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Review

Application of Artificial Intelligence on Neurodegenerative Disorder Care: A Scoping Review

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Abstract

Introduction: Neurodegenerative Disorders (NDs), which are progressive conditions characterized by the gradual loss of structure or function of neurons, including Alzheimer's disease, Parkinson's disease, Huntington's disease, and amyotrophic lateral sclerosis, present escalating global health challenges. Traditional diagnostic and therapeutic approaches are often delayed, subjective, and insufficiently personalized. The rapid development of Artificial Intelligence (AI) offers new opportunities to enhance early detection, treatment personalization, and care support through advanced data-driven methods. This review aimed to explore the current applications of AI in ND diagnosis and management.

Methods: A scoping review was conducted following Arksey and O'Malley's framework, and reported in line with PRISMA-ScR guidelines. Literature searches were performed across PubMed, ScienceDirect, and Google Scholar, limited to English-language publications from 2015 to 2025. Eligible studies focused on AI applications in ND. A two-stage screening and thematic synthesis were employed, and findings were validated through expert consultation.

Results: Out of 333 articles identified, 15 studies met the inclusion criteria. Three main application domains emerged: (1) diagnostic applications using neuroimaging, biomarkers, and wearable data, achieving high accuracy in early disease detection; (2) treatment personalization and progression modeling, including digital twin frameworks and physics-informed neural networks; and (3) AI-driven assistive technologies, such as memory companions and augmented reality–based care support systems. Despite promising results, challenges remain in data standardization, interpretability, and clinical integration.

Conclusion: AI demonstrates transformative potential in ND care, especially in diagnostics and personalized interventions. However, translation into routine clinical practice requires rigorous validation, ethical considerations, and interdisciplinary collaboration. Future research should prioritize multimodal data integration, transparent models, and patient-centered applications to ensure scalable and equitable adoption.

Keywords: *Artificial intelligence, diagnosis, machine learning, neurodegenerative disorders, treatment*

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Introduction

Neurodegenerative disorders (NDs) involve the progressive breakdown of brain or nerve cells, causing impairments in movement, memory, cognition, or behavior (Hussain et al., 2018). They represent a growing global health challenge, with Alzheimer's disease (AD) and Parkinson's disease (PD) affecting millions worldwide and imposing substantial economic and social burdens (Wang et al., 2024). These progressive disorders, marked by gradual neuronal loss, pose diagnostic and therapeutic challenges due to their heterogeneity and multifactorial causes (Wang et al., 2024). Traditional diagnostic methods often rely on subjective assessments, resulting in delayed and less personalized care. Early detection of ND is essential to initiate timely interventions, while personalized medicine optimizes treatment by tailoring approaches to individual biological and clinical profiles (Strafella et al., 2018). The emergence of artificial intelligence (AI) technologies offers unprecedented opportunities to transform neurodegenerative disorder care through data-driven precision medicine approaches (Lamptey et al., 2022; Wang et al., 2024).

Recent advancements in machine learning, deep learning, and multimodal data integration have enabled the development of sophisticated tools capable of analyzing complex neuroimaging data, identifying subtle biomarkers, predicting disease trajectories, and personalizing therapeutic interventions (Li et al., 2025). The use of AI in neurodegenerative research has accelerated over the past decade, reflected in the exponential rise of publications and clinical applications. This scoping review aims to systematically map the current state of AI applications across the spectrum of neurodegenerative disorder care, from early detection to treatment optimization and supportive care.

Understanding this evolving landscape is vital to guide research priorities and translate AI innovations into practice for better patient outcomes. Synthesizing evidence from diverse research domains allows the identification of key technological innovations, methodological approaches, clinical applications, and implementation challenges. The review also examines the evolving paradigm from traditional statistical analyses toward AI-driven, individualized modeling of neurodegenerative conditions, highlighting how these approaches enable early identification of disease onset and progression at a level of granularity and personalization not possible with conventional methods.

Methods

This scoping review was conducted following the methodological framework proposed by Arksey and O'Malley (2005) and further refined by Levac et al. (2010), with reporting guided by the PRISMA Extension for Systematic Reviews (PRISMA-ScR) checklist (Tricco et al., 2018).

The Arksey and O'Malley framework provides a systematic approach to mapping evidence in broad fields of research, particularly valuable when an area is emerging or lacks uniformity in study design and measurement.

