DIY pump takes science out of the lab

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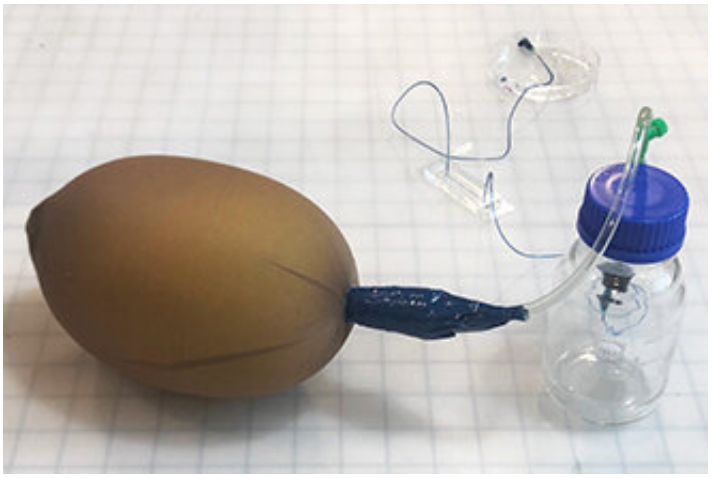

Scientists have developed a cheap and simple pump, made from balloons and stockings, that can be used to analyse water and blood samples outside of the lab. Credit: Walter and Eliza Hall Institute of Medical Research

A simple pressure pump, made from balloons and nylon stockings, will give more people in more places the ability to test for water contaminants and analyze blood samples.

The ingenious device, unveiled in the journal Lab on a Chip, costs just $2 to make yet works almost as well as its expensive and cumbersome laboratory counterparts, without the need for a high-tech laboratory.

The DIY pump creation and testing was a collaboration between researchers at RMIT and the Walter and Eliza Hall Institute. Together they designed the pump and demonstrated its viability in tests to detect

aquatic parasites and cancer cells, and study vascular diseases.

A much-needed field tool

Pumps are used to make biological samples flow through microfluidic devices, enabling their contents to be identified using a microscope.

Parasitologist Associate Professor Aaron Jex from the Walter and Eliza Hall Institute is a leading researcher in global water quality and public health interventions, and was a co-author on the study.

He said the exciting innovation could lead to the ability to test and diagnose patients for infectious pathogens and aquatic micro-organisms at the point-of-care.

"Parasitic micro-organisms have a major impact in impoverished communities in tropical and subtropical regions globally, but also in developed countries including Australia," Associate Professor Jex said.

"There is an urgent need for field-based, low-cost diagnostic tools that work in challenging, sometimes remote and often complex environments, very different from a pristine laboratory.

"As simple as it may look, this device suits those needs really well and could have a big impact."

Surprising inspiration

RMIT engineer and lead author Dr. Peter Thurgood said the team took inspiration for the simple invention from footballs, which hold large pressures when reinforced.

"We started with basic latex balloons, then realised that regular stockings made from nylon and elastane could be a perfect match to reinforce them, allowing them to hold significantly higher pressure and function as pumps," Dr. Thurgood said.

"By simply wrapping three layers of stockings around the latex balloon we were able to increase its internal pressure by a factor of 10—enough to run many water or blood analyses that would usually require large, expensive pumps."

Promising applications

The balloon pump was tested as a point-of-care diagnostic device for detection of very low concentrations of target cancer cells in liquid samples, and found to work.

RMIT biologist and co-author Dr. Sara Baratchi said it also had promising applications for early diagnosis of disease, at home or in the doctor's surgery.

"The hydrodynamic force of liquid produced by the reinforced balloon was enough to isolate cells for study, which was really amazing for a $2 pump," Dr. Baratchi said.

RMIT engineer and project lead Dr. Khashayar Khoshmanesh said more widespread application of microfluidics had been limited by the cost and size of equipment.

"By redesigning sophisticated microfluidic devices into simplified ones, we can maximise their outreach and applications," Dr. Khoshmanesh said.

Experiments showed the reinforced balloon pump could be used to

operate microfluidic devices for several hours without a significant pressure loss. The pump also fits easily within an incubator and can be left overnight.

More information: Peter Thurgood et al. Self-sufficient, low-cost microfluidic pumps utilising reinforced balloons, *Lab on a Chip* (2019). DOI: 10.1039/C9LC00618D

Provided by Walter and Eliza Hall Institute of Medical Research