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Viral Molecular Diagnostics and Evolutionary Monitoring Platform Based on Next-Generation Sequencing Technology

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The rapid emergence and evolution of viruses pose substantial threats to public health, necessitating efficient molecular diagnostic tools and continuous genomic monitoring. This talk presents a Next-Generation Sequencing (NGS)-based platform for rapid viral detection and evolutionary surveillance, enabling timely identification of emerging pathogens and real-time outbreak tracking. A key emphasis is given to SARS-CoV-2, demonstrating how genomic data can be leveraged to decipher viral transmission patterns and evolutionary dynamics. Additionally, I will discuss the application of metagenomic approaches for detecting unknown pathogens within ecosystems. Bioinformatics challenges, including phylogenetic reconstruction, global transmission monitoring, and real-time outbreak analysis, are also highlighted. Ultimately, integrating genomic diagnostics with evolutionary monitoring enhances our ability to detect, track, and respond to emerging viral threats, reinforcing the importance of surveillance efforts.