Molecular diagnostics: Precision, personalization, automation.

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Introduction

This article highlights liquid biopsy's transformative role in lung cancer management. It covers its application in diagnosis, molecular profiling, and monitoring treatment response and minimal residual disease. The authors emphasize how this non-invasive method is pushing forward personalized medicine for lung cancer patients, discussing the various circulating biomarkers it utilizes.[1].

This review explores the significant potential of Next-Generation Sequencing (NGS) in identifying pathogens in infectious diseases. It details how NGS can offer rapid and accurate diagnosis, especially for hard-to-culture or novel pathogens, and its advantages over traditional methods. The article covers various NGS applications, from whole-genome sequencing to metagenomics, emphasizing its growing importance in clinical settings and outbreak investigations.[2].

This paper provides an overview of CRISPR-based molecular diagnostic methods for infectious diseases. It highlights the high specificity and sensitivity of these systems, like SHERLOCK and DETECTR, for rapid detection of pathogens. The article discusses various CRISPR applications, including Point-of-Care testing and distinguishing between different strains, offering a comprehensive look at how CRISPR technology is revolutionizing infectious disease diagnostics.[3].

This article delves into the application of pharmacogenomics in oncology, tracing its journey from foundational research to its current impact on clinical practice. It explains how genetic variations influence drug response, allowing for more personalized cancer treatment. The authors detail how molecular diagnostics identify these variations, guiding drug selection and dosage to maximize efficacy and minimize adverse effects in cancer therapy.[4].

This systematic review explores the integration of Artificial Intelligence (AI) in medical genetics and molecular diagnostics. The authors review various AI applications, including disease diagnosis, variant interpretation, and personalized medicine, showcasing how AI algorithms enhance efficiency and accuracy in analyzing complex genetic data. It discusses both the opportunities and challenges of incorporating AI into routine diagnostic workflows.[5].

This article discusses the recent advancements in Point-of-Care (POC) molecular diagnostics for infectious diseases. It highlights how these rapid, portable devices enable timely pathogen detection outside traditional laboratory settings, improving patient management and outbreak control. The authors review emerging technologies and platforms that are making molecular testing more accessible and user-friendly for a variety of infectious agents.[6].

This article focuses on circulating tumor DNA (ctDNA) as a liquid biopsy marker for advanced lung cancer. It details ctDNA's utility in various clinical applications, including initial diagnosis, monitoring disease progression, assessing treatment response, and detecting minimal residual disease. The authors emphasize ctDNA's potential to provide real-time insights into tumor dynamics, paving the way for more personalized and adaptive treatment strategies.[7].

This comprehensive review explores the application of advanced molecular diagnostics in neurological disorders. It highlights how genomic, transcriptomic, and proteomic approaches are transforming the diagnosis and understanding of complex conditions like Alzheimer's, Parkinson's, and various neuropathies. The authors discuss the role of these techniques in identifying biomarkers, enabling earlier detection, and guiding personalized therapeutic interventions for neurological diseases.[8].

This article discusses the emerging role of non-coding RNAs (ncRNAs), such as microRNAs and long non-coding RNAs, in cancer diagnosis and therapy. It details how these molecules act as crucial regulators of gene expression and are often dysregulated in various cancers, making them valuable biomarkers. The authors explore their potential as diagnostic tools, prognostic indicators, and even therapeutic targets, offering new avenues for cancer management.[9].

This paper examines the challenges and opportunities presented by laboratory automation in molecular diagnostics. It outlines how automating various steps, from sample preparation to data analysis, can significantly improve efficiency, reduce human error, and increase throughput in diagnostic labs. The authors discuss the critical role of automation in handling the growing complexity and volume of molecular tests, while also addressing implementation hurdles and future directions.[10].

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Conclusion

Molecular diagnostics are transforming healthcare, driving personalized medicine in oncology and infectious disease management. Liquid biopsy, particularly circulating tumor DNA, proves vital for lung cancer, aiding diagnosis, monitoring, and guiding personalized treatment. Pharmacogenomics further tailors cancer therapy based on genetic profiles, while non-coding RNAs are emerging as key biomarkers and therapeutic targets. Infectious disease diagnostics benefit from Next-Generation Sequencing (NGS) for rapid pathogen identification and CRISPR-based methods for high-specificity detection, including Point-of-Care applications. Point-of-Care (POC) diagnostics enhance accessibility, improving patient management and outbreak control. Advanced molecular diagnostics also provide critical insights into neurological disorders, identifying biomarkers for earlier detection. Artificial Intelligence (AI) streamlines these diagnostic processes by improving the accuracy and efficiency of complex genetic data analysis. Laboratory automation is essential for managing the increasing volume and complexity of molecular tests, boosting efficiency and reducing errors across diagnostic workflows.

References

1. Guiqiu P, Wenjuan L, Dong L. Liquid biopsy: a new era in molecular diagnosis and personalized management of lung cancer. *J Exp Clin Cancer Res.* 2022;41:43.
2. Xiaoying T, Mengjie Z, Fulan Y. Next-generation sequencing for pathogen identification in infectious diseases: a promising diagnostic tool. *Front Microbiol.* 2023;14:1197771.
3. Wen Z, Yan S, Chuangqi C. CRISPR-based molecular diagnostic methods for infectious diseases. *Front Cell Infect Microbiol.* 2023;12:1065166.
4. Yihua Z, Miaomiao Z, Shuo W. The application of pharmacogenomics in oncology: *From basic research to clinical practice. Front Pharmacol.* 2022;13:1042790.
5. Nagwa E, Ahmed E, Mahmoud E. Artificial Intelligence in Medical Genetics and Molecular Diagnostics: *A Systematic Review. Diagnostics* (Basel). 2024;14:165.
6. Siwu W, Jie F, Shuai L. Advances in point-of-care molecular diagnostics for infectious diseases. *Biosens Bioelectron.* 2023;228:115160.
7. Haiyan L, Hongmei G, Yuan M. Circulating tumor DNA in advanced lung cancer: a liquid biopsy for diagnosis, prognosis, and therapeutic monitoring. *J Transl Med.* 2022;20:88.
8. Zhe L, Dunxun H, Rongjie Z. The application of advanced molecular diagnostics in neurological disorders: *A comprehensive review. Front Neurosci.* 2023;17:1292159.
9. Wen Z, Weiming L, Jinchang C. The emerging role of non-coding *RNAs in cancer diagnosis and therapy. Front Cell Dev Biol.* 2024;12:1332766.
10. Mohammad A, Tasneem Q, Majed A. Laboratory automation in molecular diagnostics: *Challenges and opportunities. J Clin Lab Anal.* 2021;35:e24075.

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