Open access Journal of
Neurology & Neurosurgery
ISSN: 2476-0501

Juniper Publishers
key to the Researchers

Lletter to Editor
Volume 19 Issue 5 - September 2025
DOI: 10.19080/OAJNN.2025.19.556021

Open Access J Neurol Neurosurg

AI-Powered Diagnostic Tools in Neurology: Supplement or Substitute?

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Submission: August 25, 2025; **Published:** September 18, 2025

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Abstract

The expanding application of artificial intelligence (AI) in neurology has generated significant questions regarding its place in clinical practice. Although AI applications have had considerable potential in the realms of diagnosis, treatment planning, and monitoring of patients, there are doubts about whether such tools are best thought of as substitutes for clinical expertise or as ancillary aids. The aim of this letter is to assess existing progress in AI-based diagnostic tools in neurology and ponder their role as either supplements or substitutes. Areas of interest include the application of AI to diagnostic imaging, disease detection at an early stage, and the management of different neurological diseases. In spite of these developments, a number of limitations persist. Issues including interpretability and the requirement for clinical supervision continue to limit AI from completely occupying the role of an expert.

Keywords: Artificial intelligence; Neurology; Diagnostic tools; Movement disorders; Remote monitoring

Abbreviations: AI: Artificial Intelligence; ML: Machine Learning; CNNs: Convolutional Neural Networks; LSTMs: Long Short-Term Memory networks

Introduction

Increased application of artificial intelligence (AI) in clinical neurology presents innovative opportunities for remote monitoring, diagnosis, and tailoring treatment. While there has certainly been apparent improvement, the issue remains about whether artificial intelligence would substitute the neurologist or should primarily be considered an addendum to clinical proficiency.

Recent developments in neuro-oncology highlight both the potential and limitations of artificial intelligence. Deep learning models and machine learning (ML) have demonstrated excellent accuracy in the identification of tumors, prognosis, and treatment planning, but data heterogeneity and the need for external validation have limited their translation into standard care [1]. Similarly, in infectious neurology, new diagnostic technologies with AI-powered pattern recognition have made it possible to diagnose meningoencephalitis more rapidly and precisely, particularly in rare or unusual cases [2]. These developments highlight how much potential artificial intelligence holds to augment, but not yet replace, intricate clinical judgment. Beyond some disease categories, AI advances in neurological illnesses have demonstrated exceptional diagnostic capability.

Neuro-ML methods like support vector machines and artificial neural networks have achieved over 90% accuracy in conditions such as multiple sclerosis and Alzheimer's disease [3]. There remain outstanding gaps, however, like underrepresentation of rare diseases and the absence of standardized evaluation metrics, that restrict generalizability. Aside from these developments, handwriting analysis for Parkinson's disease has evolved to be a discrete and insidious biomarker. Digital tablets and smartpens that capture dynamic variables such as velocity, pressure, and fluency allow AI models such as CNNs and LSTMs to identify prodromal Parkinsonian changes [4], with a sensitivity of up to 90% and superior performance than static criteria. Artificial intelligence applications in movement disorders extend more broadly from diagnostic phenotyping to optimization of treatment. Deep learning models like DystoniaNet have outperformed doctors

in dystonia diagnosis with near perfect accuracy; forecasting systems like DystoniaBoTXNet have improved the prediction of treatment outcomes.

In addition, artificial intelligence-based adaptive deep brain stimulation and passive monitoring technologies such as the Emerald device [5] are transforming personalized therapy. These technologies are also currently limited by the continued necessity of clinical oversight as well as issues of fairness and interpretability. Instead of as a substitute, the evidence overall indicates more favorable use of AI as an adjunct to neurologists improving accuracy, efficiency, and access. Ethical adoption of artificial intelligence in neurology will be characterized by a judiciously balanced approach to incorporating it into current processes while maintaining human decision-making priceless value.

Conflict of Interest: Authors declare that they have no conflict of interest.

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DOI: 10.19080/OAJNN.2025.19.556021

How to cite this article: Filza Haq Nawaz1, Maryam, Hadia. AI-Powered Diagnostic Tools in Neurology: Supplement or Substitute?. Open Access J Neurol Neurosurg 2025; 19(5): 556021. DOI: 10.19080/OAJNN.2025.19.556021