Researchers discover how bacteria resist antibiotics in hospitals

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Spotting infected patients, disinfecting hospitals key to curbing spread of resistant bacteria, experts say.

Scientists have uncovered a key factor to explain why antibiotic-resistant bacteria can thrive in a hospital setting.

Tiny circles of DNA called plasmids appear to be the culprit. They can easily enter bacteria and move from one bacteria to another, and some carry a gene that makes bacteria drug-resistant, a new study finds.

"The plasmids we are talking about carry an antibiotic-resistant gene to a class of antibiotic called carbapenems," said the study's co-author, Dr. Tara Palmore, an infection control specialist at the U.S. National Institutes of Health.

Carbapenems are antibiotics of last resort, and carbapenem-resistant Enterobacteriaceae (CRE) are bacterial pathogens that pose a "formidable" threat to hospitalized patients, according to the research.

The incidence of CRE has quadrupled in the last decade in the United States, according to background information in the report. CRE has been detected in nearly 4 percent of hospitals and about 18 percent of long-term acute care facilities. In addition, the researchers noted, CRE are resistant to most, if not all, antibiotics. Investigations have reported a death rate of 40 percent to 80 percent from infection.

Given ongoing concerns that even bacteria like *Klebsiella* and *Enterobacter*—which are found in the environment and in healthy stomachs—are becoming increasingly resistant to last-resort antibiotics, the researchers set out to find some answers. Their report, published Sept. 17 in *Science Translational Medicine*, showed that plasmid transfer in hospitals is likely contributing to the increase in antibiotic-resistant bacteria.

Using advanced DNA sequencing of samples from more than 1,000 patients, the researchers were able to see the complete genome of bacteria samples and identify the antibiotic-resistant genes—plasmids—located in those samples.

Plasmids can multiply independently and integrate their DNA with the DNA of the bacteria. And plasmids that have the gene that inactivates certain antibiotics can be transferred to bacteria of various types, the scientists found.

Over the course of two years, the researchers identified 10 patients seen at the U.S. National Institutes of Health Clinical Center who had resistance to carbapenems.

The investigators also found antibiotic-resistant genes in tiny collections of organisms called biofilms living in hospital sink drains in patient rooms.

This finding did not show that bacteria from the sink drain were passed to any patient, the study authors said.

But even though patients who carry this bacteria may not be sick themselves, they can pass this drug-resistant bacteria to others, they added.

Study co-author Julie Segre, chief and senior investigator at the U.S. National Human Genome Research Institute, noted, "We are trying to reinforce the message that these drug-resistant bacteria can't become so prevalent that we can no longer control them."

And she emphasized, "We are still at the point where we can make a difference in terms of controlling the bacteria."

However, Palmore said, knowing how bacteria become drug-resistant doesn't change how preventing its spread is carried out.

"It informs us of how bacteria can pick up the resistance," Palmore said. "Efforts to control these bacteria need to focus on containing them by isolating patients who are carriers of the bacteria and also by disinfecting the hospital environment where the bacteria might live."

Victoria Richards, an associate professor of medical sciences at the Frank H. Netter MD School of Medicine at Quinnipiac University in North Haven, Conn., was not involved with the study but was familiar with the findings. She said, "Bacteria don't want to be killed. When we try to kill them with antibiotics, they are going to fight back. It's an ongoing battle."

Dr. Marc Siegel, an associate professor of medicine at NYU Langone Medical Center in New York City, another expert who was not involved in the study, said, "Carbapenems are the best we have. So if you've got carbapenem-resistance, there is nowhere else for us to go. We don't have a secret treatment up our sleeves."

Siegel thinks that drug companies need to create new antibiotics, which doctors would then need to use more cautiously. In addition, he added, hospitals need to be doing a better job with disinfectants.

More information: "Single-molecule sequencing to track plasmid diversity of hospital-associated carbapenemase-producing Enterobacteriaceae," by S. Conlan et al. stm.sciencemag.org/lookup/doi/… scitranslmed.3009845