

Evolution of Alzheimer's Diagnosis: Merging Molecular and Fluid Biomarkers into Clinical Frameworks for Early and Preclinical Detection

Poster #9753

Presenting Author: Anjali Kumari¹ (Master's Research Scholar), Co-Authors: Dr. Monika Kadian^{1,2}

Affiliation: ¹Department of Pharmacology, MM College of Pharmacy, Maharishi Markandeshwar (Deemed to be University), Mullana, Ambala 133207, India.

²Pharmacology Division, University Institute of Pharmaceutical Sciences, UGC Centre of Advanced Study (UGC-CAS), Panjab University, Chandigarh 160014, India

Take Home Message

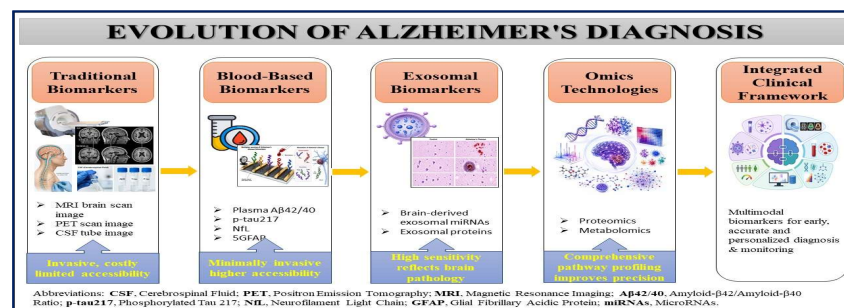
Early and preclinical detection of Alzheimer's disease is being transformed through the integration of conventional and emerging biomarkers, enabling more accessible, accurate, and personalized diagnostic strategies.

INTRODUCTION

Alzheimer's disease (AD) is a progressive neurodegenerative disorder characterized by amyloid- β plaque deposition and tau pathology. Early diagnosis is essential for timely intervention and improved clinical outcomes. While cerebrospinal fluid (CSF) biomarkers and neuroimaging remain established diagnostic approaches, emerging blood-based, exosomal, and omics-derived biomarkers offer accessible and scalable alternatives for early and preclinical disease detection.

METHODS

Major biomarker categories used in Alzheimer's disease diagnosis were examined, including cerebrospinal fluid biomarkers, neuroimaging modalities, blood-based biomarkers, exosomal biomarkers, and omics technologies. The framework below illustrates the evolution of diagnostic approaches from conventional methods to integrated multimodal strategies for early and preclinical disease detection.



CONCLUSION

A multimodal biomarker framework that synthesizes traditional methodologies, blood-based assessments, exosomal analyses, and omics approaches represents a promising strategy for the early identification of Alzheimer's disease.

Despite substantial progress, challenges related to biological variability, standardization, and large-scale validation remain.

Addressing these challenges, together with emerging innovations such as wearable sensors and digital biomarkers, will be essential for translating these advances into routine clinical practice.

RESULTS

- CSF biomarkers and neuroimaging remain the reference standards for detecting early Alzheimer's disease pathology but are limited by invasiveness, high cost, and restricted accessibility.
- Blood-based biomarkers demonstrate strong concordance with CSF and neuroimaging findings and enable the detection of pathological changes during the preclinical stages of Alzheimer's disease.
- Multi-biomarker plasma panels improve early diagnosis and longitudinal disease monitoring, particularly in resource-limited healthcare settings.
- Brain-derived exosomal biomarkers, including exosomal miRNAs and proteins, provide highly sensitive and brain-specific molecular signatures, while advances in microfluidic and biosensing technologies have enhanced their isolation and analytical performance.
- Omics approaches, particularly proteomics and metabolomics, generate comprehensive molecular profiles associated with amyloid and tau pathology, facilitating biomarker discovery, patient stratification, and improved diagnostic precision.
- Collectively, these advances illustrate the evolution of Alzheimer's disease diagnosis from conventional approaches to integrated multimodal biomarker frameworks, enabling earlier detection, improved diagnostic accuracy, and future precision medicine.

REFERENCE

- Rogacz Z, Pacuła W, Strzałka-Mrozik B, Turek A. Molecular testing in early diagnosis and clinical assessment of Alzheimer's disease: A narrative review. *Appl Sci.* 2026;16(5):2554.
- Hansson O. Blood-based biomarkers for Alzheimer's disease in clinical practice. *Nat Rev Neurol.* 2023;19:695–714.
- Agnello L, Dominici R, Gambino CM, et al. Analytical methods for fluid biomarkers in Alzheimer's disease: From discovery to clinical implementation. *J Mol Diagn.* 2026.
- Alghamdi S, Aslam A, Thapiyal S, Rustagi R, et al. Recent advances in microfluidic technologies for the detection of Alzheimer's disease biomarkers: Toward point-of-care neurodiagnostic. *Microchim Acta.* 2026.

CONTACT INFORMATION

Anjali Kumari, Master's
Research Scholars
(Pharmacology)

Email:
anjalicambail@gmail.co

[m](https://www.mmu.ac.in)
Mobile: +91-6230450769

