

Exploring the Benefits and Risks Associated with Incorporating Artificial Intelligence into the Diagnosis, Treatment, and Monitoring of Alzheimer's Disease

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ABSTRACT

Alzheimer's disease (AD) is a progressive neurodegenerative disorder and a leading cause of dementia, posing a significant global health challenge due to the difficulties of early diagnosis and the absence of a cure. This paper explores the transformative potential and associated risks of integrating artificial intelligence (AI) into the diagnosis, treatment, and monitoring of AD. The main findings indicate that AI tools, such as neuroimaging analysis and speech pattern recognition, enable significantly earlier and more accurate detection, while also paving the way for personalized treatment plans and remote patient monitoring. However, the review also concludes that these benefits are tempered by substantial ethical and practical concerns, including data privacy, algorithmic bias, and the necessity for human oversight, underscoring the need for responsible implementation.

Keywords: Artificial Intelligence (AI); Alzheimer's Disease; Early Diagnosis; Patient Monitoring; Personalized Treatment; Caregiver Support; Ethical Considerations; Digital Health Tools

INTRODUCTION

Alzheimer's disease (AD) is a progressive neurological disorder that impacts memory, thinking, and behavior (1). Alzheimer's accounts for about sixty to eighty percent of dementia cases worldwide, making it one of the most studied and widely recognized neurodegenerative conditions. Despite this high prevalence, there is still no cure for the disease, leaving the burden on AD patients and their caregivers.

Recently, advancements in the field of artificial intelligence (AI) have revolutionized the diagnosis and management of Alzheimer's disease. AI powered

tools are now capable of detecting subtle neurological changes, and AD could benefit from AI specifically because it is a disorder that progresses very slowly, leaving many people not diagnosed until late in the disease. AI may provide avenues to identify early warning signs, inform treatment decisions, and aid in monitoring patients throughout the disease course.

This paper examines the various ways artificial intelligence is being utilized to enhance the diagnosis, treatment, and monitoring of Alzheimer's disease. While numerous reviews have cataloged technical advancements in AI for AD, this work distinguishes itself by integrating analysis across the entire care continuum from early detection to long term monitoring and treatment while maintaining a critical focus on the practical and ethical implications of implementation. The focus is not just on what AI can do, but also on whether it should be used in certain situations. A further key distinction is the dedicated exploration of

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Accepted October 23, 2025

<https://doi.org/10.70251/HYJR2348.364052>

AI's role in supporting caregivers, a crucial yet often underserved aspect of AD management.

This paper first explores how AI can assist in diagnosing Alzheimer's disease through tools like speech analysis, brain scans, and digital memory tests. It also considers concerns about the accuracy and fairness of its results across different groups. The following section focuses on treatment, exploring how AI can help doctors create more personalized care plans. The paper also explores how AI can guide treatment and monitor patients using tools such as home sensors and smartphone apps, potentially improving safety and easing the burden on caregivers. It addresses concerns such as overreliance on technology, privacy issues, and the need to strike a balance between AI and human care. Finally, a dedicated section analyzes the transformative

potential and pitfalls of AI tools designed specifically to alleviate the practical and emotional burden on caregivers.

Overall, this paper examines both the benefits and risks of utilizing artificial intelligence in Alzheimer's care. It highlights fundamental ways AI can improve the lives of patients and caregivers, while also address the ethical and practical concerns that accompany it. The goal is to provide a balanced view of how this technology fits into the future of medicine and what steps need to be taken to ensure its responsible use. To provide a structured overview of the landscape this review explores, Table 1 summarizes the primary AI applications, their strengths, and associated challenges across the domains of diagnosis, treatment, monitoring, and caregiving for Alzheimer's disease.

