for Johns Hopkins Health System and one of the authors of the study. "The whole concept of the role of the environment as important in how these organisms are transmitted to patients and from patient to patient has really emerged."

Hopkins researchers spent 2 { years testing the robot technology in 2007-2009. The hospital bought several $40,000 pairs of the disinfecting robots from Bioquell Inc. and hired the United Kingdom-based company to operate them. The robots are in use in about 20 U.S. hospitals and more around the world, with about 1,000 patient rooms cleaned every month, said Mike Duclos, a Bioquell technician who helped perform the Hopkins study.

In each set, one robot fills a hospital room or unit with hydrogen peroxide mist; once the air has been saturated with the concentrated chemical, a second robot releases a catalyst that reacts with the hydrogen peroxide to turn it into water. The cleaning solution is 35 percent hydrogen peroxide, compared with the 5 percent solution sold in drugstores, making it toxic to humans but particularly effective at killing bacteria.

Bioquell crews seal up heating and cooling vents, doorways and cracks to keep the chemical in and to ensure it can saturate the room, a process that can take from an hour and a half to three hours, depending on the

humidity that day. Because the mist is produced on a microscopic level, it doesn't leave any visible moisture behind and is safe to use on electronics.

The researchers tested the technology's effectiveness by collecting data on more than 8,800 patients at the hospital. Some were excluded because of a known history with a multidrug-resistant organism, while the rest were monitored in rooms where previous patients had been found to carry any of several types of such organisms. In some cases, the robots were used to disinfect the room after normal cleaning was performed.

Researchers found that one-third as many patients acquired Staphylococcus aureus bacteria, also known as MRSA, in rooms that the robots had disinfected as in rooms they had not. When testing for a different type of bacteria, vancomycin-resistant enterococci, nearly seven times as many patients acquired the bacteria in rooms that had not been treated by the robots.

Drug-resistant bacteria have caused high-profile scares in recent years, including an outbreak that killed a seventh person at the National Institutes of Health Clinical Center in Bethesda, Md., in September. In that case, officials found that simply following CDC guidelines was not enough to rid the environment of the bacteria, and workers went far beyond the regulations to rip out plumbing found to be harboring the organisms.

Doctors and scientists have worked to fight the bacteria once they cause infections, with limited effectiveness, and potential backfires.

"We're running out of antibiotics to use," Dr. Anthony Harris, a professor of epidemiology, public health and medicine at the University of Maryland School of Medicine, said in October. "The problem arising in many hospitals is this paradigm of giving broad agents to the patient

who's right in front of you. It works in some instances, but in others, the group or public health impact is more adverse."

As an alternative, technologies that focus on killing bacteria in the hospital environment have become more widespread. In one example, robots emit ultraviolet light to kill bacteria on hospital surfaces at Chesapeake Regional Medical Center in Chesapeake, Va., and eight other facilities under a $2 million CDC grant awarded to Duke University. Other technologies being developed use hydrogen peroxide in other ways, or xenon gas, Perl said.

Proving a technology's effectiveness is crucial in addressing the problem, and means a lot of potential business for companies such as Bioquell. Its robots are also used in laboratory settings, for food and drug safety, and as defense against chemical or biological weapons, said Sean Seege, a Bioquell technician.

"It's becoming more and more difficult" to fight drug-resistant bacterial infections, Seege said. "The idea here is to prevent them."

The prospect of using the technology more widely has limitations, researchers said. The process can sometimes be impractical, since it can take several hours. Still, it only had to be skipped 4 percent of the time during the study because of an urgent need for a room, they wrote in the study.

For now, Hopkins continues to use the robots in high-priority areas like intensive-care units, Perl said. But officials plan to continue to build on the research.

"We need to do further work," Perl said. "We have to figure out how to best use them."