Identifying the research question

The primary research question guiding this scoping review was "What is the current utilization of AI applications in the care of NDs?" This broad question was formulated to capture the diverse range of AI applications across the neurodegenerative care continuum without limiting the scope to specific methodologies or outcomes.

The conceptualization of key terms was critical to defining the scope of this review. "Artificial intelligence" was defined to include machine learning, deep learning, natural language processing, computer vision, and other computational approaches that enable systems to perform tasks typically requiring human intelligence. NDs encompass conditions characterized by progressive neuronal loss, including Alzheimer's disease, Parkinson's disease, Huntington's disease, amyotrophic lateral sclerosis (ALS), and related conditions (N1). "Care applications" refer to diagnostic tools, treatment personalization approaches, disease progression modeling, and assistive technologies used in clinical or home settings.

Identifying relevant studies

A comprehensive search strategy was developed in consultation with a research librarian specializing in medical literature reviews. The search was conducted across multiple electronic databases, including Google Scholar, ScienceDirect, and PubMed. The search strategy incorporated both controlled vocabulary (MeSH terms, EMTREE terms) and free-text keywords related to artificial intelligence and NDs.

The search string was developed using Boolean operators (AND, OR) and included variations of the following key concepts:

Artificial intelligence terms: "artificial intelligence," OR "machine learning," OR "deep learning," OR "neural network," OR "natural language processing."

Neurodegenerative disorder terms: "Alzheimer's disease," OR "Parkinson's disease," OR "Huntington's disease," OR "ALS", AND "neurodegenerative*."

Care application terms: "diagnosis" AND "treatment," AND "therapy," OR "care," OR" management," OR" assistive technology," OR "digital twin."

The search was limited to English-language publications from January 2015 to December 2025 to capture the most recent advancements in AI applications, as this period coincides with the rapid growth of deep learning and multimodal AI approaches in healthcare. In addition to database searches, reference lists of included articles were screened for additional relevant studies, and relevant conference proceedings from major AI and medical informatics conferences were manually searched.

Study selection

The study selection process followed a two-stage screening approach in accordance with PRISMA-ScR guidelines. In the first stage, two independent reviewers screened titles and abstracts against predefined inclusion and exclusion criteria. In the second stage, full texts of potentially relevant articles were assessed for eligibility. Discrepancies between reviewers were resolved through consultation with a third-party expert.

Inclusion criteria

The inclusion criteria for this review comprised primary research studies or reviews that focused on the application of artificial intelligence in the care of NDs. Eligible studies reported on areas related to AI and NDs, such as diagnostic tools, treatment personalization, disease progression modeling, or assistive technologies. Only studies published in English between 2015 and 2025 were considered. This time frame was chosen to ensure the inclusion of the most recent and relevant evidence, as the field of artificial intelligence has undergone rapid advancements over the past decade. Earlier studies were excluded to avoid outdated approaches and to provide an up-to-date synthesis that reflects current trends and applications in neurodegenerative disorder care.

Exclusion criteria

Studies were excluded if they focused solely on non-neurodegenerative neurological conditions. In addition, theoretical papers without empirical validation were not considered, while studies that did not specifically address AI applications, such as those limited to general digital health tools without an AI component, were excluded to maintain a clear focus on the role of AI in neurodegenerative disorder care.

The screening process was documented using a PRISMA-ScR flow diagram (Figure 1), which illustrates the number of records identified, screened, assessed for eligibility, and included in the review, along with the reasons for exclusions at each stage.

Charting the data

A standardized data extraction form was developed based on the research questions and refined through pilot testing with a subset of included studies. Two reviewers independently extracted data from each included study using the following categories: author and year, title of the article, country of origin, study design, focus/aim of the study, AI application findings, and limitations and challenges.

The data extraction form was designed to capture both quantitative metrics (e.g., accuracy rates, sample sizes) and qualitative information (e.g., implementation challenges, ethical considerations). For studies reporting multiple AI applications, each application was documented separately to enable detailed analysis across different use cases. To ensure accuracy and consistency, the two reviewers independently extracted the data and then compared their results. Any discrepancies were resolved through discussion and consensus.

Collating, summarizing, and reporting the results

The extracted data was synthesized thematically according to the primary application domains of AI in NDs care. Descriptive statistics were used to summarize study characteristics, methodology approaches, and reported outcomes. Thematic analysis was employed to identify common challenges, implementation barriers, and future research directions across the included studies.

