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Electrified bacteria

PhD student at Furtwangen University develops method for faster determination of antibiotic resistance. The increase in antibiotic-resistant pathogens and the associated treatment, which is a major problem in public healthcare facilities, is the subject of a research project at Furtwangen University.

"The number of resistant bacterial species is growing faster than new antibiotics are being developed," says doctoral student Oliver Riester, who has been working on the topic for three years. It is therefore important that patients receive the right antibiotic as quickly as possible. To achieve this, blood samples are tested for antibiotic-resistant pathogens, for example. The current most common testing procedure takes two days or longer. Broad-spectrum antibiotics are often administered to avoid further delaying treatment during this time. "The frequent use of these drugs increases the selection pressure on the bacteria and resistant species survive," says Riester. Together with his doctoral supervisor Prof. Dr. Hans-Peter Deigner, he has developed a method that enables faster testing for antibiotic resistance. "The results are available to us after just five to ten hours," says Riester happily. In the previous method, the blood samples are incubated for a day to allow the pathogens to multiply. "A lot of time passes before the result is available, so we thought about whether it could be done faster," says Professor Deigner.

The new approach combines various electrochemical methods, including "EIS". In this context, this stands for "electrochemical impedance spectroscopy". To put it simply, a current is passed through the blood sample and the change in impedance is read out. "When the bacteria multiply, the alternating current resistance changes. This change can be measured. I programmed an algorithm especially for the evaluation," reports Riester proudly.
A self-designed, 3D-printed "chamber" always contains a mixture of blood plasma, a common type of bacteria such as E. coli or MRSA, the antibiotic to be tested and a redox-active substance that is reduced by living bacteria. Professor Deigner explains: "If the bacteria continue to grow in the presence of the antibiotic, this indicates resistance. No growth means the antibiotic is effective and can be used for treatment". The new method is more sensitive and reacts to even the smallest changes - the result is available after just five to ten hours.

"The vast majority of approaches we have tried have not worked. But the one that did work was enough," says Oliver Riester. "We have now applied for a patent for the process and are waiting for feedback." It could be another three to seven years before the patent is granted. "As a rule, several subsequent corrections are necessary, which often makes the process lengthy," says Professor Deigner, who holds around 20 patents himself.
"The next step is the proof of concept, which involves testing with real samples from the hospital," says Riester. "So it will be a while before our product is ready for the market."

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Further information

- Furtwangen University