Table 1. A Comparative Overview of AI Applications, Strengths, and Challenges in Alzheimer's Disease Management

Domain	AI Methods & Applications	Key Strengths	Key Risks & Challenges
Diagnosis	<ul style="list-style-type: none"> • Deep Learning (CNNs) on neuroimaging (MRI) • Natural Language Processing (NLP) for speech pattern analysis • Machine Learning analysis of multimodal data (biomarkers, genetics) 	<ul style="list-style-type: none"> • Enables significantly earlier detection, often pre-symptomatically • High analytical accuracy in controlled settings • Non-invasive and accessible tools 	<ul style="list-style-type: none"> • Overfitting and poor generalizability to diverse clinical settings • Algorithmic bias across different demographics and languages • "Black box" problem limits interpretability and trust
Treatment	<ul style="list-style-type: none"> • AI-driven drug discovery & repurposing • Predictive modeling for personalized treatment plans • Reinforcement Learning for adaptive therapy 	<ul style="list-style-type: none"> • Accelerates identification of drug candidates and reduces costs • Enables dynamic, tailored interventions based on individual patient data • Expands access to supportive therapies 	<ul style="list-style-type: none"> • High failure rate of AI-predicted drugs in clinical trials • Lack of biological validation for AI discoveries • Risk of over-reliance on automated systems without sufficient clinical oversight
Monitoring	<ul style="list-style-type: none"> • Analysis of digital biomarkers from wearables & smartphones • Machine Learning on longitudinal data • Remote Patient Monitoring (RPM) systems 	<ul style="list-style-type: none"> • Continuous, real-time tracking of disease progression • Enables proactive interventions and population-level health trends analysis • Creates integrated, digital health signatures from multiple data streams 	<ul style="list-style-type: none"> • Information overload and alert fatigue for clinicians • Data privacy and security concerns with continuous monitoring • Digital divide limits accessibility for underserved populations
Caregiving	<ul style="list-style-type: none"> • AI-powered reminders & medication management • Chatbots & LLMs for education and emotional support • Voice assistants to aggregate peer support tips 	<ul style="list-style-type: none"> • Reduces practical and cognitive burden on caregivers • Provides 24/7 access to information and support • Helps caregivers adapt to the patient's evolving needs 	<ul style="list-style-type: none"> • Digital literacy gap excludes some caregivers • Emotional over-reliance on AI, risking isolation and "emotional laziness" • Potential for AI "hallucinations" providing incorrect or harmful advice

WHAT IS ALZHEIMER'S, NEURODEGENERATION, AND DEMENTIA?

The Oxford Dictionary definition of neurodegeneration refers to the gradual breakdown and death of neurons. In AD, this process is speculated to be triggered by the abnormal accumulation of proteins in and around the neurons of the brain. These include amyloid plaques, which form between nerve cells, and tau tangles, which accumulate within the neurons (2). Over time, these protein clusters interrupt the brain's ability to communicate and function properly. As more neurons become damaged, the brain begins to shrink, particularly in areas responsible for memory and decision-making, such as the hippocampus.

The early symptoms of AD are often mild and easy to overlook. People may forget names or appointments, lose track of where they have placed items, or struggle to find the right words during conversations. These changes can initially seem like a normal part of aging, but they gradually become more noticeable and disruptive to the individual's life. As the disease worsens, individuals may struggle with basic tasks such as cooking, managing finances, or getting dressed. In the final stages, they may lose the ability to recognize loved ones, speak clearly, or care for themselves. Because the disease progresses slowly, many people are not diagnosed until it is already advanced. This delay limits the effectiveness of available treatments and leaves families unprepared for the emotional and physical challenges of caregiving. To improve early diagnosis and long-term care, researchers are turning to new tools like artificial intelligence. AI offers the potential to identify early warning signs, inform treatment decisions, and aid in monitoring patients throughout the disease course.

HOW HAS AI BEEN USED SO FAR IN MEDICINE AND NEUROSCIENCE?

Artificial intelligence, or AI, is already transforming the way doctors care for patients on many levels. In many areas of medicine, AI helps with reading medical images, predicting disease risk, and organizing patient records. These tools can also aid in identifying tumors in scans and analyzing patterns in blood tests and medical records. In the field of neuroscience, AI is being used to study the brain in ways that were previously impossible. For example, computers can now help identify signs of neurological problems, such as stroke, epilepsy,

or dementia, using MRI scans or speech samples (3). These tools can find changes that are too subtle for humans to notice. One review article published on PubMed explained how AI supports early detection of dementia, assists with virtual cognitive testing, and can even help caregivers with daily planning (4). In many cases, AI is used as a support tool. It does not make decisions for doctors, but it can highlight patterns and offer suggestions based on a large amount of data. This enables healthcare providers to act more quickly and with greater confidence.