The results were organized into the following thematic categories based on the primary application of AI, including diagnostic applications, treatment personalization and disease progression modeling and assistive technologies and care support systems.

For each thematic category, we documented the range of AI methodologies used, data sources integrated, reported effectiveness metrics, and implementation considerations. Cross-cutting themes regarding data quality requirements, model interpretability, and ethical considerations were also identified and analyzed.

Consultation

As an optional stage in the Arksey and O'Malley framework, we conducted a consultation with experts in neurology, geriatrics, and AI to validate our findings and ensure comprehensive coverage of the field (Buus et al., 2022). This consultation included three neurologists specializing in NDs, two AI researchers with expertise in healthcare applications, and one ethicist with experience in digital health technologies.

The consultation process involved sharing preliminary findings and receiving feedback on the completeness of the identified application domains, the accuracy of the methodological categorization, the relevance of the identified implementation challenges, and the appropriateness of the proposed future research directions.

This consultation helped refine our interpretation of the literature and ensured that our synthesis reflected current clinical and technical perspectives on AI applications in neurodegenerative disorder care.

Results

Study characteristics

The initial search strategy identified 333 records across three databases. All articles were filtered using the PRISMA ScR guideline (Figure 1). Initially, 18 duplicated articles were removed. Afterwards, 315 articles were checked against inclusion and exclusion criteria, and 233 articles were excluded, yielding 82 articles for full-text review. Finally, 15 articles were included in the review after excluding 67 articles from full-text due to: irrelevant (n=44); no clear outcome (n=14), and instrumental testing (n=09).

The included studies spanned 10 countries, with the majority from the United States of America (20%). The publication years ranged from 2015 to 2025, with a notable increase in publications after 2019, reflecting growing interest in AI applications for NDs. Study designs included quantitative studies (20%), mixed-method studies (20%), and systematic reviews/meta-analyses (60%).

Summary of included studies

Supplementary Table provides a comprehensive overview of the key characteristics, methodologies, findings, and limitations of representative studies included in this review.

Applications of AI in ND care

The review identified three main areas of AI applications in ND care: (1) diagnostic applications; (2) treatment personalization; and (3) assistive technologies and care support systems (Figure 2).

