Engineering team invents lab-on-a-chip for fast, inexpensive blood tests

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While most blood tests require shipping a vial of blood to a laboratory for analysis and waiting several days for the results, a new device invented by a team of engineers and students at the University of Rhode Island uses just a pinprick of blood in a portable device that provides results in less than 30 minutes.

"This development is a big step in point-of-care diagnostics, where testing can be performed in a clinic, in a doctor's office, or right at home," said Mohammad Faghri, URI professor of mechanical engineering and the lead researcher on the project. "No longer will patients have to wait anxiously for several days for their test results. They can have their blood tested when they walk into the doctor's office and the results will be ready before they leave."

With the new lab-on-a-chip technology, a drop of blood is placed on a plastic polymer cartridge smaller than a credit card and inserted into a shoebox-sized biosensor containing a miniature spectrometer and piezoelectric micro-pump. The blood travels through the cartridge in tiny channels 500 microns wide to a detection site where it reacts with preloaded reagents enabling the sensor to detect certain biomarkers of disease.

Several patents are pending on the invention.

Compared to similar devices in development elsewhere, the URI system is much smaller, more portable, requires a smaller blood sample, and is

less expensive. While the sensor costs about $3,200, each test costs just $1.50, which is the cost for the plastic cartridge and reagents.

The first cartridges the researchers developed focus on the detection of C-reactive proteins (CRP) in the blood, a preferred method for helping doctors assess the risk of cardiovascular and peripheral vascular diseases. From 2002 to 2004 (the only years for which data are available), the number of CRP tests paid for by Medicare tripled from 145,000 to 454,000, and it is estimated that those numbers have quadrupled since then.

Faghri said that additional cartridges can be designed to detect biomarkers of other diseases. The researchers are already working to engineer the device to detect levels of the beta amyloid protein that can be used as a predictor of Alzheimer's disease. The device can also be engineered to detect virulent pathogens, including HIV, hepatitis B and H1N1 (swine) flu.

The next generation of the device will incorporate a hand-held sensor that will reduce manufacturing costs. Faghri also envisions a further miniaturization of the invention that can be adapted as a smartphone application. By embedding the biosensor in the cartridge and using the computer power of the phone, as well as its wireless communication capabilities, Faghri believes that patients may be able to conduct the tests themselves and have the results transmitted immediately to their doctor's office via their phone. Among many other benefits, this should help to significantly reduce health care costs.

"We are already making progress on many of the steps toward the next generation of the system, and it won't be long before we can begin to commercialize it," Faghri said.