Blood test can detect presence of deadly superbugs in less than one hour

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Elements of the new BYU-devised system for rapid detection of superbugs in blood. Credit: Claire Moore/BYU Photo

If you have antibiotic-resistant bacteria in your blood, you need to know pretty quick what's going on in there. Like, really quick. Like less than

24 hours quick. Because these type of bacteria (aka superbugs) are a growing and deadly threat.

"Once you're trying to diagnose the disease, the clock is ticking," said Aaron Hawkins, professor of electrical and computer engineering. "Every hour the disease is untreated, survivability drops by about 7%. You want to know what you're fighting immediately so you can apply the right treatments."

Unfortunately, current superbug testing methods take 24 hours—or longer—which is often too late for the person, and can lead to irreversible damage. Four BYU professors across four disciplines—molecular biology, chemistry, integrated optics and chemical processing—are here to help. They've created a method to extract superbugs from whole blood, prep them for testing and then provide a diagnosis all in under one hour.

The rapid diagnosis method will not only save lives, but it will also save doctors from misusing the rare valuable antibiotics that can still treat the most drug-resistant bacteria.

"That was always our goal, to do it in an hour," Hawkins said. "It's quite exciting that we've been able to combine all of our efforts and hit that benchmark."

Hawkins, along with BYU professors Adam Woolley, William Pitt and Richard Robison, and UC Santa Cruz professor Holger Schmidt, published the details of their new method in the journal *Lab on a Chip*. Not only can they deliver results under the 1-hour benchmark, they can also simultaneously test for three different superbugs in that window.

The system takes a sample of a patient's blood and first spins out the billions of blood cells in order to isolate the bacteria. DNA is then

extracted from these bacteria and, if they match known sequences from antibiotic-resistant strains, the DNA will be labeled with fluorescent molecules. Sampled DNA is pushed through a fluid channel on the microchip where it passes through a tiny curtain of light. A fluorescent signal coming from labeled DNA indicates when drug-resistant bacteria are present.

The team's ability to rapidly detect multiple bacteria on the same chip at the same time, known as multiplexing, came through their development of a number of technical innovations. By developing new efficiencies to spinning technology, the team created a faster way to do the separation (separating the bacteria from the blood), built new chips to process the samples and engineered an optical detection method that uses various laser colors to identify different bacteria.

The innovations come after five years of work and academic publications funded by a $5.4 million grant from the National Institutes of Health .

The plan to take the technology to market is to install the tiny, 1-centimeter-square chip on a disposable cartridge that's small, inexpensive and can be used in a hospital environment. The research team is now working with a startup company in the Bay Area to get the technology to healthcare professionals.

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