

The Role of Artificial Intelligence in Stroke

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Abstract

Artificial Intelligence (AI) is transforming healthcare, particularly in stroke diagnosis, management, and rehabilitation. Stroke, a leading cause of mortality and disability, requires rapid intervention for improved outcomes. AI's ability to process vast amounts of data and detect patterns has revolutionized stroke care. Machine learning (ML) algorithms are now used to analyze Computerized Tomography (CT) scans and Magnetic Resonance Imaging (MRI) scans for early stroke detection, helping to determine the type, location, and severity of brain damage. AI is also integrated into predictive modeling systems, assessing stroke risk factors for better prevention management.

AI enhances clinical decision-making by providing personalized treatment recommendations, such as optimal therapies like thrombolysis or thrombectomy. Additionally, AI supports post-stroke rehabilitation by enabling adaptive learning in robotic-assisted therapy and virtual reality, offering personalized recovery plans. The rapid growth of AI in stroke care has the potential to improve patient outcomes, reduce diagnosis time, and provide continuous monitoring.

However, challenges like data privacy, model interpretability, and regulatory approval remain significant barriers. Future research should focus on enhancing AI system accuracy, ensuring generalization across diverse populations, and improving the integration of AI tools into clinical workflows to optimize stroke management.

Keywords: *Artificial Intelligence, Stroke, Machine Learning, Early Detection, Medical Imaging, Predictive Modeling, Thrombolysis, Thrombectomy, Rehabilitation, Robotic-Assisted Therapy, Virtual Reality, Personalized Treatment, Clinical Decision-Making, Data Privacy, Model Interpretability, Healthcare Technology.*

Introduction

Stroke is one of the leading causes of death and long-term disability worldwide, with significant socioeconomic consequences. Early diagnosis, prompt treatment, and effective rehabilitation are key to improving outcomes for stroke patients. Recent advancements in Artificial Intelligence (AI) are beginning to play a transformative role in all stages of stroke management. AI techniques, particularly machine learning (ML) and deep learning (DL), offer substantial potential for improving the speed, accuracy, and precision of stroke diagnosis, treatment planning, and rehabilitation.

AI algorithms can analyze medical images such as CT scans and MRIs to quickly detect stroke-related abnormalities, allowing for faster diagnosis and treatment initiation. This is crucial as the effectiveness of stroke treatments is highly time-dependent early intervention can significantly reduce brain damage and improve patient recovery. Deep learning models, for instance, have been shown to outperform traditional imaging analysis methods in terms of both speed and diagnostic accuracy, especially in distinguishing between ischemic and hemorrhagic strokes ^[1]. AI's ability to automatically process vast amounts of imaging data also reduces the burden on healthcare professionals, enabling them to focus on critical decision-making.

Beyond diagnosis, AI is also making significant contributions in predicting stroke risk. By analyzing large datasets, including patient demographics, medical history, lifestyle factors, and genetic information, AI models can identify individuals at high risk for stroke. These predictive tools can assist in preventive care by flagging high-risk patients early, allowing for timely interventions such as lifestyle modifications or the initiation of appropriate medical treatments ^[2].

In terms of treatment, AI algorithms assist clinicians in selecting the most effective therapies for individual stroke patients. For example, machine learning can predict the response to clot-busting medications or help guide decisions regarding mechanical thrombectomy based on patient-specific variables. These AI models incorporate a wide range of factors, improving clinical decision-making and ensuring that stroke patients receive the most personalized and evidence-based care possible ^[3].

AI is also revolutionizing stroke rehabilitation, where technologies like robotic devices, virtual reality (VR), and cognitive training software are being developed to facilitate personalized, adaptive recovery plans. AI systems monitor patient progress in real time and adjust therapies based on individual needs, improving rehabilitation outcomes. Furthermore, AI-based speech and cognitive therapies are being used to support patients recovering from communication and cognitive impairments ^[4].

Despite the promising potential of AI in stroke care, challenges remain. Issues such as data privacy, algorithm transparency, and the integration of AI tools into existing clinical workflows need to be addressed. Moreover, the clinical validation of AI applications in stroke management is still ongoing, and further research is necessary to ensure their safety and efficacy across diverse patient populations [5].

The Role of Artificial Intelligence in Stroke Diagnosis

Stroke is one of the leading causes of death and long-term disability worldwide, making early and accurate diagnosis crucial for effective management. Traditionally, the diagnosis of stroke involves neuroimaging (e.g., CT or MRI scans) and clinical evaluation, with doctors interpreting the results to determine the type, location, and severity of the stroke. In recent years, AI has emerged as a transformative tool in stroke diagnosis, enabling more efficient, accurate, and timely detection, which is essential for minimizing brain damage and improving patient outcomes.

AI has revolutionized the way neuroimaging is used in stroke diagnosis. Deep learning models, particularly convolutional neural networks, have been applied to analyse CT and MRI scans of the brain. These models can detect abnormalities in the brain's vascular structures, including ischemic and haemorrhagic strokes, by analysing features in the images that may be missed by human radiologists.

