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ARTIFICIAL INTELLIGENCE FOR PERSONALIZED POST-STROKE REHABILITATION: SOCIAL, ETHICAL, AND CLINICAL IMPLICATIONS

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ABSTRACT

Objectives: Stroke is one of the leading causes of mortality and long-term disability worldwide. Recent advances in artificial intelligence (AI) have created new possibilities for improving the individualization and effectiveness of post-stroke rehabilitation. This narrative review aims to summarize current applications of AI in post-stroke rehabilitation and to discuss associated opportunities and limitations.
Methods: A narrative review was conducted using PubMed and Google Scholar databases. The analysis focused on stroke, post-stroke rehabilitation, and the use of AI in the rehabilitation process. Publications from 2000 and early 2026 were included.
Key Findings: The reviewed literature indicates that AI-based technologies may support stroke rehabilitation through improved treatment personalization, outcome prediction, continuous patient monitoring, and remote delivery of therapy. Machine learning algorithms, AI-enabled wearable devices, and computer vision techniques facilitate more detailed function assessment of motor and cognitive performance. In addition robotic rehabilitation systems, virtual and augmented reality environments may enhance patient engagement and support functional recovery. However, clinical implementation remains limited due to insufficient validation in large randomized trials, lack of standardization, data privacy issues, ethical and regulatory concerns, and unequal access to advanced technologies.
Conclusions: AI has the potential to contribute to more personalized and data-driven approaches in post-stroke rehabilitation. Nevertheless, its integration into routine clinical practice requires further high-quality clinical studies, interdisciplinary collaboration, and the development of ethical and regulatory frameworks to ensure safe and effective implementation.

KEYWORDS

Artificial Intelligence (AI); Stroke; Neurorehabilitation; Telerehabilitation; Wearable Devices

CITATION

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1. Introduction

Stroke is a sudden onset of neurological deficits caused by acute vascular damage to the central nervous system (Mansfield, Inness, & Mcilroy, 2018; Potter, Tannous, & Vahidy, 2022). It is one of the leading causes of death and long-term disability worldwide, resulting in a significant social and economic burden (Feigin et al., 2025; Saini, Guada, & Yavagal, 2021). Despite declining post-stroke mortality rates, the number of patients living with permanent stroke-related sequelae is increasing, particularly among older adults (Wang et al., 2024).

The most common consequences of stroke include motor, sensory, and cognitive impairments, which limit the ability to perform activities of daily living and hinder social functioning (Alt Murphy et al., 2025). Patients often experience difficulties with gait, balance, and postural control, reducing their quality of life and increasing the risk of falls (Mansfield, Inness, & Mcilroy, 2018). Due to the heterogeneous clinical course of stroke, rehabilitation requires an individualized therapeutic approach (Bonkhoff & Grefkes, 2022).

The rapid development of artificial intelligence (AI) has led to its increasing use in medicine, including post-stroke rehabilitation [8]. AI-driven tools enable the analysis of large clinical datasets, support personalized therapy, and facilitate the monitoring of treatment progress (Lanotte, O'Brien, & Jayaraman, 2023). Despite their considerable potential, the implementation of these technologies faces several challenges, such as a limited data standardization, restricted model generalizability, the risk of bias, and ethical concerns related to medical data security. Therefore, a comprehensive analysis of current AI applications in individualized stroke rehabilitation is needed to evaluate their clinical usefulness, limitations, and future potential (Sorkin et al., 2026). The aim of this narrative review is to analyze current AI-based approaches in rehabilitation after stroke and discuss their benefits, barriers, and future perspectives.

2. Methodology

A narrative review was conducted using the PubMed and Google Scholar databases, including studies published between 2000 and May 2026. The selected literature provides a comprehensive overview of both traditional approaches and recent advancements in AI-driven rehabilitation technologies. The following keywords were used in various combinations: "stroke", "post-stroke rehabilitation", "stroke rehabilitation", "artificial intelligence", "artificial intelligence in medicine", "artificial intelligence in rehabilitation", and "artificial intelligence in stroke rehabilitation".