AI IN DIAGNOSIS OF ALZHEIMER'S

AD remains one of the most challenging neurodegenerative disorders to diagnose in its early stages, often leaving patients and caregivers in prolonged states of uncertainty. Traditional diagnostic methods, including cognitive assessments, cerebrospinal fluid analysis, and neuroimaging, typically identify AD only after significant neurodegeneration has occurred (5). However, recent advances in AI are revolutionizing early detection by analyzing subtle, preclinical biomarkers that precede direct cognitive decline, as shown in previous diagnostic methods (6, 7). These innovations not only can improve diagnostic accuracy but also provide caregivers with critical time to prepare for disease progression.

One of the most promising ways artificial intelligence is transforming Alzheimer's diagnosis is through the analysis of neuroimaging data. These AI tools have significantly improved the accuracy and efficiency of interpreting brain scans, which is critical for detecting early signs of Alzheimer's-related structural and functional changes. Earlier detection can make a significant difference in treatment outcomes and patient quality of life (8). One major advancement in this area is the use of computer-aided diagnosis (CAD) systems. These systems combine advanced signal processing with AI and machine learning techniques to support medical professionals and caregivers. These systems do not replace human judgment and instead, enhance it. By analyzing physiological signals and brain images more quickly and precisely than traditional methods, they help caregivers make better-informed clinical decisions (9).

A notable trend in neuroimaging is the evolution from single method analysis toward integrated, multi modal approaches. Early applications of deep learning models, such as Convolutional Neural Networks (CNNs), demonstrated remarkable success in analyzing structural

MRI scans, achieving high accuracy (99.9%) in classifying Alzheimer's disease (10-12). This highlighted AI's potential to transform diagnostic approaches. Building on this foundation, researchers are increasingly combining neuroimaging with other data types, such as biological markers and genetic information, to enhance early detection (13). These multi modal approaches represent a dominant theme in current research, as they more effectively capture the complex reality of Alzheimer's disease. Furthermore, AI systems are now detecting subtle patterns in brain structure that are too subtle for human observation, providing early warning signs long before significant cognitive decline (14, 15). The overarching trend shows AI moving diagnosis from reactive confirmation of neurodegeneration toward proactive risk prediction. However, a key limitation remains the challenge of standardizing these advanced models across diverse clinical settings and ensuring their interpretability for healthcare providers. A critical consideration that tempers the excitement around such high accuracy rates is the challenge of overfitting and generalizability. Models like CNNs can become so specialized to the specific dataset on which they are trained that they fail to perform accurately on new data from different hospitals or patient populations. This is a form of overfitting, where the model learns the "noise" of the training data rather than the underlying biological signals of Alzheimer's. Consequently, a model demonstrating 99% accuracy in a controlled research setting may see a significant drop in performance when applied in a real-world clinical environment with different MRI machines and a more diverse patient demographic. Techniques like data augmentation and dropout are used to combat this, but the fundamental issue remains: AI's diagnostic power is only as reliable as the breadth and quality of the data it was trained on, highlighting a major hurdle for widespread clinical adoption.

AI driven speech analysis has emerged as a promising non-invasive method for early AD detection (8,16). A key strength of this approach is the ability of Natural Language Processing (NLP) models to identify subtle linguistic changes, such as alterations in speech rhythm and syntactic simplification, potentially years before clinical diagnosis (17-19). This early detection is critical as it can lead to better outcomes and allow families more time to plan care. Research demonstrates that models using both speech and text, especially those that rely on automatic speech recognition (ASR) generated transcripts, achieve high accuracy in detecting AD (20). The practicality of this method is a

major advantage; it is easy to use, often working through smartphone apps, which makes it more accessible for patients who may not live near specialized clinics. Furthermore, it provides objective, trackable metrics that help researchers and clinicians measure disease progression over time (21, 10, 16). The consistent finding across studies is that integrating multiple features from spontaneous speech is extremely effective in classifying individuals, highlighting speech analysis as a powerful and accessible tool for Alzheimer's diagnosis (22-24). A prevailing theme in this research, however, is the ongoing challenge of ensuring these models are robust and equitable. A key limitation is that their performance can be influenced by external factors such as background noise, audio quality, and linguistic and cultural variations in speech patterns, which must be addressed for reliable real world use.

