$3 paper device could accurately detect cancer in 60 minutes

By StudyFinds Staff · Reviewed by Steve Fink
Research led by Dr. XiuJun (James) Li, University of Texas at El Paso
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FACT CHECKED

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A team of researchers from The University of Texas at El Paso, led by Xiujun (James) Li, Ph.D., has created a low-cost, portable device that can detect colorectal and prostate cancer in as little as one hour. (Credit: The University of Texas at El Paso)

EL PASO, Texas — In a breakthrough that could make early cancer detection more accessible worldwide, researchers have developed a simple, low-cost testing device that can detect multiple cancer markers in blood with greater sensitivity than current

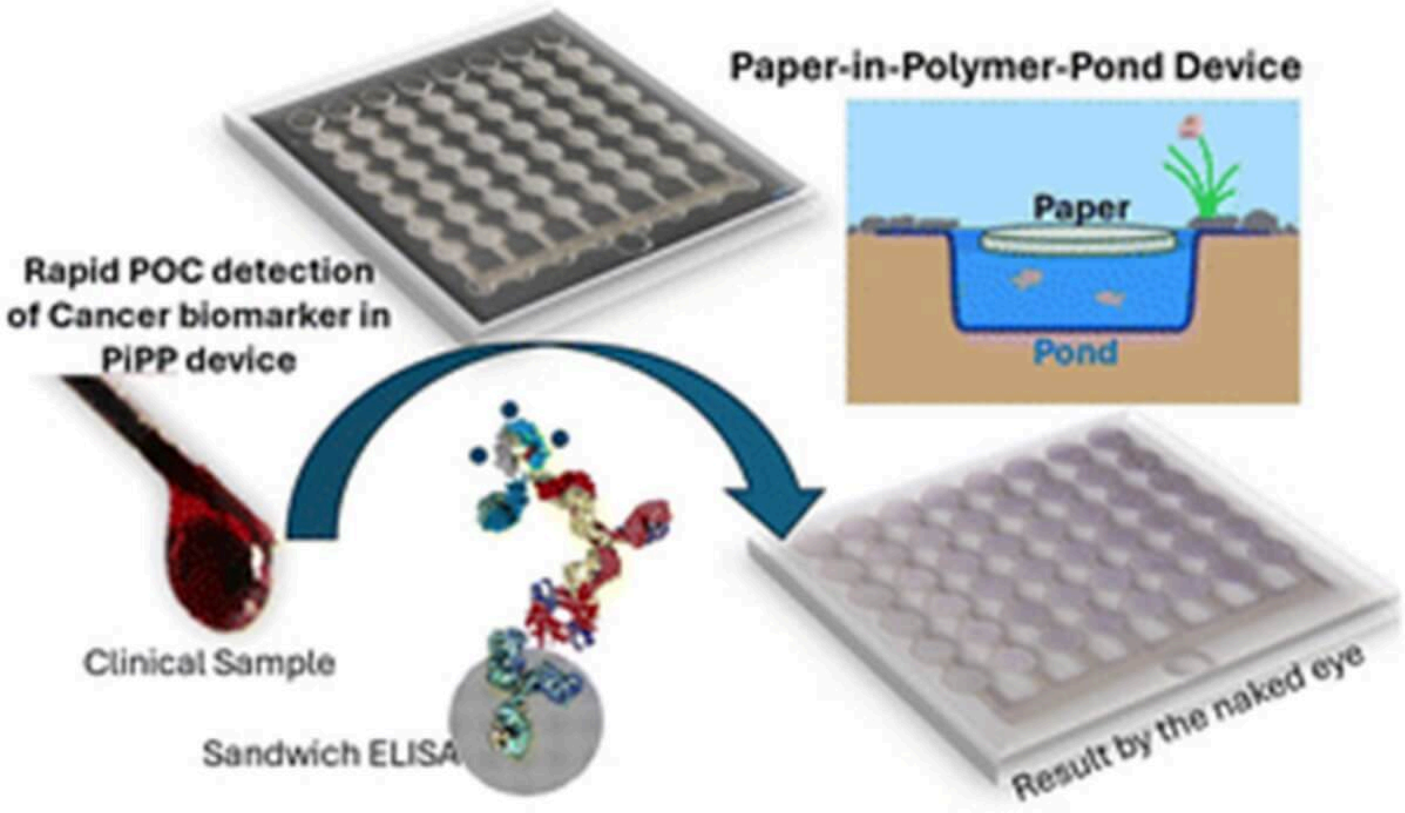
methods. Perhaps even more impressive: results could be available from the cancer test within an hour!

The innovative system, described in a recent paper published in *Lab on a Chip*, combines ordinary paper and plastic materials to create this inexpensive but highly accurate diagnostic tool.