In addition, the reference lists of relevant articles were manually screened to identify additional eligible studies. A total of 37 articles were included in the final review. The selection was based on relevance to stroke rehabilitation, conventional rehabilitation methods, and the application of AI-based tools in clinical practice. Single-patient case reports were excluded.

3. Functional Consequences of Stroke

Stroke is the second leading cause of death and the third leading cause of combined death and disability worldwide. Every year, around 12 million people experience a stroke, many of whom live with its long-term consequences.

Globally, ischemic stroke accounts for 65.3% of all stroke cases and is caused by a complete occlusion of an artery. Hemorrhagic stroke, resulting from the rupture of blood vessel and bleeding into the surrounding tissue, includes intracerebral hemorrhage (ICH), accounting for 28.8%, and subarachnoid hemorrhage (SAH), which accounts for 5.8% of cases.

The main risk factors for stroke are associated with unhealthy lifestyle behaviors. These include high systolic blood pressure, elevated LDL cholesterol levels, smoking, alcohol consumption, excessive sodium intake, elevated fasting plasma glucose, insufficient fruit and vegetable consumption, excess body weight, and physical inactivity. According to the World Bank income classification, metabolic risk factors account for the largest proportion of disability-adjusted life years (DALYs) lost due to stroke, ranging from 66% to 70% across all countries. A healthy diet and regular physical activity are important not only for the primary stroke prevention, but also for its secondary prevention. Survivors often require long-term support in maintaining healthy lifestyle habits, particularly when complications such as swallowing disorders or disabilities are present (Feigin et al., 2025). Among the long-term neurological sequelae of stroke, motor impairments are particularly significant because of their impact on functional independence. Rehabilitation therefore plays a central role in managing these deficits. Post-stroke movement disorders may result from lesions affecting any segment of the motor circuitry and are generally divided into hyperkinetic, characterized by excessive, involuntary movements, and hypokinetic disorders, characterized by reduced or slowed movement (Tater & Pandey, 2021). Motor and language dysfunctions have the most noticeable impact on everyday functioning. In addition, stroke may affect complex motor skills as well as sensory and cognitive functions. Patients frequently experience anxiety, fatigue, and depression, which further reduce quality of life (Rimmele & Thomalla, 2022). According to Suri et al., the posterolateral thalamus was the region most commonly affected, while dystonia was the most usually reported movement disorder. Following ischemic stroke, parkinsonism and chorea were observed most often, whereas dystonia and tremor predominated after hemorrhagic stroke (Suri et al., 2018).

These findings highlight the importance of long-term multidisciplinary care, including physical and occupational therapy, in supporting the daily functioning of stroke survivors.

4. Conventional Post-Stroke Rehabilitation: Aims and Principles

Stroke survivors most often experience motor, cognitive, and functional deficits, depending on the brain region affected. Therapy should address all of these aspects, although the exact timing of initiation and intensity depend on the patient's condition.

Rehabilitation should begin as soon as the patient is clinically stable and able to tolerate the process, usually more than 24 hours after stroke onset, with adequate intensity, typically involving combined therapies totaling more than 3 hours daily (Winstein et al., 2016).

4.1 Physical rehabilitation

Physical therapy following stroke is a fundamental component of recovery, as the most common consequences include gait disturbances and significant muscle weakness that substantially limit daily functioning **(**Alessandro et al., 2020). The primary aims are to maximize independence, improve quality of life, and enable patients to re-engage in social life **(**Alt Murphy et al., 2025). Among the most important therapeutic objectives is the restoration of independent walking ability (Cao & Elkins, 2024). Rehabilitation encompasses training in functional activities such as transfers, standing up, sitting down, stair climbing, turning, and activities of daily living performed with or without assistive devices (Langhorne, Coupar, & Pollock, 2009).

The therapy is based on task-oriented training, which promotes repetitive motor learning and enhances functional performance (Hubbard, Parsons, Neilson, & Carey, 2009). Resistance training is applied to increase muscle strength. However, its use is limited in individuals with severe paresis. In such cases repetitive functional exercises and electrostimulation are preferred. Repetitive movements practice has been shown to improve both muscle function and strength (de Sousa, Harvey, Dorsch, & Glinsky, 2018). Treadmill training may also be incorporated as an adjunct therapy, although no clear superiority over overground walking has been demonstrated in patients who can walk independently.

