Researchers develop simple, affordable HIV testing device

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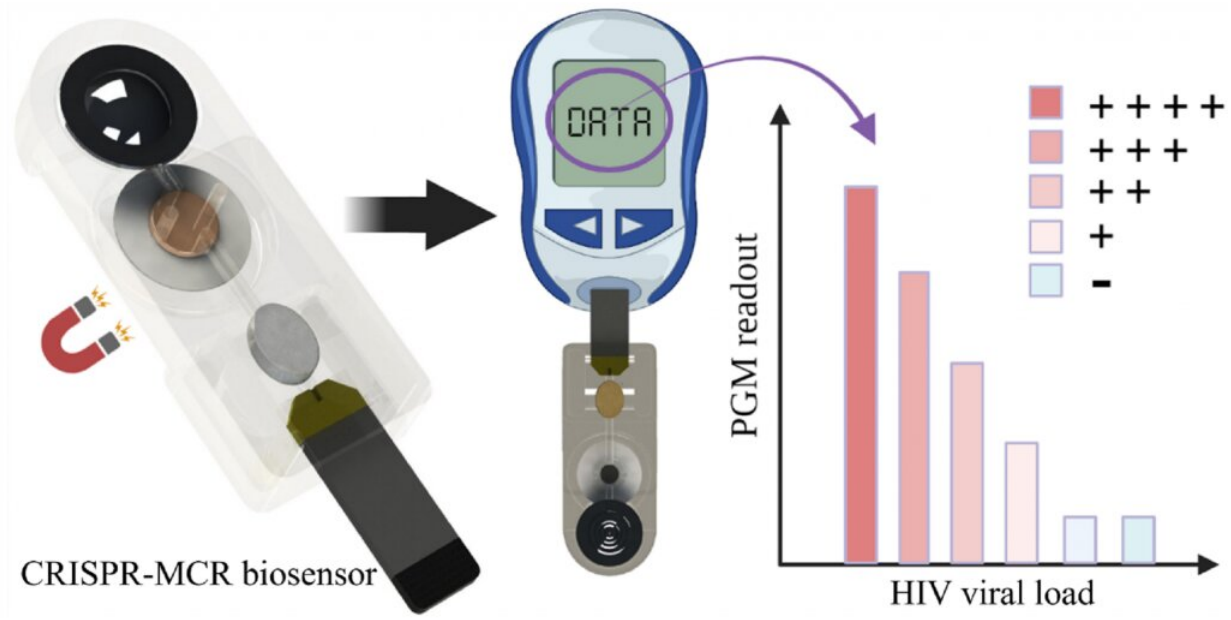

A simple, portable, CRISPR-powered microfluidic biosensor for HIV virus detection using a personal glucose meter. Credit: Changchun Liu

HIV is one of the world's most serious public health challenges, and molecular detection plays a significant role in early diagnosis and antiretroviral therapy for HIV patients. The current "gold standard" of HIV testing requires expensive instruments and highly-trained personnel—leaving an unmet need for a rapid, sensitive, and affordable approach for molecular detection of HIV at the point of care.

Published in the journal *ACS Nano*, a research team led by Changchun Liu in the Department of Biomedical Engineering present a low-cost, bioinspired Clustered Regularly Interspaced Short Palindromic Repeats (CRISPR)-powered biosensor for point of care testing of the HIV virus using a simple personal glucose meter—similar to diabetes home testing.

"Inspired by the multicompartment structures in living cells, we propose a membrane-separated, microfluidic, CRISPR-powered cascade reaction system," Liu says, "by combining with personal glucose biosensing technology, it is developed into a portable, disposable diagnostic platform for molecular detection of HIV virus and other pathogens."

Dr. David Banach in the Division of Infectious Diseases in the School of Medicine, Lori Avery in the Department of Pathology of Laboratory Medicine, and Ziyue Li, Naoki Uno, and Xiong Ding in the Department of Biomedical Engineering also contributed to this study.

CRISPR technology is on the cutting edge for highly sensitive and specific nucleic acid-based molecular detection of different pathogens. When used alongside simple isothermal amplification technologies, it becomes a powerful diagnostic tool. However, the combination of isothermal amplification reaction and CRISPR detection systems have limited capabilities, requiring separate reaction tubes and multiple manual operations which increases the risk of contamination and is not ideal for simple and effective point of care applications.

To improve compatibility, the researchers presented a nanoporous membrane-separated cascade reaction system and integrated it into a simple, portable CRISPR-mediated cascade reaction (MCR) biosensor for HIV nucleic acid testing using a low-cost glucose meter to eliminate the need for complex instruments and well-trained personnel.

The researchers were able to detect sensitivities of 43 copies of HIV DNA and 200 copies of HIV RNA per test—exhibiting great potential for rapid detection of HIV virus and other infectious diseases at the point of care.

"Globally, HIV infection has a disproportionate impact on underserved populations with limited access to laboratory testing," says Banach. "This technology has the potential to bring point of care HIV testing to settings where early diagnosis and monitoring during treatment are critical."

More information: Ziyue Li et al, Bioinspired CRISPR-Mediated Cascade Reaction Biosensor for Molecular Detection of HIV Using a Glucose Meter, *ACS Nano* (2023). DOI: 10.1021/acsnano.2c12754

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