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Reimagining Neurology: From Reactive Treatment to Predictive and Preventive Care

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Opinion

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Abstract

Neurology has traditionally focused on diagnosing and managing neurological disorders after the onset of clinical symptoms, when irreversible neuronal damage has often already occurred. Although significant advances in neuroimaging, molecular diagnostics, pharmacotherapy, and neurorehabilitation have improved patient outcomes, the growing global burden of neurological diseases highlights the limitations of a predominantly reactive healthcare model. Emerging developments in predictive biomarkers, artificial intelligence (AI), digital health technologies, wearable devices, genomics, and precision medicine are creating new opportunities to identify individuals at risk, monitor disease progression in its earliest stages, and implement preventive interventions before permanent neurological impairment develops. This evolving paradigm has the potential to transform neurological practice from symptom-centered care to proactive brain health management. However, achieving this transition will require robust clinical validation, equitable access to innovative technologies, standardized regulatory frameworks, interdisciplinary collaboration, and increased public awareness. This perspective presents the view that the future of neurology should prioritize prediction, prevention, and personalized care alongside traditional therapeutic approaches.

Keywords: Neurology; Predictive medicine; Preventive care; Brain health; Artificial intelligence; Precision neurology; Digital biomarkers; Personalized medicine; Early diagnosis; Neurodegenerative diseases

Introduction

Neurological disorders are among the leading causes of disability and mortality worldwide, affecting millions of people and imposing an enormous social and economic burden. Diseases such as Alzheimer's disease, Parkinson's disease, stroke, multiple sclerosis, epilepsy, and amyotrophic lateral sclerosis continue to increase because of population aging, lifestyle changes, and improved life expectancy. Despite remarkable advances in neuroscience, clinical diagnosis and treatment remain largely reactive, with interventions initiated only after neurological symptoms become clinically evident. At this stage, irreversible neuronal injury has often already occurred, limiting the effectiveness of available therapies [1].

Over the past decade, advances in molecular biology, neuroimaging, genomics, and computational sciences have changed our understanding of neurological diseases. Rather than being sudden events, many neurological disorders develop gradually over several years through complex biological alterations. This knowledge provides an opportunity to identify disease before significant neurological damage develops. Consequently, neurology is

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entering a new era in which prediction and prevention may become as important as diagnosis and treatment [2,3].

In my opinion, the future of neurological care should not be measured solely by the ability to treat disease but also by the ability to preserve brain health throughout life. Healthcare systems should therefore invest more heavily in early risk assessment, preventive interventions, and continuous monitoring instead of waiting until irreversible disability occurs.

Why Reactive Neurology Is No Longer Enough

The current healthcare model is primarily designed to diagnose neurological diseases after symptoms have appeared. While this approach has improved patient management, it has significant limitations. Many neurodegenerative diseases begin years or even decades before the first clinical manifestations become noticeable. By the time cognitive decline, tremors, weakness, or motor dysfunction develop, substantial neuronal loss has already occurred [2,4].

For example, Alzheimer's disease pathology involving amyloid-beta accumulation and tau abnormalities begins long before memory impairment becomes clinically apparent. Similarly, Parkinson's disease is associated with progressive degeneration of dopaminergic neurons years before characteristic motor symptoms appear. These observations suggest that current neurological practice often intervenes too late to prevent disease progression.

In my view, continuing to rely predominantly on symptom-based diagnosis is unlikely to substantially reduce the global burden of neurological disorders. Earlier intervention should become a primary objective of modern neurology [5].

Predictive Neurology: A New Clinical Paradigm

Recent technological innovations provide an opportunity to shift neurological care toward prediction rather than reaction. Blood-based biomarkers, advanced neuroimaging, genetic testing, wearable devices, and digital biomarkers can detect subtle biological changes before clinical symptoms become evident.

Artificial intelligence further strengthens predictive neurology by analyzing complex clinical and molecular datasets that exceed human analytical capacity. Machine learning algorithms can identify high-risk individuals, estimate disease progression, and support individualized treatment planning [6].

However, I believe these technologies should complement not replace clinical expertise. Neurological diagnosis requires careful interpretation of patient history, neurological examination, imaging findings, and laboratory investigations. AI should function as a clinical decision-support tool rather than an autonomous decision-maker.

Prevention Should Become a Core Objective of Neurology

Historically, preventive medicine has been more closely associated with cardiovascular disease and diabetes than neurological disorders. Nevertheless, increasing evidence indicates that many neurological diseases share modifiable risk factors.

Control of hypertension, diabetes, obesity, smoking, sleep disorders, hearing loss, physical inactivity, depression, and social isolation may reduce the risk of cognitive decline, stroke, and dementia. Public education regarding healthy lifestyles should therefore become an essential component of neurological practice.

In my opinion, neurologists should play a greater role in preventive healthcare rather than focusing exclusively on disease management. Routine neurological consultations should increasingly include risk-factor assessment, patient education, and long-term brain health promotion [7].

Challenges to Implementing Predictive and Preventive Neurology

Although predictive neurology offers exciting opportunities, several barriers remain. Advanced molecular diagnostics and AI-based technologies are expensive and may not be readily available in many healthcare settings, particularly in low- and middle-income countries.

Another challenge involves validation of predictive biomarkers across diverse populations. Many promising biomarkers remain confined to research settings and require further clinical evaluation before widespread implementation.

Ethical issues must also be considered. Predicting an individual's future risk of developing Alzheimer's disease or Parkinson's disease raises important questions regarding psychological impact, privacy, insurance discrimination, and informed consent [8].

Healthcare professionals will also require additional training to interpret genomic data, digital biomarkers, and

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AI-generated clinical predictions responsibly.

A Personal Perspective on the Future of Neurology

In my view, neurology is approaching one of the most significant transformations in its history. Future neurological practice should emphasize maintaining brain health throughout life instead of simply responding to disease after neurological injury has occurred.

Hospitals may gradually evolve into centers that continuously monitor neurological health using wearable technologies, digital biomarkers, remote patient monitoring, and precision diagnostics. Individuals identified as being at increased risk could receive personalized prevention programs combining lifestyle modification, pharmacological intervention, cognitive training, and regular monitoring.

Equally important, interdisciplinary collaboration should become the standard of care. Neurologists, primary care physicians, geneticists, psychologists, rehabilitation specialists, data scientists, and public health experts must work together to establish comprehensive preventive neurology programs.

Although this vision cannot be achieved immediately, the direction of neurological medicine is becoming increasingly clear. Prediction, prevention, and personalization should complement existing therapeutic approaches and become central principles of neurological care during the coming decade.

Conclusion

Neurology is entering an era in which prediction and prevention have the potential to reshape clinical practice. Advances in biomarkers, artificial intelligence, digital health technologies, and precision medicine are enabling earlier disease detection and more personalized care than ever before. While significant scientific, ethical, and healthcare-system challenges remain, the opportunity to preserve brain health before irreversible neurological damage occurs represents a major step forward.

I believe the future of neurology should not be defined solely by better treatments but by preventing neurological diseases whenever possible. Achieving this goal will require collaboration among clinicians, researchers, policymakers, and technology developers, together with sustained investment in innovation and public health initiatives. Reimagining neurology from a reactive discipline to a predictive and preventive specialty has the potential to improve patient outcomes, reduce the burden of neurological disorders, and establish a more sustainable model of neurological healthcare for future generations.

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