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Current and Future State of Metagenomics for Infectious Disease Testing

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With the rapid advancement of next-generation sequencing (NGS) technology, metagenomic next-generation sequencing (mNGS) has emerged as a pivotal tool in precision medicine, particularly for complex infectious disease diagnostics. mNGS enables unbiased pathogen detection and provides comprehensive insights into dynamic host-microbiome interactions, significantly enhancing diagnostic sensitivity and specificity. This presentation will systematically introduce the latest developments in mNGS applications for infectious disease testing, including the evolution of sequencing technologies, comparative analysis between 16S rRNA amplicon sequencing and shotgun metagenomics, and standardized processing workflows for clinical specimens. Additionally, we will thoroughly examine the critical challenges in clinical implementation, such as contamination control strategies, quality standardization, complex data interpretation, and regulatory considerations. Finally, we will explore future directions for optimizing mNGS through technological innovations and workflow improvements to advance its clinical utility in infectious disease diagnosis, ultimately facilitating precision diagnostics and personalized therapeutic approaches.