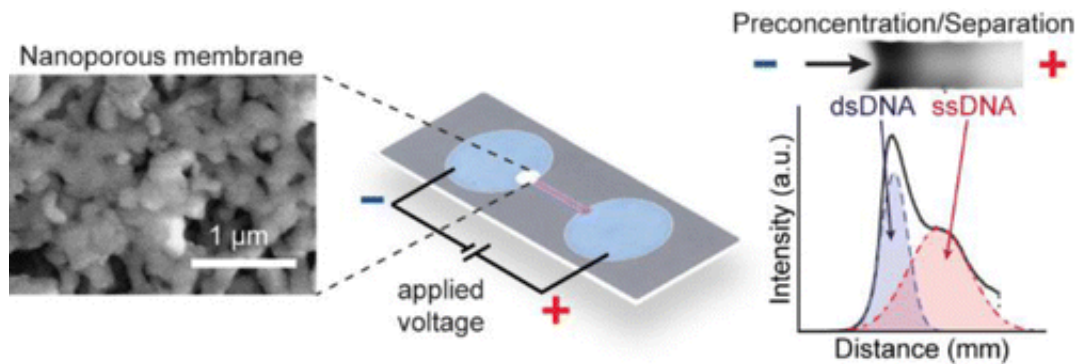


# Paper-based test could diagnose hepatitis B and assess male fertility at low cost

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Scientists have developed a new paper device that analyzes DNA and could rapidly and inexpensively assess disparate conditions including hepatitis B and male infertility, which together affect millions of people around the world. The test, reported in the *Journal of the American Chemical Society*, could be of particular help diagnosing people in low-income areas.

DNA analysis has become a valuable tool in forensic science, genetics and disease diagnosis. But carrying out such analyses requires expensive lab equipment, making its application out of reach for many people who live in resource-limited places. Advances in nanomaterials, however, could make analysis of genetic material possible at a much lower cost. David Sinton and colleagues wanted to see if they could come up with a

new paper device with such nanomaterials to test DNA without the use of high-tech facilities.

The researchers made a paper-based diagnostic test out of materials that cost less than \$1 per device. After only a 10-minute run, the device could detect the hepatitis B virus in blood serum at a level low enough to flag an early-stage acute infection, which is critical to help prevent its spread. It also could determine the DNA integrity of sperm—a predictor of fertility—from semen samples as accurately as current clinical methods.

**More information:** Max M. Gong et al. Direct DNA Analysis with Paper-Based Ion Concentration Polarization, *Journal of the American Chemical Society* (2015). [DOI: 10.1021/jacs.5b08523](https://doi.org/10.1021/jacs.5b08523)

### **Abstract**

DNA analysis is essential for diagnosis and monitoring of many diseases. Conventional DNA testing is generally limited to the laboratory. Increasing access to relevant technologies can improve patient care and outcomes in both developed and developing regions. Here, we demonstrate direct DNA analysis in paper-based devices, uniquely enabled by ion concentration polarization at the interface of patterned nanoporous membranes in paper (paper-based ICP). Hepatitis B virus DNA targets in human serum are simultaneously preconcentrated, separated, and detected in a single 10 min operation. A limit of detection of 150 copies/mL is achieved without prior viral load amplification, sufficient for early diagnosis of hepatitis B. We clinically assess the DNA integrity of sperm cells in raw human semen samples. The percent DNA fragmentation results from the paper-based ICP devices strongly correlate ( $R^2 = 0.98$ ) with the sperm chromatin structure assay. In all cases, agreement was 100% with respect to the clinical decision. Paper-based ICP can provide inexpensive and accessible advanced molecular diagnostics.

Provided by American Chemical Society

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