Smartphone Device Can Diagnose Bacterial Infections

Someday soon, hospital physicians and nurses may use small smartphone-connected devices to quickly diagnose bacterial infections such as E.coli and MRSA.

Ralph Weissleder, MD, PhD, director of the Massachusetts General Hospital Center for Systems Biology, and Hakho Lee, PhD, also a principal investigator at the center, are leading a team of researchers that has created such a device. Called Polarization Anisotropy Diagnostics (PAD), it has shown promising results in a small study.

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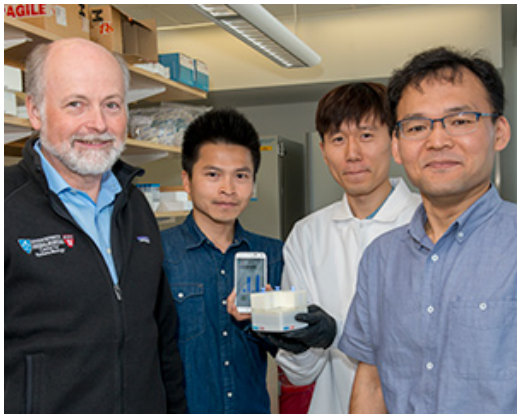
Bacterial Infections Pinpointed

The PAD device is about the size of a Rubik's Cube. And it can make a diagnosis within two hours of receiving a patient sample. By comparison, getting similar results back from a testing lab, can take anywhere from a couple of days to a few weeks. In the meantime, doctors must make a diagnosis based on the patient's symptoms.

Dr. Weissleder gives this example: A patient comes to the hospital shivering, short of breath and in extreme pain. Healthcare providers suspect a bacterial infection is causing sepsis, a life-threatening infection. They immediately begin treatment, which includes antibiotics—but they don't know yet which bacteria are making the patient sick. So they prescribe the antibiotic most likely to help or give several types of antibiotics.

When the lab results return two weeks later, the healthcare providers learn if they suspected the right bug. If they were wrong, they must change the course of antibiotics.



But if PAD identifies the bacteria within two hours, physicians can prescribe the right antibiotics sooner. Patients can recover faster, with fewer side effects.

How the Device Works

To use the PAD device, a sample from the patient is placed into a tiny vial along with a special detection probe. The vial is slid into a box that snaps onto the PAD cube.

Members of the team that created the new device, (from left) Ralph Weissleder, MD, PhD; Chen-Han Huang, PhD; Kisoo Park, PhD; and Hakho Lee, PhD.

box that shape onto the PAD cube.

Inside the box, probes search the patient sample for matching bacterial DNA. When a match is detected, the probes glow, sending a signal that specific genes are present. The system uses those genes to identify the bacteria. That data is sent to a smartphone.

On the smartphone screen, PAD identifies whether a bacterial infection is present. The researchers' current device can already specifically identify nine common infections and determine whether the one involved is resistant to antibiotics.

In a small study, the team tested its device against the gold standard of having a lab grow a bacteria culture to identify it. PAD did just as well as a lab culture in testing for the presence of the bacteria E. coli, Klebsiella, Acinetobacter, Pseudomonas and Staphylococcus aureus, and in reporting how much bacteria was present and whether it was antibiotic-resistant.

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Other Potential Uses

In addition to hospital use, Dr. Weissleder says the device could be helpful in nursing homes, in places with limited healthcare resources and in the food industry. No training is really needed to operate it, he adds. It would particularly improve the care of patients often hospitalized for infections, such as people with asthma and diabetes.

Hospitals could also use PAD to control infections, such as MRSA (Methicillin-resistant Staphylococcus aureus), by testing swabs of doorknobs and medical equipment to determine if cleaning products are removing bacteria. Quickly identifying MRSA and other infections found in hospitals, could limit their spread.

Healthcare-associated infections are a major problem affecting more than 600,000 patients each year, Dr. Weissleder says. "Sadly, more than 10 percent of patients who get these infections will die and the infections incur more than $100 billion in related costs."

The device could also make the diagnostic process less expensive.

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How Philanthropy Can Help

The MGH Center for Systems Biology is working on other devices to speed diagnosis, including one for cancer. But funding such projects can be difficult, Dr. Weissleder says. The bacterial device study was supported in part through philanthropy and the center. Future studies in patients will require additional funding to build more devices and probes for other bacteria. The team is exploring obtaining a federal grant, but research funding has become much more difficult to obtain.

Philanthropic support could help researchers test the PAD device in larger studies, improve the prototype and expand the number of bacterial infections it could identify.

To make a donation to support the work of Dr. Weissleder, Dr. Lee, and other researchers at the MGH Center for Systems Biology, please contact us.