Another crucial element of rehabilitation is the prevention of secondary complications of immobilization, such as joint contractures, which may affect up to 50% of patients within six months after stroke (Cao & Elkins, 2024). In upper limb therapy, task-based functional training is essential, alongside constraint-induced movement therapy (CIMT), which reduces compensatory movement patterns and supports functional recovery (Hubbard, Parsons, Neilson, & Carey, 2009).

Spasticity remains a significant clinical issue, and botulinum toxin plays an important role in its management. In the upper limb, it improves range of motion and facilitates activities of daily living, whereas in the lower limb, it reduces muscle tone that impedes walking (Foley et al., 2013; Kaji et al., 2010).

Balance and gait impairments significantly increase the risk of falls. Stroke survivors experience falls approximately twice as often as healthy individuals, and up to 70% experience a fall within the first six months after discharge (Batchelor, Hill, Mackintosh, & Said, 2010). The consequences include injuries and a fear of falling, which further reduce activity levels and hinder rehabilitation progress. Therefore, prevention programs should be implemented early and involve both the patient and caregivers, with an emphasis on balance training, task-oriented therapy, and tai chi exercises, as well as the use of orthopedic aids such as a cane or an AFO brace **(**Alessandro et al., 2020).

Dysphagia is another common post-stroke complication, occurring in 42–67% of patients during the acute phase (first days post-stroke) (Hinchey et al., 2005). It may lead to aspiration, pneumonia, malnutrition, and dehydration, significantly worsening the patient's overall condition and quality of life. When oral feeding is ineffective or unsafe, nutritional support (via nasogastric tube, enteral feeding, or PEG) is required. Treatment also includes swallowing exercises, postural adjustments during feeding, and dietary modifications **(**Alessandro et al., 2020).

4.2 Cognitive rehabilitation

Cognitive rehabilitation after stroke plays a crucial role, as up to 80% of patients experience cognitive impairments. If these impairments become chronic, they significantly undermine the effectiveness of physical rehabilitation, limit independence, and hinder a return to occupational and social activities. Therefore, cognitive rehabilitation should be conducted in parallel with physical therapy and training in activities of daily living, rather than as a separate intervention.

The rehabilitation process encompasses various domains of cognitive function, including attention (simple and complex), working memory, information processing speed, executive functions, language abilities, and visuospatial functions. Particular importance is attached to the so-called "cognitive triad" - attention, working memory, and information processing speed - which should be a therapeutic priority due to their key impact on the success of rehabilitation.

Interventions are based primarily on repetitive training within a stimulus-response paradigm, involving a gradual increase in cognitive load and systematic stimulation of attention and information processing. This approach is consistent with the principles of motor learning, in which the patient learns to optimize motor, sensory, and cognitive functions through repetitive and task-oriented exercises (Alt Murphy et al., 2025).

Another important element of rehabilitation is the improvement of speech and communication, which should be supported by educating the family and caregivers on strategies to facilitate communication. In cases of visual impairments, which occur in 20–57% of patients, neuroophthalmic rehabilitation is used, encompassing compensatory and optical methods aimed at maximizing the use of the remaining visual field and reducing functional limitations in daily life (Alessandro et al., 2020).

5. AI in medicine

Artificial intelligence (AI) is a field of computer science focused on replicating human intelligence. It includes machine learning (ML), which involves developing algorithms that allow systems to learn from data without explicit programming, and deep learning (DL), which analyzes data through multiple computational layers (Shafaat et al., 2022). In rehabilitation, ML models can predict functional recovery outcomes and dynamically adjust therapy intensity (Kopalli et al., 2025). One of the fundamental applications is image classification using convolutional neural networks (CNNs), which analyze images through multilayered mathematical computations and are trained on large datasets (Kamel & Wintermark, 2026).