Cancer remains one of the world's deadliest diseases, with an estimated 19.31 million new cases and 10 million deaths reported in 2020. While developed countries often have access to sophisticated cancer screening methods, developing nations face significant barriers to early detection, leading to higher mortality rates despite lower cancer incidence. This disparity in healthcare access contributes to unnecessary deaths that could be prevented through earlier diagnosis.

The new testing platform, called a paper-in-polymer-pond (PiPP) device, was created by researchers at the University of Texas at El Paso (UTEP). It works by combining the best properties of paper and plastic materials to create a hybrid testing surface that can detect multiple cancer markers simultaneously. The system uses ordinary chromatography paper – similar to coffee filter paper – placed within a precisely designed plastic framework.

"Our new biochip device is low-cost — just a few dollars — and sensitive, which will make accurate disease diagnosis accessible to anyone, whether rich or poor," says lead author XiuJun (James) Li, Ph.D., a UTEP professor of chemistry and biochemistry, in a media release. "It is portable, rapid and eliminates the need for specialized instruments."



A paper-in-polymer-pond (PiPP) hybrid microfluidic microplate for multiplexed ultrasensitive detection of cancer biomarkers (Credit: Lab on a chip)

The device focuses on detecting two important cancer markers: carcinoembryonic antigen (CEA), which is associated with colorectal cancer, and prostate-specific antigen (PSA), which helps diagnose prostate cancer. These proteins appear in blood at very low levels in early-stage cancers, making them difficult to detect with conventional methods.

What makes this innovation particularly promising is its combination of simplicity and effectiveness. The entire testing process takes just one hour, compared to the 16 hours

needed for traditional testing methods. The device can detect these cancer markers at extremely low concentrations – about 10 times more sensitively than current commercial testing kits. Additionally, it requires only a small drop of blood and can be read using an ordinary office scanner or smartphone camera.

Perhaps most importantly, the system is designed to be both affordable and reusable. The plastic framework can be used multiple times by simply replacing the paper component, making it especially suitable for clinics in resource-limited settings. The device doesn't require expensive laboratory equipment or specially trained personnel to operate, addressing major barriers to cancer screening in developing regions.

Despite the promising results, the path to making this device available to the public will take time. The prototype must undergo rigorous clinical trials with actual patients, a process that could take several years. Like all medical diagnostic devices, it will require final approval from the Food and Drug Administration before physicians can use it in clinical settings. This thorough validation process, while time-consuming, is essential to ensure the device's safety and effectiveness in real-world medical situations.

"Dr. XiuJun Li's innovation significantly improves point-of-care diagnostics by reducing detection times and the need for costly instruments," says Robert Kirken, dean of the College of Science at UTEP. "This makes it ideal for resource-limited settings, which will improve early diagnosis and lead to better cancer outcomes. I look forward to seeing what this innovation leads to."

Paper Summary

Methodology

The PiPP device consists of three plastic layers with precisely cut channels and wells, plus a specially treated paper layer. When a blood sample is added, it flows through these channels, allowing cancer markers to bind to specific antibodies on the paper. A series of chemical reactions then produces a visible purple color, with darker purple indicating higher levels of cancer markers. The intensity of this color can be measured using basic imaging equipment, providing accurate quantitative results.

Key Results

In laboratory testing, the device successfully detected both CEA and PSA at very low concentrations – as low as 0.32 nanograms per milliliter for CEA and 0.20 nanograms per milliliter for PSA. These levels are well below the clinical thresholds used to diagnose cancer (5 ng/mL for CEA and 4 ng/mL for PSA). The system also showed excellent accuracy when testing blood samples spiked with known amounts of these cancer markers, with recovery rates between 90% and 110%.

Study Limitations

While promising, the study has several limitations. The testing was primarily conducted using laboratory samples rather than real patient specimens, meaning additional clinical validation is needed. The researchers acknowledge that the device's

effectiveness in real-world medical settings still needs to be proven through further studies with actual patient samples.

Discussion & Takeaways

The development of this device represents a significant step toward making cancer screening more accessible in resource-limited settings. Its ability to detect multiple cancer markers quickly and accurately, combined with its low cost and simple operation, could help address the disparity in cancer outcomes between developed and developing nations. The technology could potentially be adapted to detect other disease markers as well.

Funding & Disclosures

The research was supported by multiple organizations, including the Cancer Prevention and Research Institute of Texas, the National Institutes of Health, and the National Science Foundation. Two of the researchers have submitted a patent application related to the device, indicating potential commercial development plans.

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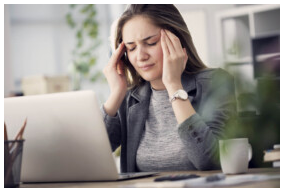

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