Separation line

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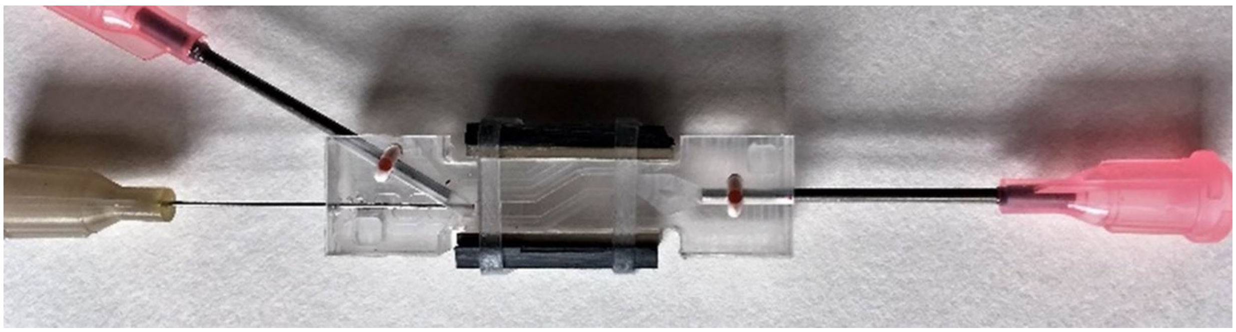

Credit: Erin Dauson, Department of Civil and Environmental Engineering, Carnegie Mellon University

For patients in need of blood, it's fatally important that they receive the right type. That's why doctors will often give emergency room patients universal donor blood, rather than waiting for the results of a blood test. Blood tests take a long time to process, are expensive, and leave room for human error—putting a vial of blood in the wrong rack, mislabeling it, or sending the chart to the wrong room. If blood tests could be handled right at the point of care, it could revolutionize diagnosis and treatment.

To revamp the way blood tests are administered, Carnegie Mellon University researchers created a point-of-care device that uses sound waves to separate blood cells. The device, developed by civil and environmental engineering (CEE) post-doctoral researcher Erin Dauson, CEE professors Kelvin Gregory and Irving Oppenheim, and Associate Professor of Chemical Engineering Kris Dahl, has the potential to allow doctors to perform blood tests in the same room as the patient.

The handheld device, made of plexiglass, contains a tiny channel that flows at an angle. On either side of the channel, lead zirconate titanate (PZT) crystals vibrate when excited with an electric voltage, creating bulk waves that propagate in the channel. The sound waves apply a force to the particles flowing through the channel, causing the particles to separate based on size, shape, and compressibility.

For example, a red blood cell (RBC) will follow the streamline, or the direction that the fluid flows, even if the flow curves at an angle. But white blood cells, because they are larger than RBCs, are pushed with more force and are deflected out of the streamline into a separate line.

"We want to supplement current blood testing methods with a point-of-care option using this device," says Dauson. "We're trying to address some of the limitations of current methods by applying our device to applications in blood typing and complete blood count."

Current methods for separating cells require adding molecular tags that modify the cells and limit their uses for further study. With these methods, researchers can only separate one or two cell types at a time. Unlike current methods, the device created by the Carnegie Mellon researchers doesn't alter the cell's make-up in any way. And it only requires a small amount of blood to complete a test.

With this technology, doctors could administer blood counts or blood typing tests right in their offices—with only one drop of blood. Once the device is perfected, it can also be inexpensively produced in large quantities.

"There are a variety of applications that we're touching on," says Gregory. "But ultimately it is about diagnosis. We're talking about a pinprick of blood instead of drawing five milliliters of blood from an artery. Very low volume and very rapid diagnosis, leading to faster decisions about treatment."

With their novel device design, the research team has opened the doors to efficient, inexpensive, and minimally invasive blood testing. The team will continue to optimize the device before pursuing avenues for commercializing the instrument.

More information: Erin R. Dauson et al, Human blood cell separation using bulk acoustic waves in a machined PMMA microchannel, *2017 IEEE International Ultrasonics Symposium (IUS)* (2017). DOI: 10.1109/ULTSYM.2017.8092324

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