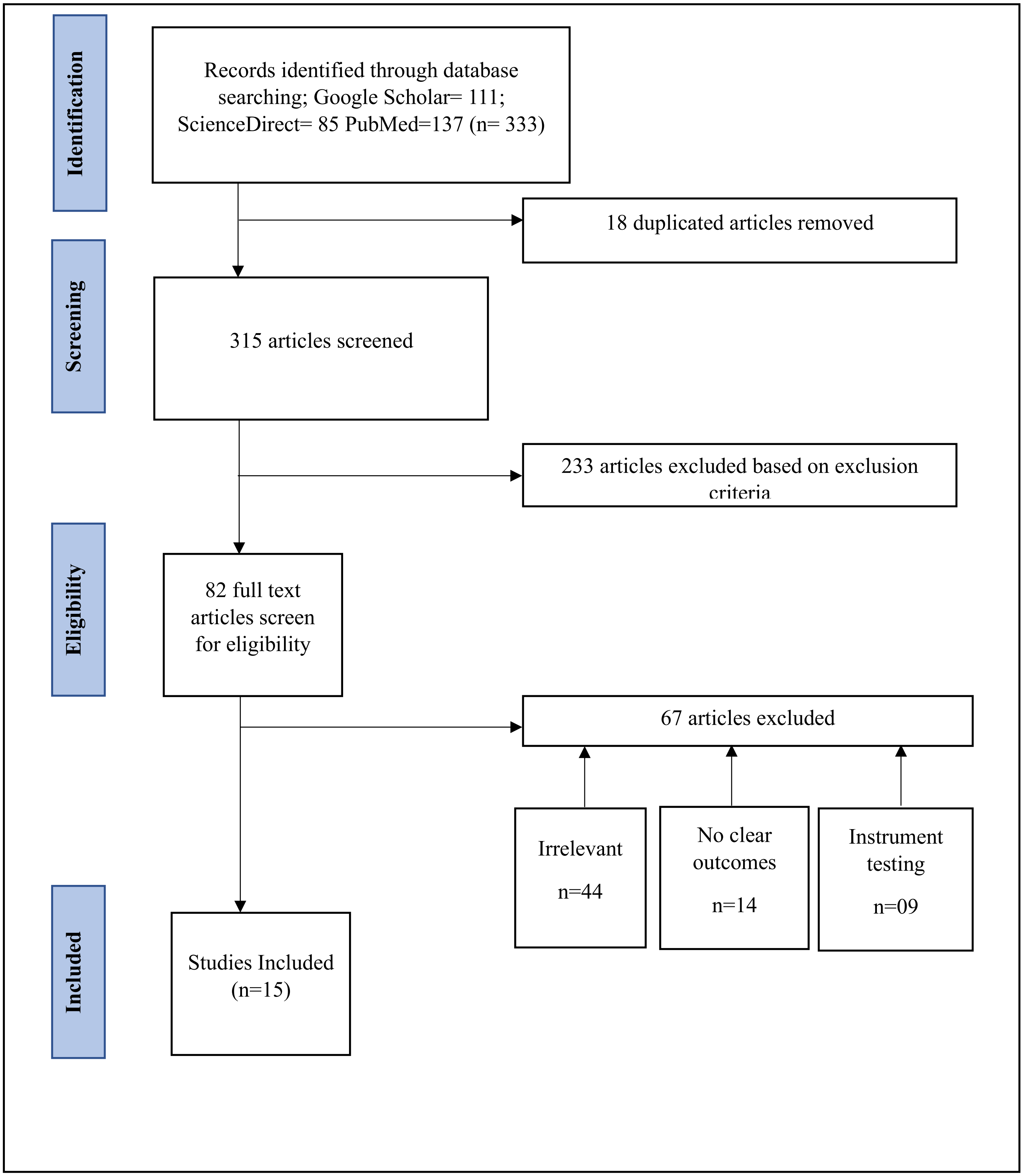

Figure 1: Study selection process

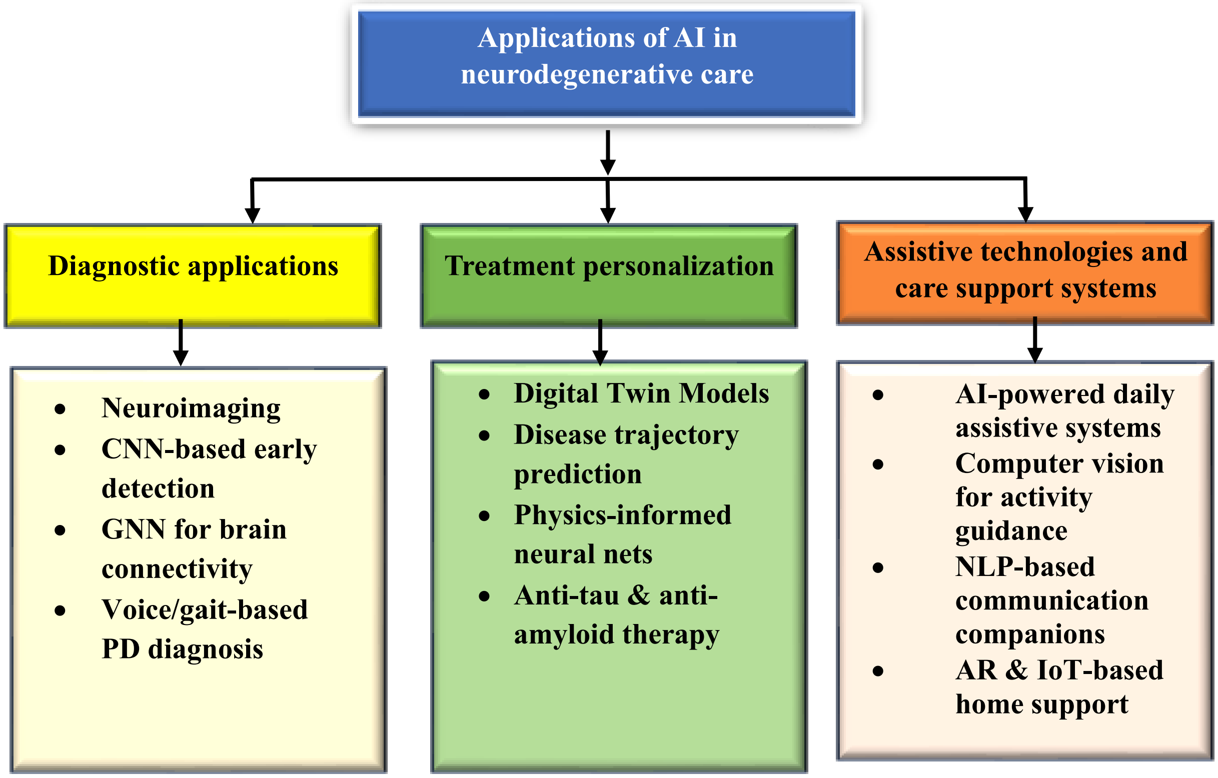

Figure 2: Applications of AI in neurodegenerative disorder care

Diagnostic applications of AI

The diagnostic applications of AI in NDs represent the most extensively researched area. Neuroimaging techniques, particularly structural and functional MRI, PET, and Diffusion Tensor Imaging (DTI), have become central to AI-assisted diagnosis, with Convolutional Neural Networks (CNNs) showing exceptional performance in identifying subtle patterns indicative of early disease stages (Almotiri, 2025; Kumar et al., 2024).

Single-modality approaches have been identified to integrate multiple data sources, including imaging, genetic information, cognitive assessments, and fluid biomarkers, creating more comprehensive diagnostic framework (Koksalmis et al., 2025; Cao et al., 2025). In Alzheimer's disease (AD), AI models have effectively distinguished healthy controls, Mild Cognitive Impairment (MCI), and AD patients by analyzing hippocampal atrophy, amyloid deposition, and disruptions in functional connectivity, particularly within the Default Mode Network (DMN), which is prone to atrophy and white matter microstructure changes (Koksalmis et al., 2025; Ren et al., 2025).

In PD, AI has been used to identify motor and non-motor symptoms via voice analysis, gait patterns, and wearable sensor data (Yang et al., 2025). Deep learning models, particularly multitask neural networks, can assess disease severity and predict progression from voice features, outperforming traditional diagnostics. Similarly, gait analysis enables AI to classify NDs by detecting distinctive movement patterns (Shokrpour et al., 2025; Wodzinski et al., 2019).

The application of Graph Neural Networks (GNNs) represents another significant advancement, enabling the analysis of brain connectivity matrices to detect subtle network disruptions that precede overt clinical symptoms (Abadal et al., 2025). These approaches have proven particularly valuable for early detection when interventions may be most effective, potentially identifying pathological changes decades before clinical manifestations become apparent.

Treatment personalization

