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Innovative hand-held lab-on-a-chip could streamline blood testing

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Samuel K. Sia, assistant professor of biomedical engineering at Columbia Engineering, has developed an innovative strategy for an integrated microfluidic-based diagnostic device—in effect, a lab-on-a-chip—that can perform complex laboratory assays, and do so with such simplicity that these tests can be carried out in the most remote regions of the world. In a paper published in *Nature Medicine* online on July 31, Sia presents the first published field results on how microfluidics—the manipulation of small amounts of fluids—and nanoparticles can be successfully leveraged to produce a functional low-cost diagnostic device in extreme resource-limited settings.

Sia and his team performed testing in Rwanda over the last four years in partnership with Columbia's Mailman School of Public Health and three local non-government organizations in Rwanda, targeting hundreds of patients. His device, known as mChip (mobile microfluidic chip), requires only a tiny finger prick of blood, effective even for a newborn, and gives—in less than 15 minutes—quantitative objective results that are not subject to user interpretation. This new technology significantly reduces the time between testing patients and treating them, providing medical workers in the field results that are much easier to read at a much lower cost. New low-cost diagnostics like the mChip could revolutionize medical care around the world.

"We have engineered a disposable credit card-sized device that can produce blood-based diagnostic results in minutes," said Sia. "The idea is to make a large class of diagnostic tests accessible to patients in any

setting in the world, rather than forcing them to go to a clinic to draw blood and then wait days for their results."

Sia's lab at Columbia Engineering has developed the mChip devices in collaboration with Claros Diagnostics Inc., a venture capital-backed startup that Sia co-founded in 2004. (The company has recently been named by MIT's Technology Review as one of the 50 most innovative companies in the world.) The microchip inside the device is formed through injection molding and holds miniature forms of test tubes and chemicals; the cost of the chip is about $1 and the entire instrument about $100.

Sia hopes to use the mChip to help pregnant women in Rwanda who, while they may be suffering from AIDS and sexually transmitted diseases, cannot be diagnosed with any certainty because they live too far away from a clinic or hospital with a lab. "Diagnosis of infectious diseases is very important in the developing world," said Sia. "When you're in these villages, you may have the drugs for many STDs, but you don't know who to give treatments to, so the challenge really comes down to diagnostics." A version of the mChip that tests for prostate cancer has also been developed by Claros Diagnostics and was approved in 2010 for use in Europe.

Sia's work also focuses on developing new high-resolution tools to control the extracellular environments around cells, in order to study how they interact to form human tissues and organs. His lab uses techniques from a number of different fields, including biochemistry, molecular biology, microfabrication, microfluidics, materials chemistry, and cell and tissue biology.

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