RECENT ADVANCES IN THE PHARMACOLOGICAL MANAGEMENT OF ALZHEIMER'S DISEASE: INTEGRATING EMERGING THERAPIES WITH AI AND COMPUTATIONAL APPROACHES FOR PRECISION MEDICINE

Sarasij Majee[1], Dipanwita Maity[2], Subhadip Das[3], Sourajyoti Goswami[4], Dibyendu Mukherjee[5], Subrata Kumar Majumdar[6] and Kousik Roy[2]*

[1]Department of Computer Science Engineering, Swami Vivekananda Institute of Science & Technology (SVIST), Dakshin Gobindapur, Sonarpur, Kolkata - 700145

[2]Department of Pharmaceutical Technology, Maulana Abul Kalam Azad University of Technology, NH-12, Haringhata, Nadia, Pin-741249, West Bengal

[3] Department of Computer Science and Engineering, Bengal College of Engineering and Technology, Durgapur- 713212, West Bengal

[4]Department of Pharmaceutical Chemistry, Bengal College of Pharmaceutical Science and Research, Durgapur-713212, West Bengal

[5]Department of Computer Science and Engineering, Sanaka Educational Trust, Durgapur-713212, West Bengal

[6]Department of Mechanical Engineering, Sanaka Educational Trust, Durgapur-713212, West Bengal

*Corresponding Author Email ID: Kousikroy002@gmail.com

ABSTRACT

A major worldwide neurodegenerative disease Alzheimer's disease (AD) is distinguished by its intricate pathophysiology and poor response to treatment. The effectiveness of conventional biomarkers and medication targets (Aβ, tau) as well as symptomatic therapies (cholinesterase inhibitors memantine) has been modest. This paper examines the ways in which artificial intelligence specifically machine learning and deep learning has transformed drug development, biomarker identification and AD diagnosis. AI has made it possible for early detection, risk stratification and precision therapy by combining multi-modal data (neuroimaging, genomes, proteomics and electronic health records). We showcase the most advanced techniques including CNNs, RNNs, Transformers, GNNs and knowledge graphs and we talk about how AI-driven drug screening and repurposing pipelines (like sildenafil for possible AD therapy) speed up the discovery process. In order to improve precision care in AD we also look at methodological issues, gaps in clinical validation and suggest an integrated AI framework.

Keywords: *Alzheimer's disease, Artificial intelligence (AI), conventional methods, Drug discovery, Drug repurposing, Digital twins, Precision medicine*

1. INTRODUCTION

Alzheimer's disease being a progressive neurodegenerative disorder and the prime cause of dementia is going to affect 139 million people by 2050 and this is going to put down a tremendous load on the global health-care set-up. The characteristics of this disease are amyloid-beta plaques deposition, tau-protein tangles and decline in cognitive functioning. It varies tremendously in its clinical course and so is a major problem in early diagnosis and subsequent treatment. Traditional methods are very invasive and expensive and they most of the time cannot detect the disease at its early-stage. Artificial Intelligence can be used with Machine Learning and Deep Learning techniques enabling the analysis of complex data such as neuroimaging, genetic profiles and clinical records. From