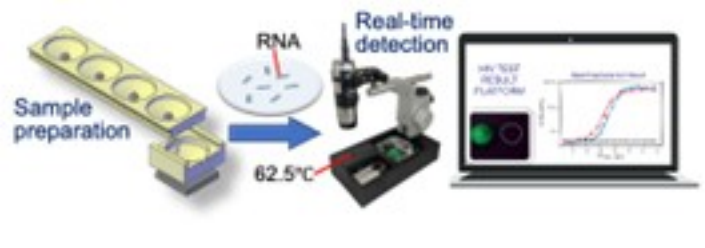
Transforming HIV diagnosis: a low-cost, point-of-care detection solution



An HIV detection platform combining paper-based sample preparation with real-time isothermal amplification.

GA, UNITED STATES, February 28, 2025 /EINPresswire.com/ -- A team of researchers from the University of Florida has developed an innovative handheld device for human immunodeficiency virus (HIV) detection that combines paper-based sample preparation with real-time isothermal amplification. This low-cost, portable platform promises rapid and accurate HIV diagnosis at the point of care (POC), overcoming the limitations of traditional laboratory-based tests. By eliminating the need for complex equipment and specialized personnel, this device is poised to revolutionize early HIV detection and management, particularly in resource-limited settings. With results delivered in as little as 60 minutes, the device offers unprecedented speed and reliability, matching the sensitivity of standard laboratory assays.

Human immunodeficiency virus (HIV) remains a global health challenge, with millions of people affected worldwide. Early diagnosis is essential for timely antiretroviral therapy and preventing transmission. However, current nucleic acid tests (NATs) often require advanced laboratory infrastructure and trained personnel, making them impractical in low-resource settings. While antibody-based rapid tests provide convenience, they lack sensitivity during the acute phase of infection and fail to distinguish between acute and chronic stages. These limitations highlight the urgent need for affordable, sensitive, and portable HIV detection tools that can be easily deployed at the point of care (POC).

On September 6, 2024, a team from the University of Florida unveiled their handheld HIV detection platform, published (DOI: 10.1038/s41378-024-00822-1) in Microsystems & Nanoengineering. This device integrates paper-based sample preparation with real-time reverse transcription loop-mediated isothermal amplification (RT-LAMP), offering an affordable and efficient alternative for HIV testing. The device stands as a breakthrough in POC diagnostics, combining simplicity, portability, and high sensitivity to create a solution that could transform global HIV testing.

The new HIV detection platform offers a novel integration of paper-based sample preparation

and isothermal amplification, eliminating the need for lab equipment like centrifuges or pipettes. Viral RNA is extracted from samples onto a paper substrate, and subsequently amplified via RT-LAMP in a compact, battery-powered heating unit. Detection is achieved through colorimetric indicators or real-time imaging. The device demonstrated a detection limit of 30 copies/mL of HIV RNA, a level comparable to traditional laboratory methods, with no cross-reactivity to hepatitis C virus (HCV). Clinical testing confirmed 100% specificity, ensuring the device's accuracy for HIV diagnosis. Moreover, the real-time detection capability allows for quantitative viral load measurement, which is critical for assessing treatment efficacy and drug resistance. By delivering results in under 60 minutes, the device significantly reduces the time required compared to traditional PCR-based methods, providing a rapid diagnostic solution in resource-poor environments.

Dr. Z. Hugh Fan, a key researcher on the project, emphasized the transformative potential of this technology: "Our handheld device addresses the critical need for rapid, accurate, and accessible HIV testing. By integrating sample preparation and real-time detection in a portable format, we have created a tool that can change the landscape of HIV diagnosis, particularly in resource-limited areas where laboratory infrastructure is scarce."

This handheld HIV detection platform can have wide-reaching implications for global health. Its low cost, portability, and high sensitivity make it an ideal tool for POC testing in low-resource environments, where access to traditional diagnostic methods is limited. In addition to improving HIV management and treatment outcomes, the technology’s adaptability opens the door for detecting other pathogens, expanding its potential to revolutionize infectious disease diagnostics worldwide.

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