Breakthrough allows fast, reliable pathogen identification

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Life-threatening bacterial infections cause tens of thousands of deaths every year in North America. Increasingly, many infections are resistant to first-line antibiotics. Unfortunately, current methods of culturing bacteria in the lab can take days to report the specific source of the infection, and even longer to pinpoint the right antibiotic that will clear the infection. There remains an urgent, unmet need for technologies that can allow bacterial infections to be rapidly and specifically diagnosed.

Researchers from the University of Toronto have created an electronic chip with record-breaking speed that can analyze samples for panels of infectious bacteria. The new technology can report the identity of the pathogen in a matter of minutes, and looks for many different bacteria and drug resistance markers in parallel, allowing rapid and specific identification of infectious agents. The advance was reported this month in the journal *Nature Communications*.

"Overuse of antibiotics is driving the continued emergence of drug-resistant bacteria," said Shana Kelley (Pharmacy and Biochemistry), a senior author of the study. "A chief reason for use of ineffective or inappropriate antibiotics is the lack of a technology that rapidly offers physicians detailed information about the specific cause of the infection."

The researchers developed an integrated circuit that could detect bacteria at concentrations found in patients presenting with a urinary tract infection. "The chip reported accurately on the type of bacteria in a

sample, along with whether the pathogen possessed drug resistance," explained Chemistry Ph.D. student Brian Lam, the first author of the study.

One key to the advance was the design of an integrated circuit that could accommodate a panel of many biomarkers. "The team discovered how to use the liquids in which biological samples are immersed as a 'switch' – allowing us to look separately for each biomarker in the sample in turn," said Ted Sargent (Electrical and Computer Engineering), the other senior author of the report.

"The solution-based circuit chip rapidly and identifies and determines the antibiotic resistance of multiple pathogens – this represents a significant advance in biomolecular sensing," said Paul S. Weiss, Kavli Chair in NanoSystems Science and Director of the California NanoSystems Institute at UCLA.

Ihor Boszko, Director of Business Development at Xagenic, a Toronto-based in vitro diagnostics company said the breakthrough could have significant practical implications. "This kind of highly sensitive, enzyme-free electrochemical detection technology will have tremendous utility for near patient clinical diagnostics. Multiplexing of in vitro diagnostic approach adds the capability of simultaneously testing for multiple viruses or bacteria that produce similar clinical symptoms. It also allows for simple and cost effective manufacturing of highly multiplexed electrochemical detectors, which will certainly have a significant impact on the availability of effective diagnostic tools."

More information: The paper, "Solution-based circuits enable rapid and multiplexed pathogen detection," can be found at www.nature.com/ncomms/2013/130 … full/ncomms3001.html

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