AI has enabled researchers to discover new methods for detecting Alzheimer's disease earlier and more easily, including through blood and cerebrospinal fluid (CSF) biomarkers, which are less invasive and more cost-effective than traditional tests (8). Tools like computerized cognitive tests and speech analysis, powered by AI, are also showing better results in measuring memory loss and other early signs of Alzheimer's. Machine learning can sort through large sets of brain and psychological data to make diagnoses more accurate, especially when different kinds of data are combined (25). AI has even been used to analyze handwriting, and newer methods like quantum AI seem to outperform older systems when it comes to early screening (26).

Despite significant advancements, challenges persist in how AI is utilized to diagnose Alzheimer's, particularly in standardizing data, simplifying model interpretation, and ensuring its effectiveness across diverse populations and medical settings (13, 8, 27). Ethical issues and the integration of AI into real-world clinics also remain concerns. Solving these problems is essential to help AI reach its full potential in both research and clinical care (13). Researchers, clinicians, and regulatory agencies must collaborate to develop AI tools that are trustworthy, ethical, and genuinely beneficial for Alzheimer's patients and society. Looking ahead, future studies may focus on utilizing more advanced imaging techniques and identifying early biomarkers that appear at the onset of Alzheimer's disease (28). There's also growing interest in explainable AI (XAI), which helps make AI decisions more understandable to humans by offering

more transparency into how those systems work—something especially important in medical settings (12, 29). Finally, the journey from a high performing algorithm to a clinically useful tool is fraught with implementation challenges. Real world clinical feasibility involves more than just accuracy; it requires integration into busy hospital workflows, seamless interoperability with existing electronic health records, and manageable computational costs. Furthermore, for any AI tool to be adopted, it must earn the trust of clinicians. This necessitates moving beyond “black box” models to (XAI) that can justify its diagnoses in a way a human doctor can understand. Without this transparency and practical integration, even the most accurate AI models risk remaining confined to research labs, never fulfilling their potential to impact patient care on a broad scale. The major limitation of artificial intelligence in healthcare is the lack of reproducibility and generalizability across real-world settings. Many AI systems that perform well in controlled studies struggle to maintain the same accuracy when applied to diverse hospitals or patient populations (88, 89). This inconsistency often stems from limited data diversity, nonstandardized methods, and poor documentation, which make it difficult to compare and replicate results. Although doctors generally express optimism about AI's potential, many report that hospitals are not yet equipped with the training, infrastructure, or resources needed for effective implementation (89). In addition, data quality remains a major concern. AI tools rely on large, high-quality datasets, but medical data are often incomplete or inconsistent. Strict privacy laws and ethical restrictions also make it difficult to share patient information, limiting the size and diversity of training datasets. As a result, models often fail to reflect the complexity of real-world conditions, which can reinforce existing biases and produce unreliable outcomes. Collaborative approaches, such as federated learning, may help improve reproducibility by allowing models to learn from multiple data sources without compromising privacy. However, without stronger standards for data collection, transparent reporting, and external validation, AI continues to face serious challenges in earning trust and proving its value in clinical medicine.

AI IN TREATMENT OF ALZHEIMER'S

AI is transforming Alzheimer's drug discovery by rapidly analyzing large datasets to identify potential

treatments and therapeutic targets (30, 31). Modern machine learning algorithms can screen millions of molecules, predicting how drugs interact with targets, and optimizing promising compounds much faster than traditional methods (32, 33).

These AI systems detect complex patterns that humans might overlook, revealing new approaches to combat Alzheimer's. Researchers have developed network-based AI models that combine different biological data types to pinpoint promising drug candidates (34). This approach has identified existing medications like pioglitazone (for diabetes) and atenolol (for high blood pressure) as potentially beneficial for Alzheimer's (34). Since these drugs already have established safety profiles, they could potentially reach patients faster than newly developed treatments. However, this accelerated pipeline introduces a key challenge: the ‘black box’ problem. Many AI models provide limited explanation for why a drug is predicted to work, making it difficult for researchers to biologically validate its mechanism of action for Alzheimer's, which can lead to costly dead ends in clinical trials.

AI is particularly important for drug repurposing, which is basically finding new medical uses for existing drugs (33). This approach significantly reduces development time and costs compared to creating new medications from scratch. Scientists are also using AI to design specialized PROTAC molecules that may target *alzheimer's*-related proteins in innovative ways (35). By processing complex biological data, AI helps optimize clinical trial designs for Alzheimer's treatments (30). This capability is especially important given the historically high failure rates of Alzheimer's drug trials.