Treatment personalization and disease progression modeling represent a paradigm shift from traditional one-size-fits-all approaches toward precision neurology. Digital twin technology has emerged as a particularly promising framework, enabling the creation of virtual patient replicas that continuously integrate real-world clinical, genetic, imaging, and physiological data. In this context, a digital twin functions as a dynamic computational model that mirrors an individual's unique disease trajectory. By simulating disease progression under multiple scenarios, digital twins allow clinicians and researchers to predict future health outcomes, evaluate the potential impact of various treatment options, and adjust care plans in real time. This enables tailored interventions, early detection of complications, and more precise monitoring, ultimately supporting truly personalized and adaptive neurological care (Papachristou et al., 2024).

These digital twins integrate multimodal longitudinal data to generate personalized forecasts, reducing clinical uncertainty and promoting more ethical, individualized decision-making. By capturing nonlinear trajectories, integrating latent variables, and modeling uncertainty, such frameworks provide a more nuanced and responsive understanding of neurodegeneration that surpasses conventional statistical methods. Recent innovations in this domain include the development of sophisticated state-space models combined with deep learning architectures that can predict individualized disease trajectories with unprecedented accuracy (Koksalmis et al., 2025).

Physics-informed neural networks (PINNs), combined with Bayesian methods, offer a major advance in modeling treatments like anti-tau and anti-amyloid therapies for Alzheimer's. PINNs play a distinctive role in treatment prediction by integrating established biological or physiological laws directly into the neural network's architecture. Unlike conventional deep learning models that rely purely on data to learn patterns, PINNs embed mathematical equations.

Anti-tau therapies target the tau protein to treat neurodegenerative diseases such as; genetically targeted therapies, antisense oligonucleotides (ASOs) like BIIB080 and NIO 0752, and microtubule stabilizers such as Davunetide and Epothilone D, and small molecule enzyme inhibitors like Fasudil and LY3372689. Anti-amyloid therapies such as Lecanemab and Donanemab are treatments for early Alzheimer's disease that aim to remove amyloid plaques from the brain, slowing cognitive and functional decline. By integrating biological principles and physical constraints, these models provide more reliable predictions of therapeutic outcomes amid the complex, nonlinear dynamics of neurodegeneration (Schäfer et al., 2021) .