AI plays an increasingly important role in post-stroke diagnosis, treatment, and rehabilitation by enabling the analysis of clinical datasets, outcome prediction, and support for personalized therapy (Rondina & Nachev, 2025). In ischemic stroke, rapid interpretation of imaging studies is critical, particularly in hospitals without access to neuroradiology specialists or outside standard working hours (Shafaat et al., 2022). Stroke is considered one of the most promising areas for the development of intelligent medical systems due to the importance of diagnostic imaging and the availability of extensive datasets from computed tomography (CT) and magnetic resonance imaging (MRI) (Rondina & Nachev, 2025).

AI is also used to predict stroke prognosis. Models integrating clinical data, imaging findings, and demographic information can forecast functional outcomes after treatment. Studies have employed CNNs, support vector machines (SVMs), and integrated clinical-imaging models to predict the degree of disability and rehabilitation outcomes, thereby supporting treatment planning and the organization of medical care (Rondina & Nachev, 2025). The application of AI also includes predicting functional outcomes and dynamically adjusting the intensity of therapy to individual patient needs (Kopalli et al., 2025).

Current applications of AI extend beyond neurology and include medical fields such as breast cancer screening through mammography, automatic skin disease classification using smartphone-based CNNs, and the detection of colorectal polyps during colonoscopy. These technologies can reduce the risk of overlooking potentially malignant lesions, support diagnosis, and facilitate clinical decision-making. AI can also improve patient education and self-management of chronic diseases, including monitoring of diet and physical activity (Sung, 2023).

The integration of AI into post-stroke rehabilitation covers the entire treatment process, from acute diagnosis to long-term recovery (Kopalli et al., 2025).

6. The Use of AI in Post-Stroke Rehabilitation

AI is playing an increasingly important role in post-stroke rehabilitation by addressing the limitations of traditional therapeutic methods. The recovery process after a stroke is highly variable and depends on many factors, such as the extent of brain damage, the patient's overall health, and the quality and timing of rehabilitation. Currently, post-stroke rehabilitation includes physical therapy, occupational therapy, speech therapy, and cognitive therapy. Despite the effectiveness of these methods, their limitations include insufficient personalization of therapy, variable treatment outcomes, and limited access to intensive and continuous rehabilitation, particularly in resource-constrained settings.

The integration of AI into stroke care aims to improve diagnostics, optimize treatment plans, personalize rehabilitation, and enable remote monitoring of therapy (Kopalli et al., 2025). AI-based technologies make it possible to tailor exercises to the patient's current capabilities and monitor rehabilitation progress in real time. As a result, therapy can also be conducted at home, increasing access to rehabilitation and potentially improving treatment effectiveness (Rondina & Nachev, 2025).

The use of AI in post-stroke rehabilitation encompasses both early diagnosis and support for the recovery of motor and cognitive functions. Imaging techniques utilizing DL in the analysis of CT and MRI enable faster stroke diagnosis and identification of the ischemic penumbra, facilitating the implementation of more personalized therapeutic interventions. AI-based decision support systems can also assist in the treatment of the acute phase of stroke, including determining eligibility for thrombolysis and endovascular therapy. In physical rehabilitation, AI-controlled robots and exoskeletons provide precise and adaptive support, while virtual and augmented reality technologies offer patients immersive therapeutic environments tailored to their individual needs (Kopalli et al., 2025).

6.1 Ambulatory Rehabilitation

Post-stroke rehabilitation should begin while the patient is still hospitalized, as studies have not confirmed the effectiveness of care models based solely on early home-based treatment ("hospital at home"). Moreover, strategies aimed at avoiding hospitalization after a stroke have been shown to lead to poorer treatment outcomes. A prospective study involving 457 patients compared early home care with hospitalization and found that one-third of patients receiving home therapy ultimately required hospital admission (Kalra et al., 2000).

In selected cases, outpatient rehabilitation can serve as an effective supplement to or continuation of inpatient care. Such a care model may reduce the risk of rehospitalization, decrease the incidence of adverse events, and lower overall treatment costs while increasing patients' chances of maintaining independence. However, it is emphasized that multidisciplinary therapy should be provided at a standard comparable to inpatient care. It is also important that the patient is able to actively participate in therapy and attend sessions independently or receive support from family members or caregivers (Rousseaux, Daveluy, & Kozlowski, 2009).