The advantages of AI in drug discovery include the faster identification of potential treatments, the discovery of new uses for existing drugs, reduced development costs, and improved clinical trial planning. However, challenges remain, including the need for high-quality data for AI analysis, the requirement for real-world testing of AI predictions, the evolution of AI frameworks, and improved integration with current drug development processes. Future research focuses on validating AI-identified treatments in clinical studies and on making a clear set of standards for evaluating AI drug discovery systems.

A major trend in Alzheimer's treatment is the shift toward truly personalized and adaptive care management. AI systems analyze comprehensive

patient data including medical history, genetics, and lifestyle factors to create individualized treatment plans (30, 36, 37). This personalization extends beyond initial planning to dynamic adjustment, where AI monitors real-time data to track disease progression and modify treatments as needed (38). The technology can predict individual responses to specific therapies, helping to optimize outcomes while minimizing side effects (39). Through reinforcement learning, these systems continuously adapt treatment strategies based on patient response, creating an evolving, personalized approach to care (40, 41). However, a significant theme emerging in personalized AI treatment is the tension between customization and over-reliance. These models depend on a constant stream of high-quality, real-world data, and their adaptive nature requires continuous clinical oversight to ensure that automated adjustments align with the patient's overall well-being and do not deviate from standard care principles.

Beyond pharmaceutical interventions, AI is revolutionizing symptom management and quality of life improvements. AI-powered tools now support therapeutic interventions like reminiscence therapy, using personal photos to stimulate memory recall through accessible platforms like smartphones and laptops (42). This represents a significant advancement in making supportive care more widely available. Simultaneously, AI is driving innovation in treatment mechanisms, helping researchers discover new receptors affected by Alzheimer's pathology (43). The integration of AI with emerging technologies like nanomedicine is creating new possibilities for targeted drug delivery and highly personalized therapeutic approaches (32). These applications demonstrate AI's expanding role from treatment discovery to comprehensive care implementation, working alongside caregivers through remote monitoring and decision support systems (36). The overarching trend is clear: AI is enabling a more responsive, accessible, and precisely tailored approach to Alzheimer's management that addresses both disease modification and quality of life concerns.

While AI shows great potential in treating Alzheimer's disease (AD), several challenges limit its broader use. One major issue is the lack of standardized practices and clear regulations, which makes it harder to adopt AI tools responsibly (36). Ethical concerns like model accuracy and patient data privacy are also critical, as errors could lead to misdiagnosis or poor treatment, and sensitive information must be protected (36). AD's complex causes, including both

genetic and environmental factors, are difficult for AI to fully capture (36). The high failure rate of clinical trials in AD underscores the significant gaps in our understanding of the disease, which also limits the effectiveness of AI (44). Finally, while AI thrives on large, diverse datasets, combining data from many sources creates challenges in maintaining consistency and quality (45).

AI IN THE MONITORING OF ALZHEIMER'S

AI is increasingly used to track biomarkers at both the individual and population levels, providing insights into Alzheimer's disease risk and progression. Longitudinal data collected over multiple clinic visits can model symptom progression patterns at the single-subject level, even in healthy individuals with a family history of AD (46, 47). For example, studies have analyzed plasma biomarker (amyloid-beta (A β)42/40 ratio, pTau181, pTau231, neurofilament light chain (NfL), and glial fibrillary acidic protein (GFAP) trajectories in cognitively unimpaired older adults with and without familial risk (48). PET imaging has also been validated for tracking pathological changes in preclinical AD (48).

At the same time, AI enables population-level monitoring by integrating large datasets from wearables, smartphones, and clinical studies to detect trends across age groups (49, 50). These digital biomarkers help capture AD heterogeneity and identify subgroups with distinct features, such as altered sleep variables and elevated heart rates, which may guide precision medicine strategies (50). Multimodal studies that combine self-collected olfactory and motion data with large clinical datasets further improve early screenings and timely interventions (51). Together, longitudinal and population-level biomarker tracking enhances our ability to predict disease incidence, reduce progression, and tailor interventions at both the individual and community scale (49, 52). This shift towards continuous, passive data collection, however, raises a critical trend: the problem of information overload and alert fatigue for clinicians. Without sophisticated systems to filter and prioritize this constant stream of data, there is a risk that genuinely important changes could be lost in a sea of insignificant fluctuations, potentially overwhelming healthcare systems rather than streamlining them.

