ADVANCED MOLECULAR DETECTION

Combating Healthcare-Associated Infections and Antibiotic Resistance

A strain of Candida auris *cultured in a petri dish at CDC.*

At any time in the United States, at least 1 in 31 hospitalized patients has a healthcare-associated infection (HAI). HAIs are infections people can get while receiving medical treatment, including those caused by antibiotic-resistant organisms. At least 2 million people in the United States become infected with bacteria that are resistant to antibiotics each year and more than 23,000 people die from these infections. AMD technology is one of the tools scientists are using to search for and identify novel and emerging ways in which antibiotic resistance occurs and spreads.

COMBATING ANTIBIOTIC RESISTANCE

Antibiotic resistance (AR) occurs when germs develop the ability to defeat the drugs designed to kill them. That means the germs continue to grow and develop resistance. AR has the potential to impact all Americans at every stage of life, as well as the healthcare, veterinary, and agricultural industries, making it one of the world's most urgent public health problems. Predicting how pathogens will become resistant is a challenge. However, AMD technologies help CDC scientists study existing and emerging antibiotic-resistant organisms, including some of the biggest threats, like *Clostridioides difficile* (*C. diff*), "nightmare bacteria" carbapenem-resistant Enterobacteriaceae (CRE), the fungus *Candida auris*, *Mycobacterium tuberculosis*, and *Neisseria gonorrhoeae*. By adding AMD technologies to antibiotic resistance surveillance, scientists can look more deeply at these germs and help healthcare providers select the most effective medications to treat infections.

DISCOVERING DANGEROUS FUNGUS IN U.S. HOSPITALS

In 2016, CDC alerted U.S. hospitals and clinicians to be on the lookout for a dangerous multidrug-resistant fungus, *Candida auris*. It was not long before CDC scientists detected *C. auris* infections in patient samples shared from laboratories around the nation. Furthermore, AMD technology revealed *C. auris* strains were closely related to each other, which helped investigators understand how the fungus was spreading in healthcare settings. With the help of AMD technology, CDC scientists are discovering which antifungal medications are most effective against *C. auris* and tracking how it spreads in healthcare facilities. AMD plays a role in helping CDC scientists devise ways to detect, control, and stop the spread of this potentially deadly pathogen.

"One family of germs, carbapenem-resistant Enterobacteriaceae (CRE), has become resistant to all or nearly all the antibiotics we have today."

PREVENTING HEALTHCARE-ASSOCIATED INFECTIONS

Healthcare facilities are battling to protect their patients from healthcare-associated infections (HAIs), including those caused by antibiotic-resistant organisms, and prevent their spread. CRE, a germ that usually strikes patients in healthcare settings, has become resistant to all or nearly all the antibiotics we have today. These "nightmare bacteria" can also spread their resistance to other bacterial species. Using AMD, CDC scientists are studying the building blocks of genetic material for CRE and other threats to better understand how these bacteria spread to and share resistance with other bacteria. Improving our ability to detect and identify characteristics of these bacteria will help determine how specific interventions would be successful in stopping their spread and help healthcare facilities prevent infections.

TRACKING AND STOPPING RESISTANCE GENES

The *mcr*-1 gene hitches a ride on a plasmid, a small piece of DNA that is able to move from one bacterium to another. This gene has the potential to spread to other bacteria, making them resistant to colistin, a last-resort antibiotic for some multidrug-resistant infections. AMD technology has been particularly enlightening in outbreaks where resistance genes are carried on plasmids. Such outbreaks may involve multiple species of bacteria, and it can be difficult to decipher using conventional laboratory methods. As a result, CDC now recognizes two types of HAI outbreaks: "classic" outbreaks due to a single pathogen, and newly-recognized outbreaks due to a plasmid spreading antibiotic resistance across multiple pathogens. With AMD technologies, CDC is tracking these outbreaks faster and stopping them sooner.

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