AI can further support outpatient rehabilitation through remote therapy delivery, real-time patient monitoring, and preliminary prediction of clinical results (Sorkin et al., 2026).

6.2 AI in Physical Rehabilitation

Virtual reality (VR) and augmented reality (AR) are increasingly being used in post-stroke rehabilitation as tools supporting the recovery of motor and cognitive functions. These technologies, which utilize AI algorithms, enable the creation of immersive and interactive therapeutic environments tailored to the individual needs of the patients, thereby enhancing rehabilitation effectiveness through more engaging and adaptive forms of therapy (Kopalli et al., 2025).

Mechanical assistance technologies with body weight support, such as electromechanical gait trainers and robotic devices, are also applied in motor rehabilitation. These methods are considered particularly useful during the early post-stroke period (<3 months), especially in patients who have lost the ability to walk independently. VR may further contribute to improvements in gait function by creating motivating therapeutic environments that encourage active participation in therapy, although the availability of this type of technology remains limited.

For patients with paralysis or significant muscle weakness, robotic rehabilitation may also be considered. It primarily supports the performance of activities of daily living. However, its effect on increasing muscle strength has not yet been conclusively demonstrated (Alessandro et al., 2020). Through intensive, repetitive, and precise task-oriented training, robot-assisted rehabilitation may positively influence motor recovery after stroke. Robotic systems allow accurate reproduction of programmed movement trajectories, implementation of training modes adapted to the patient's condition, objective data collection, and continuous assessment of therapeutic progress. At the same time, the need for further development of the intelligence and reliability of these systems prior to their wider clinical implementation is emphasized (Afridi, Obaid, Raheel, & Rathore, 2025).

Fully Immersive Virtual Reality (FIVR) is of particular interest because its high level of immersion enables patients to experience a sense of presence within the virtual environment. FIVR may serve as an effective complement to conventional post-stroke rehabilitation by providing additional functional benefits. Studies have demonstrated that VR positively affects upper limb function, particularly dexterity and hand movement control in stroke patients. VR-based therapy may also improve gait parameters and dynamic balance, thereby increasing patient independence in daily functioning.

VR increases patient engagement in the therapeutic process thanks to the high level of immersion and interactivity offered by the training environment. This technology also allows for flexible adaptation of exercises to the individual needs and functional abilities of patients. Despite promising research results, significant heterogeneity in research methodologies and reported outcomes of VR therapy has been emphasized, indicating the need for further high-quality studies (Demeco et al., 2023).

The development of AI in physical rehabilitation also includes the use of sensors and DL algorithms to analyze gait parameters, predict fall risk, and plan targeted therapeutic interventions. Furthermore, AI-assisted therapeutic games (AI-VG) may aid swallowing rehabilitation through interactive training with dynamic difficulty adjustment, thereby increasing patient engagement in therapy (Zhang & Yu, 2025).

6.3 AI in Neurorehabilitation

The approaches discussed in physical rehabilitation focus primarily on improving motor function through direct movement assistance. However, they should be complemented by methods that allow for the analysis of the neural mechanisms underlying functional deficits. In this context, neurorehabilitation plays a significant role by utilizing AI to analyze and interpret nervous system activity.

The acquisition and processing of neural signals constitute the foundation of brain-computer interfaces (BCIs) used in neurorehabilitation. BCI systems rely on the precise recording and interpretation of brain activity, allowing communication with and control of external devices, which is particularly important for patients with motor impairments following stroke or other neurological conditions (Kopalli et al., 2025).

AI also supports magnetic resonance images analysis in acute ischemic stroke (AIS), enabling automatic segmentation of infarct areas, detection of large-vessel occlusion, and prediction of patient prognosis. The obtained data may serve as a basis for determining the optimal timing for beginning early rehabilitation.

The integration of wearable devices with ML algorithms allows for the real-time collection of movement parameters, such as joint angles or muscle activation patterns. This allows quantitative evaluation of rehabilitation progress while reducing reliance on the therapist's subjective judgement. One example involves systems based on neural networks that automatically analyze movements performed by stroke patients during rehabilitation training and provide personalized feedback.