The integration of these advanced modeling approaches has significant implications for clinical trial design and patient stratification. By identifying subgroups of patients with similar progression patterns, AI models can facilitate the development of more targeted clinical trials with a higher likelihood of success, addressing the historically high failure rates in neurodegenerative drug development (Makutam et al., 2024).

Assistive technologies and care support systems

AI-powered assistive technologies are transforming care for individuals with NDs by addressing daily living challenges, reducing caregiver burden, and improving quality of life. Leveraging computer vision, natural language processing, and sensor technologies, these intelligent systems deliver personalized support while preserving patient autonomy and dignity. (Brotosaputro et al., 2024).

Modern AI-driven assistive systems typically employ a combination of deep learning models, reinforcement learning, and context-aware algorithms to adapt to the user’s cognitive and physical abilities. For instance, computer vision models often use convolutional neural networks (CNNs) or vision transformers, enabling the system to recognize objects, detect patient movements, and interpret environmental contexts. NLP-based dialogue systems, powered by transformer models such as ChatGPT Define architectures, facilitate natural, two-way communication with patients, supporting comprehension, emotional reassurance, and task prompting. Sensor fusion and predictive analytics, often using recurrent neural networks (RNNs) or temporal convolutional networks, allow these systems to model behavioral patterns and anticipate patient needs.

Generative AI models like Memory Companion integrate multimodal inputs to help patients recall past experiences, reducing anxiety and improving intrapersonal and interpersonal functioning. These systems go beyond simple reminder functions by creating contextualized memory prompts that adapt to individual cognitive profiles, representing a significant advancement over traditional approaches like static annotations or simplified environments, which have proven only partially effective (Al-Rajab et al., 2025; Danmaisoro et al., 2024).

Augmented reality (AR) combined with Internet of Things (IoT) technologies has enabled the development of sophisticated environmental support systems that guide patients through daily activities while maintaining privacy and independence. These assistive systems provide real-time task prompting through AR interfaces without compromising patient privacy, addressing a critical gap in current care approaches for mild AD patients who require support with everyday tasks but retain significant functional capacity (Jo & Kim, 2019).

These technologies address four critical care challenges: (1) reducing the burden on public finances by delaying or eliminating the need for institutional care, (2) lessening the psychological burden on formal caregivers and families, (3) compensating for the severe shortage of human caregivers while improving care quality, and (4) empowering patients with NDs to maintain independence and confidence.

Discussion

This scoping review highlights a rapidly evolving landscape of AI applications in ND care, marked by major methodological advances alongside persistent implementation challenges. The scoping review depicts that AI is reshaping ND care in three major areas: diagnosis, treatment personalization, and supportive care. Advances in neuroimaging analysis and multimodal data integration have strengthened early and accurate identification of disease patterns. At the same time, emerging modelling approaches such as digital twins and physics-informed neural networks are enabling more individualized predictions of disease progression and treatment responses, moving practice closer to precision neurology. In parallel, AI-enabled assistive technologies using vision, language, and sensor-based systems are improving daily functioning, reducing caregiver burden, and supporting patient independence. Together, these developments indicate a clear shift toward more proactive, personalized, and patient-centered care models, demonstrating how AI can improve decision-making, optimize resource use, and enhance overall quality of life for individuals with neurodegenerative conditions.

Current state of AI applications in neurodegenerative disorder care

AD research has progressed from traditional cognitive testing to neuroimaging, CSF biomarkers, and now digital twin frameworks, reflecting a clear shift toward data-driven, personalized care using AI (Zhang et al., 2025).

The most advanced applications lie in diagnostic support, where AI models show exceptional accuracy in early detection of NDs. One of the most mature domains in AI for neurodegenerative diseases lies in diagnostic imaging. CNN applied to MRI data has shown remarkably high accuracy in classifying AD, mild cognitive impairment (MCI), and healthy controls. For instance, a novel CNN architecture leveraging dual filter-pooling pathways achieved classification accuracies exceeding 99% across multiple diagnostic categories using the ADNI dataset (Assy et al., 2024). Another deep learning model reported a 99.68% accuracy in discriminating among several dementia stages, including very mild to moderate AD (Dardouri, 2025). Broader reviews indicate that 3D CNNs, which capture full volumetric brain structure, attain diagnostic accuracies between 93% and 97% when detecting early AD signs (Mohsen, 2025).