1. **Ischemic vs. Haemorrhagic Stroke Detection:** One of the most critical diagnostic tasks is distinguishing between ischemic strokes and hemorrhagic strokes. AI models can identify key features in brain scans that differentiate the two, such as the presence of blood clots, edema, and other subtle changes in brain tissue. Several studies have shown that deep learning algorithms are highly accurate in diagnosing the type of stroke, often outperforming human radiologists in terms of both speed and accuracy [1].
2. **Automated Detection of Stroke Lesions:** Deep learning models can also automatically detect ischemic lesions, which are areas of the brain affected by a stroke. AI tools have been shown to reliably identify and quantify lesion volumes, which can then be used to assess the severity of the stroke and predict patient outcomes. The precise identification of the lesion's location and extent is critical for selecting the appropriate treatment, such as thrombolysis or mechanical thrombectomy [5].

The effectiveness of stroke treatments, particularly for ischemic stroke, is highly time-dependent. Clot-dissolving drugs must be administered within a critical window, typically 3 to 4.5 hours from symptom onset, for optimal effectiveness.

3. **Reduction in Diagnostic Time:** AI systems can significantly reduce the time required to diagnose a stroke, particularly in emergency settings. AI tools can rapidly analyze brain scans and provide near-instantaneous feedback on whether a stroke has occurred. The ability to quickly identify stroke and classify its type allows healthcare providers to administer treatment more quickly associated with improved outcomes [6].
4. **Time to Thrombectomy Decision:** Mechanical thrombectomy, a procedure to remove large clots from the brain's arteries, has become a standard treatment for certain types of ischemic stroke. AI tools are increasingly used to assess whether a patient is a good candidate for thrombectomy. By assessing factors such as the ischemic

and the infarct core, AI models can provide guidance on the likelihood of a successful outcome with thrombectomy [3].

Another important application of AI in stroke diagnosis is its ability to predict patient outcomes based on neuroimaging and clinical data. By using machine learning algorithms that analyze a combination of factors such as the location and size of the stroke, the patient's age, comorbidities, and early clinical indicators AI models can predict the likelihood of recovery, disability, and mortality.

5. **Quantification of Stroke Severity:** AI can help quantify the severity of a stroke by automatically measuring the volume of affected brain tissue, both in ischemic and hemorrhagic cases. These measurements can be used to guide clinical decisions, such as the choice of rehabilitation strategies and the likelihood of requiring long-term care. AI tools are also being developed to help track changes in brain tissue over time, providing clinicians with important insights into the progression of the stroke and the effectiveness of treatment [2].
6. **Outcome Prediction Models:** Machine learning algorithms can also predict the probability of functional recovery, the need for rehabilitation, and the potential for long-term disability. These predictions are based on large datasets that include both imaging data and clinical factors, which help clinicians better understand how an individual patient might respond to various treatment modalities.

AI can enhance stroke diagnosis not only by analyzing medical images but also by integrating multiple data sources. For example, AI systems can combine Electronic Health Record data, patient demographics, vital signs, and even genetic information to provide a more comprehensive understanding of the patient's condition. By analyzing these diverse datasets, AI can offer insights that would be difficult for clinicians to obtain manually, thereby improving diagnostic accuracy and personalizing care.

7. **Integration of Clinical and Imaging Data:** AI platforms that combine clinical data (such as medical history, age, blood pressure, cholesterol levels, and previous stroke history) with imaging data can produce a more holistic assessment of stroke risk and help prioritize treatment options. By integrating this broad range of information, AI models can help in making more accurate diagnostic decisions and identifying patients who may require additional care, rehabilitation, or long-term monitoring [7].
8. **Telemedicine for Remote Diagnosis:** AI is also making stroke diagnosis more accessible, particularly in rural and underserved regions, through telemedicine platforms. AI-based systems can assist healthcare providers in remote areas by providing automated stroke diagnosis based on transmitted imaging and clinical data. These systems allow for quicker decision-making, even when specialized stroke expertise is not immediately available, thus expanding access to high-quality care [8].

Challenges and Future Directions

Despite the promising applications of AI in stroke diagnosis, there are several challenges that need to be addressed for widespread adoption:

1. **Data Privacy and Security:** Given the sensitive nature of medical data, there are concerns about data privacy and

security. AI systems require large datasets to train their algorithms, and ensuring the protection of patient data is critical.

2. **Clinical Validation and Integration:** While AI models have shown impressive results in research settings, there is still a need for robust clinical validation and long-term studies to ensure their reliability in real-world clinical environments. Additionally, integrating AI tools into existing healthcare workflows is a complex process that requires coordination between AI developers, clinicians, and healthcare institutions.
3. **Transparency and Explainability:** AI models, particularly deep learning systems, are often considered "black boxes," meaning it can be difficult to understand how they arrive at specific conclusions. Ensuring that AI systems are transparent and their decision-making process is explainable is essential for gaining the trust of healthcare professionals and patients alike.