Furthermore, combining AI with technologies such as optical coherence tomography (OCT) enables more accurate assessment of the extent of brain damage and rehabilitation effectiveness. AI-assisted EEG analysis, on the other hand, can be used to predict patients' rehabilitation potential, supporting the planning of more individually tailored therapeutic strategies (Zhang & Yu, 2025).

6.4 AI-assisted cognitive assessment and rehabilitation

AI-based tools used for cognitive assessment enable the evaluation of various aspects of intellectual performance, including memory, attention, executive functioning, and problem-solving abilities. These systems rely on interactive digital platforms and intelligent testing methods that facilitate the collection of comprehensive data on patients' cognitive functioning (Kopalli et al., 2025).

Computer-assisted therapies may complement standard neurorehabilitation approaches. In this context, VR-based games may contribute to improving patients' attention and visuospatial memory.

Computer-based forms of perceptual training, including visual recovery training, are also applied. However, current evidence remains insufficient to confirm their unequivocal clinical effectiveness. At the same time, multimodal spatial-audiovisual exploration represents a rehabilitation approach that supports patients with visuospatial perception disorders and may be used as a complement to neurocognitive therapy. Additionally, the use of VR environments aimed at enhancing visuospatial representation may further contribute to functional improvements in cognitive performance (Alessandro et al., 2020).

6.5 AI-enabled wearable technologies in rehabilitation

AI-enabled wearable technologies are playing an increasingly important role in rehabilitation, enabling continuous real-time monitoring of patients. Their implementation allows for the ongoing collection of data on gait and mobility data representing a significant extension of traditional functional assessment methods.

These systems utilize sensors such as accelerometers, gyroscopes, and pressure sensors to record detailed information regarding a patient's movement patterns and physical activity. The sensors are integrated into devices such as smart shoe inserts, monitoring belts, or ankle bands, enabling non-invasive data collection during everyday activities (Kopalli et al., 2025).

A particularly important application for wearable technology is remote rehabilitation, in which lightweight devices, including electromyographic sensors, are combined with cloud-computing technologies. This allows patients to continuously track biological parameters and receive remote medical support while remaining at home. Simultaneously, physicians can adjust treatment plans in real time through cloud-based platforms, which increases the effectiveness and flexibility of rehabilitation conducted outside the clinical setting (Zhang & Yu, 2025).

6.6 AI in Telerehabilitation

AI-powered telerehabilitation platforms are increasingly transforming the model of remote care, enabling personalized, scalable, and more effective delivery of rehabilitation services. These systems use AI algorithms to design and implement individualized rehabilitation programs that can dynamically adapt to the needs of a specific patient (Kopalli et al., 2025).

The strongest available evidence across the entire spectrum of post-stroke care, including rehabilitation, pertains to telerehabilitation and brain-computer interfaces (BCIs), for which early randomized controlled trials have been described (Sorkin et al., 2026).

Telerehabilitation also provides a significant solution to systemic constraints, offering more accessible and cost-effective alternatives to traditional inpatient rehabilitation. It enables a reduction in hospitalizations, alleviates transportation-related issues, and compensates for the shortage of rehabilitation centers through remote access to therapy through videoconferencing or telephone calls. Constant supervision and regular feedback encourage active engagement of post-stroke patients in home-based training (Afridi, Obaid, Raheel, & Rathore, 2025).

AI in medical rehabilitation holds significant potential due to its ability to analyze large and complex sets of clinical data collected during patient treatment. It enables the identification of patterns in the course of the disease and the recovery process that would be difficult to detect using traditional analytical methods. A key application of AI is to support personalized therapy by selecting treatment strategies based on individual patient data, which can lead to improved functional outcomes and increased rehabilitation effectiveness (Lanotte, O'Brien, & Jayaraman, 2023).

The use of artificial intelligence in post-stroke rehabilitation encompasses a wide range of technologies that support diagnosis, treatment, and patient monitoring. Despite promising results, the implementation of these solutions is associated with significant limitations that require further analysis.