AI systems can enhance biomarker assessment by flagging values that cross thresholds, indicating elevated risk, prompting individuals to seek further

evaluation (53). One proposed strategy involves models that incorporate clinical and biomarker data for personalized assessments (53). However, reliance on biomarkers such as amyloid- β and phosphorylated tau remains controversial. Many asymptomatic individuals with abnormal profiles never develop cognitive decline, raising concerns about overdiagnosis and psychosocial consequences (54). Because of this, biomarker positivity is increasingly seen as a sign of elevated risk rather than a definitive diagnosis, particularly in the absence of cognitive symptoms (54).

Olfactory dysfunction is a well-established early sign of Alzheimer's pathology, and AI is now being used to transform simple smell tests into powerful, quantitative diagnostic tools (55, 56). The key trend here is the enhancement of traditional biomarkers through machine learning. AI models do not just automate smell tests; they identify complex patterns in the data that are not apparent through manual scoring, significantly improving the sensitivity and objectivity of olfaction as a biomarker (57). Furthermore, the most promising applications of AI in this area follow the broader trend of multi-modal integration. By combining olfactory data with other metrics, such as motor function or brain imaging, these systems create a more comprehensive and accurate profile of disease risk and progression than any single measure could provide (51, 59). This underscores a major theme in AI monitoring: the move from isolated biomarkers to integrated, digital health signatures.

AI systems are most effective when integrated with physician expertise, enhancing decision-making in AD care (60, 61). They support remote monitoring and patient care, complementing direct clinical oversight (62, 63). Applications like the "Mindup" app facilitate communication between caregivers and doctors, while telemedicine and Remote Patient Monitoring (RPM) expand access to personalized care (63, 64). Systems like Alzheimer's Patient Notification tools, which store medical histories and provide real-time updates, demonstrate how AI can streamline consultations and follow-up (62). Ultimately, integrating AI into clinical practice builds a more connected, data-driven, and patient-centered healthcare ecosystem (65). However, challenges such as data privacy and infrastructure must be addressed for full-scale adoption (64). Additionally, a prevailing challenge in this domain, however, is ensuring health equity. The benefits of these digital tools are not universally accessible, creating a 'digital divide.' Their effectiveness is often limited

by a patient's or caregiver's digital literacy, access to reliable technology, and high-speed internet, potentially worsening existing health disparities for elderly and low-income populations.

CAREGIVER EXPERIENCE

Caregivers for individuals with Alzheimer's disease face immense practical and emotional challenges, but AI offers a suite of tools designed to alleviate this burden and enhance the quality of care. A primary application is in medication management, a critical and often stressful daily task. AI-powered systems, including mobile applications like AlzCure and smart IoT-based dispensers, automate the creation of medication schedules, provide reliable reminders for patients, and send alerts for missed doses. This automation is crucial for ensuring adherence to complex treatment regimens, directly enhancing patient safety and reducing the cognitive load on caregivers (66-68). Looking forward, AI's predictive analytics capabilities show significant promise for moving beyond simple management to optimizing treatment itself. By learning from clinical data and expert decisions, AI models can potentially forecast medication success, paving the way for faster access to personalized and more effective therapeutic interventions for patients (69)

Beyond managing medications, AI is a powerful tool for caregiver education and knowledge acquisition. The progressive and complex nature of Alzheimer's disease often leaves caregivers feeling unprepared. AI directly addresses this need through conversational systems and chatbots like ADQueryAid and Chatbot-A, which are built on advanced Large Language Models (LLMs). These platforms serve as accessible, 24/7 resources, offering caregivers straightforward, authoritative explanations of the disease, its symptoms, and its progression. This immediate access to reliable information is crucial for enhancing health literacy, alleviating anxiety, and empowering caregivers in their shared decision-making with healthcare professionals (70-72).

