OPEN ACCESS Freely available online

Journal of Medical Daignostic Methods

Commentary

Point-of-Care CRISPR-Based Diagnostics: Future of Infectious Disease Detection

Emily R. Stanton*

Department of Molecular Medicine, King's College London, London, United Kingdom

DESCRIPTION

The COVID-19 pandemic underscored the urgent need for fast, accurate and scalable diagnostic tools for infectious diseases. Traditional diagnostics, such as PCR and ELISA, though highly accurate, often require centralized laboratories, skilled personnel and sophisticated infrastructure. These limitations make them less ideal for rapid or remote disease detection, especially in outbreak scenarios or low-resource environments. In this context, CRISPR-based diagnostics have emerged as a innovative with the potential to redefine Point-Of-Care (POC) testing. Originally known for its gene-editing capabilities, CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) has recently been adapted into highly sensitive molecular diagnostic platforms. When combined with isothermal amplification and lateral flow technology, CRISPR can detect viral or bacterial nucleic acids in minutes with minimal equipment and at a fraction of the cost of standard laboratory methods.

The mechanics of CRISPR-based diagnostics hinge on programmable Cas enzymes (e.g., Cas12, Cas13) that recognize specific genetic sequences. Upon detecting the target nucleic acid, these enzymes cleave a reporter molecule, producing a detectable signal either fluorescent or colorimetric. Systems such as SHERLOCK (Specific High Sensitivity Enzymatic Reporter Unlocking) and DETECTR (DNA Endonuclease Targeted CRISPR Trans Reporter) have demonstrated remarkable specificity and sensitivity in identifying pathogens like SARS-CoV-2, Zika virus and even drug-resistant bacteria.

The transformative potential of CRISPR-based POC diagnostics lies in several key advantages:

Speed and Simplicity: Results can be obtained in under an hour, with minimal training required for operators. Devices can be battery-operated and portable, suitable for use in clinics, airports, or field settings.

High Sensitivity and Specificity: CRISPR systems can discriminate between closely related strains or even single-nucleotide mutations, which is critical in detecting variants or antibiotic resistance genes.

Scalability and Cost-Effectiveness: Unlike PCR machines, CRISPR diagnostic kits are low-cost and do not require complex thermal cycling. This makes them highly scalable and ideal for resource-limited settings.

Multiplexing Potential: Emerging CRISPR platforms are being engineered to detect multiple pathogens in a single test, enabling syndromic diagnostics, especially useful in fever clinics or during pandemics.

Despite its promise, the field faces several challenges. One of the main hurdles is regulatory approval and standardization. Most CRISPR-based diagnostic systems are still under development or in limited use under emergency authorization. For widespread clinical adoption, strong validation against gold-standard methods is essential. Moreover, while lateral flow assays are user-friendly, they often lack the quantitative precision of laboratory tests. Integrating CRISPR diagnostics with smartphone-based readers or microfluidic chips may bridge this gap, allowing semi-quantitative analysis and data digitization in real time.

Another critical consideration is data privacy and biosecurity. As these diagnostics become more integrated with digital health platforms, safeguarding patient information and preventing misuse of genetic data will be paramount. Ethical frameworks must evolve alongside technological capabilities. The rapid development and deployment of CRISPR diagnostics have largely been supported by high-income countries with strong biotech ecosystems. However, for these tools to make a global impact especially in controlling outbreaks in low-income settings technology transfer, capacity building and equitable pricing models are needed. Collaborative efforts through global health alliances can ensure that the benefits of CRISPR-based diagnostics reach the populations most vulnerable to infectious disease threats.

CONCLUSION

CRISPR-based diagnostics represent a change of opinion in the field of infectious disease detection, especially at the point of care. Their unparalleled combination of speed, accuracy, affordability and portability addresses many of the limitations associated with traditional diagnostic tools. As new variants of pathogens continue to emerge and global health systems prepare

Correspondence to: Emily R. Stanton, Department of Molecular Medicine, King's College London, London, United Kingdom, E-mail: emilysanton@kcl.ac

Received: 31-Jan-2025, Manuscript No. JMDM-25-38009; **Editor assigned:** 03-Feb-2025, PreQC No. JMDM-25-38009 (PQ); **Reviewed:** 17-Feb-2025, QC No. JMDM-25-38009; **Revised:** 24-Feb-2023, Manuscript No. JMDM-25-38009 (R); **Published:** 03-Mar-2025, DOI: 10.35248/2168-9784.25.14.510

Citation: Stanton ER (2025). Point-of-Care CRISPR-Based Diagnostics: Future of Infectious Disease Detection. J Med Diagn Meth. 14:510.

for future pandemics, the ability to detect diseases rapidly and reliably outside conventional laboratories is more vital than ever.

For high-income countries, CRISPR diagnostics offer the potential to decentralize testing, reduce burden on centralized labs and improve outbreak response times. For low-resource settings, they may be the key to bridging the diagnostic gap that has long contributed to delayed care and uncontrolled disease spread. As the technology matures and gains regulatory approval, the focus must shift toward global accessibility, clinical integration and continuous innovation. With strategic investments and international collaboration, CRISPR-based point-of-care diagnostics could soon become the gold standard for managing infectious diseases ushering in a new era of personalized, precise and accessible global health.