7. Discussion

7.1 Limitations and Challenges

The effectiveness of AI in stroke rehabilitation is closely linked to multiple interdependent factors. Challenges related to data quality, model transparency, clinical integration, highlight the continuing disconnect between technological innovation and real-world clinical application.

Most rehabilitation systems are built on retrospective datasets derived from relatively small cohorts (usually only a few hundred participants) which may fail to capture the full diversity of impairments seen in the broader stroke population, thereby increasing the risk of systematically biased outcomes (Senadheera et al., 2024). Equally important is the lack of standardization in reporting and the absence of established guidelines for AI systems in post-stroke rehabilitation. Heterogeneity in data reporting across sources may lead to biased or unreliable models and hinder their clinical implementation. Limited transparency regarding how AI systems generate their outputs, combined with the presence of errors and performance variability, may contribute to reduced trust in AI-based decision-support tools (Lanotte, O'Brien, & Jayaraman, 2023). Standardization is therefore necessary to facilitate data interoperability and improve the reliability of AI systems.

Safety and usability of AI-based assistive systems represent another challenge. The two primary rehabilitation settings include inpatient rehabilitation in hospitals or specialized centers and home-based rehabilitation, with facility-based therapy posing relatively low risk of device malfunction or improper use, as patients remain under continuous supervision of trained therapists. In contrast, home-based rehabilitation with AI models may introduce usability issues; for example, some patients discontinue the use of sensor-based devices due to limited familiarity with the technology and difficulties in operating such systems (Senadheera et al., 2024). Importantly, the effective and safe use of AI-based systems depends on adequate training of both healthcare professionals and patients, as insufficient user preparation may reduce the potential benefits of implementing advanced technologies.

In addition to the barriers mentioned above, the financial one cannot be ignored. As shown in the study the use of wearable robots in rehabilitation is associated with costs that are two to three times higher compared to conventional therapy, so the difference is significant (Carpino, Pezzola, Urbano, & Guglielmelli, 2018). Implementing AI systems in stroke rehabilitation practices still requires significant investment that not all medical centers can afford.

7.2. Future Directions

Although AI has already demonstrated significant potential in stroke rehabilitation, its widespread clinical implementation still requires further development and integration into routine healthcare practice. In the context of future research, it will be important to focus on several key areas for the further development of rehabilitation systems based on AI methods. To avoid the problems of generalization across populations and model overfitting, future research should focus on creating large, diverse, and representative databases (Pedroso, Schwamm, & Khera, 2026). These should include diverse patient populations, covering a wide range of impairments and stages of recovery, which would allow drawing more reliable conclusions regarding the clinical applicability of the system and its use in clinical practice (Taghi, Serrien, Fonseca, & Deshpande, 2026). Studies should also consider that stroke rehabilitation protocols vary significantly depending on the functional areas requiring therapy. Providing individualized patient care and integrating AI-based tools into rehabilitation requires collaboration to refine assessment tools and develop personalized rehabilitation interventions. In summary, AI-based technologies may significantly enhance the delivery of post-stroke rehabilitation. However, further progress will depend on interdisciplinary collaboration and the development of specific guidelines to overcome technical limitations, ethical issues, and challenges related to clinical integration (Senadheera et al., 2024).

8. Conclusions

AI is increasingly being incorporated into the diagnosis, treatment, and rehabilitation of stroke patients. Modern technologies based on AI, such as rehabilitation robots, exoskeletons, VR systems, brain-computer interfaces, wearable technologies, and telerehabilitation, offer new opportunities to improve patients' functional capacity and independence. By analyzing large sets of clinical and imaging data, AI supports early stroke diagnosis, predicts patient outcomes, and aids in the development of personalized long-term motor and cognitive rehabilitation. Conventional rehabilitation methods remain the foundation of stroke care, and AI should be considered a complementary tool, not a replacement, to standard therapy. Despite promising results, the implementation of AI in clinical practice is still limited by challenges related to data standardization, model reliability, ethical issues, usability, and high costs. Further large-scale clinical studies, interdisciplinary collaboration, and the development of standardized guidelines are necessary to ensure the safe and effective integration of AI into routine stroke rehabilitation.

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