Graph Neural Networks (GNNs) have become increasingly prominent for analyzing brain connectivity. A directed-structure learning GNN (DSL-GNN), trained on effective brain connectivity data in EEG, imaging-derived connectivity measures demonstrated exceptional diagnostic performance, achieving accuracy as high as 97.4% in distinguishing AD from PD, and nearly 94% when discriminating disease states from healthy controls (Cao et al., 2024).

A rapid 10-minute resting-state fMRI scan combined with AI analysis of the Default Mode Network (DMN) has been shown to predict dementia onset up to nine years in advance with approximately 80% accuracy, highlighting its potential for early, non-invasive detection(Devlin, 2024). However, clinical adoption remains limited, with most tools still in research or pilot phases. Emerging areas such as treatment personalization and disease progression modeling, particularly through digital twin frameworks, show promise but require further clinical validation before widespread use (Calderone et al., 2025; Gu et al., 2025).

A notable trend is the growing emphasis on multimodal data integration, with recent studies moving beyond single data sources to combine imaging, genetic, clinical, and real-world behavioral data (Lee et al., 2024). This approach more effectively captures the complex, multifactorial nature of NDs but introduces significant challenges regarding data standardization, quality control, and computational requirements.

The concept of digital twins, computational models that simulate individual disease progression, has gained momentum in predictive and personalized neurology. Digital Twin Generators (DTGs), which use neural networks trained on large longitudinal datasets, offer a scalable approach to modeling patient trajectories and providing individualized simulations and prognoses (Akbarialiabad et al., 2025). Meanwhile, some studies emphasize the broad potential of digital twins in healthcare applications, including drug development, clinical trial simulations, and therapeutic personalization (Alsalloum et al., 2024).

Although specific applications of physics-informed neural networks (PINNs) in AD treatment are not yet widely reported, integrating biological constraints with probabilistic learning frameworks (e.g., Bayesian models) represents a logical extension to improve model fidelity and therapeutic prediction. Beyond diagnostics and treatment modeling, AI-driven assistive technologies are reshaping care for neurodegenerative conditions. While empirical research on generative "Memory Companions" is still limited, their potential to deliver multimodal, context-aware memory prompts aligns with emerging trends in personalized assistive support.

Augmented Reality integrated with Internet of Things (IoT) devices has shown potential for guiding patients through daily activities in real-time, preserving independence while maintaining privacy. Early works combining these technologies suggest such systems could significantly alleviate caregiver burden and delay institutionalization, though systematic evaluations are still needed to validate their impact fully.

Despite these promising technological advances, a significant gap persists between research development and clinical implementation. Practical barriers include limited integration with existing healthcare IT infrastructures, regulatory and ethical uncertainties regarding data privacy, the lack of standardized evaluation frameworks, and insufficient clinician training and acceptance. Many AI tools remain confined to controlled research environments, with few demonstrating real-world robustness across diverse clinical settings. Additionally, high costs, interoperability issues, and the absence of clear reimbursement pathways slow adoption. Addressing these practical and systemic barriers is essential to ensure that AI innovations transition from experimental tools to standard components of neurodegenerative disorder care.

Implementation challenges and ethical considerations

Despite promising technological advancements, several critical challenges hinder the widespread implementation of AI in neurodegenerative disorder care. Data quality and availability represent fundamental obstacles, as high-quality, large-scale datasets are essential for developing robust AI models but remain scarce due to the resource-intensive nature of longitudinal neurodegenerative disorder studies (Habbal et al., 2025; Kale et al., 2024).

Model interpretability remains a persistent challenge, particularly for deep learning approaches that often function as "black boxes," making it difficult for clinicians to understand and trust AI-generated recommendations. While explainable AI (XAI) techniques like SHAP values and saliency maps have made progress in this area, more clinically intuitive explanation frameworks are needed to facilitate adoption in real-world settings (Mohapatra et al., 2025).

Generalizability across diverse populations presents another significant hurdle, as many AI models perform well on the datasets, they were trained on but fail to maintain accuracy when applied to different demographic groups or clinical settings (Hanna et al., 2025). This limitation is particularly concerning given the known disparities in neurodegenerative disorder presentation and progression across different racial, ethnic, and socioeconomic groups.