Perhaps one of the most valuable benefits of AI is its ability to provide adaptive support that evolves in tandem with the patient's condition. Alzheimer's is a dynamic disorder, and caregivers' needs change dramatically from diagnosis through the severe stages. AI-driven tools are uniquely suited to this challenge. Systems like the GPT-4o-based chatbot "Carey" are designed to offer not just informational support

but also crucial emotional support, creating a safe space for caregivers to express their struggles and receive guidance (73). Furthermore, AI can analyze longitudinal data on a patient's behavior and medical history to help caregivers anticipate and understand new symptoms, effectively learning how to manage an evolving disorder (74). A crucial ethical risk here is emotional over-reliance. While these chatbots can provide 24/7 comfort, they cannot form genuine human bonds. Dependence on AI for emotional support could inadvertently isolate caregivers from their personal support networks, a phenomenon known as 'emotional laziness,' which may exacerbate feelings of loneliness in the long term.

Finally, AI facilitates connection and knowledge sharing by aggregating and disseminating practical wisdom. Voice assistant apps can collect and curate tips and strategies from online peer support groups, enabling caregivers to learn from the experiences of others without needing to navigate social media platforms. This empowers them with a continuous stream of practical advice on everything from nutrition and brain health to managing difficult behaviors, enabling them to adapt their care strategies effectively over the long and challenging course of the disease (75, 76). In essence, AI transforms the caregiving experience from one of isolated struggle to one of supported, informed, and adaptive management.

Despite the promising opportunities that artificial intelligence offers for caregiving, its adoption and real-world effectiveness still face major challenges (78). One of the biggest barriers is digital literacy, especially among older adults and caregivers from underserved backgrounds. Many lack the technical skills or access to devices needed to fully benefit from AI tools, such as mobile health apps or virtual assistants (79, 80). This gap can create inequality, where only certain groups gain the advantages of AI-powered support while others are left behind. Even among caregivers who do use these tools, challenges like privacy concerns, data sharing, and the time required to learn new technologies often discourage consistent engagement (81). Caregivers may also worry that relying too much on AI could reduce their independence or sense of control over care decisions.

Another growing concern is emotional over-reliance on AI companions or chatbots. These tools can help ease stress by offering reminders, conversation, or words of encouragement, but they cannot truly replace human connection (82, 83). Studies suggest that depending

too heavily on AI for emotional comfort can lead to "emotional laziness," where users lose motivation to seek or maintain real relationships (84). Over time, this could worsen loneliness and isolation, especially among vulnerable or elderly users (85). AI systems also have technical and ethical limitations. Chatbots may sometimes produce incorrect or misleading information, known as "hallucinations," which could be harmful in caregiving situations (86). Furthermore, algorithmic bias remains a serious issue, as these systems may not perform equally well for people of different ages, ethnicities, or socioeconomic backgrounds (87). While AI can help caregivers manage stress, monitor patients, and improve safety, it should serve as a complement and not a replacement for human empathy and judgment. Ensuring proper oversight, digital literacy support, and ethical standards is key to integrating these technologies responsibly into Alzheimer's care.

CONCLUSION

The journey to integrate artificial intelligence into Alzheimer's disease care represents a significant turning point in how we understand, treat, and support individuals affected by this challenging condition. AI has shown extraordinary promise in identifying early signs of the disease through advanced brain imaging, subtle changes in speech, and digital biomarkers, often long before clinical symptoms become apparent (10,19). Beyond detection, AI is opening doors to personalized treatment strategies, helping match therapies to individuals based on their unique medical history and genetic profile, while also speeding up the discovery of new drugs (30; 34). For caregivers, AI offers practical tools for medication management, remote monitoring, and accessible education, easing daily burdens and providing much-needed support (70, 77).

Yet, these exciting possibilities come with important responsibilities. As AI becomes more embedded in healthcare, we must carefully address issues of fairness, making sure these tools work reliably for people of all backgrounds and do not perpetuate existing disparities (13). Protecting patient privacy is equally critical, as sensitive health data must be handled with the utmost care and security (70). Alzheimer's is a complex disease, shaped by many factors, and AI models must be thoughtfully designed to capture this complexity without oversimplifying (36). Most importantly, technology should assist, not replace, the human touch that remains essential to compassionate care (77).

Moving forward, success depends on collaboration across disciplines, with clinicians, researchers, engineers, and caregivers working together to create AI solutions that are not only innovative but also ethical, equitable, and deeply human-centered (13). With careful implementation, AI can help transform the landscape of Alzheimer's care, bringing new hope to patients and their families as they navigate this challenging journey.

CONFLICT OF INTERESTS

The author declares no conflicts of interest related to this work.

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