Ethical considerations add another layer of complexity to AI implementation in neurodegenerative care. Privacy concerns are paramount when dealing with sensitive health data, particularly as AI systems increasingly incorporate real-world monitoring through wearables and environmental sensors. The potential for algorithmic bias must be carefully addressed to prevent exacerbating existing healthcare disparities, especially for underrepresented populations in training datasets.

Future research directions

Based on the findings of this review, several strategic research priorities should be addressed to advance the field. Standardized, large-scale datasets are very necessary. There is an urgent need for international consortia to harmonize data collection protocols and create shared repositories that capture the full spectrum of NDs across diverse populations.

Robust and generalizable models are needed for personalized care. Research should prioritize the development of more robust AI models through advanced transfer learning techniques, domain adaptation methods, and hybrid training frameworks that maintain performance across different clinical settings. Integration of biological knowledge: The incorporation of biological knowledge into AI architectures represents a promising direction, with physics-informed neural networks and mechanistic modeling approaches offering the potential to create more interpretable and biologically plausible models.

Significant investment is needed in explainable AI research specifically tailored to NDs, with a focus on developing clinically intuitive explanation frameworks that clarify not only "what" the model predicts but also "why" and "how confident" the model is in its predictions. Research should focus on developing AI systems that seamlessly integrate into clinical workflows rather than requiring significant changes to established practices, with particular attention to user interface design and decision support mechanisms.

AI applications in neurodegenerative disorder care are advancing rapidly, particularly in diagnostic imaging, disease modeling, and assistive technologies. While deep learning and digital twin frameworks show high diagnostic accuracy and potential for personalized care, their integration into clinical practice remains limited by regulatory, infrastructural, and translational challenges. Clinicians should stay informed about emerging tools, researchers should focus on real-world validation and multimodal approaches, and policymakers must create supportive frameworks to enable safe, ethical, and scalable implementation. Collaborative efforts across these groups are essential to translate AI innovations into routine care.

Limitations

This scoping review has several limitations. The search was restricted to English-language publications from 2015–2025 and three major databases (PubMed, ScienceDirect, and Google Scholar), which may have led to language and publication bias and the omission of relevant technical or earlier studies. The included studies were highly heterogeneous in design, methodology, sample size, and AI application focus, precluding direct comparison or quantitative synthesis. Consistent with scoping review methodology, no formal quality appraisal was performed; therefore, the strength of evidence and risk of bias within individual studies were not systematically assessed. Many studies relied on small or retrospective datasets and lacked external validation, limiting generalizability. Incomplete reporting of datasets, algorithms, and evaluation metrics also constrained reproducibility assessment. As only published studies were included, positive reporting bias is possible. Moreover, given the rapid pace of AI innovation, the findings reflect the field's status at the time of review and may quickly evolve.

Conclusion

This scoping review has mapped the current evidence on artificial intelligence applications in the care of NDs, emphasizing diagnostic support, treatment personalization, and assistive technologies. The findings indicate that AI, particularly deep learning and multimodal approaches, is increasingly explored for its potential to improve early detection, predict disease progression, and support individualized care in conditions such as Alzheimer's and Parkinson's disease. Emerging developments include the use of digital twin frameworks for simulating patient-specific trajectories, graph-based and physics-informed models for incorporating biological mechanisms, and assistive technologies leveraging generative and context-aware AI to support daily functioning. While these innovations highlight promising directions, most studies remain at experimental or pilot stages, and their translation into routine clinical care is not yet established.

Important challenges identified during this literature review include the need for high-quality and diverse datasets, issues of model interpretability and transparency, limited external validation, and questions about clinical workflow integration. Ethical and equity-related considerations such as privacy, algorithmic bias, and accessibility were also noted as key areas requiring careful attention. Successful translation of AI research into clinical practice will critically depend on multidisciplinary collaboration between clinicians, data scientists, engineers, ethicists, and policymakers. Such partnerships are essential to ensure that AI tools are clinically meaningful, technically robust, ethically sound, and aligned with real-world healthcare needs. Future research should prioritize implementation-oriented studies, standardization of evaluation methods, and close cooperation among technical and clinical stakeholders. While AI has shown considerable potential, its role in neurodegenerative disorder care should be understood as an evolving field requiring cautious optimism, sustained validation, and careful integration within existing healthcare systems.

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Conflict of interest

The authors declared that they have no conflicts of interest.

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Supplementary Table

https://drive.google.com/drive/u/4/folders/1RmDkyAFWV2fVl_H7tZbPHyLIV0NAZmUp