Rehabilitation and Recovery After Stroke: The Role of Artificial Intelligence

Stroke often results in significant motor and cognitive impairments, leading to long-term disability. Rehabilitation plays a crucial role in helping stroke survivors regain lost functions, such as motor skills and cognitive abilities, and in maximizing independence. Traditionally, rehabilitation therapies have been manual, relying on physical therapists and caregivers to provide personalized care. However, with the advancement of AI, rehabilitation after stroke has been revolutionized through the development of AI-driven tools and technologies. These innovations, including robotic exoskeletons, VR platforms, and personalized exercise programs, have the potential to enhance rehabilitation outcomes significantly.

AI in Robotic Exoskeletons

One of the most promising AI-driven innovations in stroke rehabilitation is the use of robotic exoskeletons. These wearable devices are designed to assist patients in regaining mobility and strength in their limbs by providing support and facilitating movement. Robotic exoskeletons are equipped with sensors and AI algorithms that monitor a patient's movement and adjust the device's functionality to match their rehabilitation needs.

1. **Assistive Technology for Motor Recovery:** Robotic exoskeletons are primarily used for improving motor function, especially for patients who have suffered severe motor impairments due to stroke. These exoskeletons work by providing mechanical support to the limbs, allowing patients to perform physical tasks such as walking or reaching. The AI component of the exoskeletons is responsible for analyzing the patient's movements and adjusting the device's assistance accordingly, enabling tailored and progressive rehabilitation [9].
2. **Real-time Feedback and Adjustments:** AI algorithms provide real-time feedback, allowing the robotic device to adjust its movements based on the patient's motor performance. If the system detects that a patient is struggling with specific movements or shows improvement in others, the AI adjusts the exoskeleton's assistance in response. This dynamic adjustment accelerates recovery by ensuring that each patient receives the optimal level of support tailored to their condition. Additionally, AI allows for more frequent monitoring,

ensuring that rehabilitation continues at the right intensity without overwhelming the patient.

VR has emerged as another valuable tool in stroke rehabilitation, enabling patients to engage in interactive, immersive exercises that promote recovery. AI is used in VR platforms to personalize the rehabilitation experience by monitoring patient progress and adjusting scenarios to challenge the patient's abilities without causing frustration or fatigue.

3. **Immersive Rehabilitation Exercises:** VR rehabilitation platforms typically involve interactive exercises that simulate real-world scenarios, such as walking in a park or performing activities of daily living. The immersive nature of VR allows stroke patients to practice these activities in a controlled environment, which can significantly improve motor skills, balance, and cognitive functions. AI algorithms within the VR system monitor patient performance and provide real-time adjustments to difficulty levels, based on the patient's abilities and progress. For instance, if a patient is struggling with a specific motion, the VR system may provide additional guidance or modify the task to focus on improving that particular skill [10].
4. **Personalized Rehabilitation Programs:** VR platforms use AI to tailor rehabilitation programs to the specific needs of the patient. By analysing data from motion sensors, the AI tracks improvements or setbacks in patients' performance during VR exercises and adjusts the intensity and difficulty accordingly. This approach ensures that patients progress at their own pace and are continuously challenged without overexerting themselves. Personalized programs also make rehabilitation more enjoyable and engaging, increasing adherence to the therapy.

Personalized exercise programs are essential for optimizing recovery in stroke rehabilitation. AI can analyze a patient's progress in real-time and create individualized rehabilitation plans based on their unique needs and recovery trajectory. AI-driven exercise programs help patients perform the right exercises, at the right time, and with the appropriate intensity.

5. **Adaptive Exercise Plans:** AI algorithms in personalized exercise programs use data from various sources, such as sensors and wearables, to continuously assess a patient's condition. This data can include heart rate, muscle performance, joint movement, and other physiological metrics. Based on this real-time information, the AI adjusts exercise regimens to optimize rehabilitation and ensure that patients are working at their most effective level of intensity [11].
6. **Continuous Monitoring and Feedback:** AI systems can provide ongoing feedback to patients, alerting them to their progress and areas requiring improvement. These systems can also monitor patients' compliance with exercise schedules, helping clinicians and therapists track rehabilitation goals and modify exercise plans accordingly. Continuous monitoring helps patients stay motivated and focused on their recovery, with data that can be easily shared with healthcare providers to make adjustments when necessary.
7. **Remote Monitoring and Tele-Rehabilitation:** With the advent of telemedicine, AI-driven exercise programs are increasingly being used in remote rehabilitation. AI

systems allow clinicians to monitor patients' progress from a distance, reducing the need for in-person visits while still maintaining a high standard of care. Remote monitoring ensures that patients, particularly those in rural or underserved areas, continue their rehabilitation without needing to travel to specialized centers [12].

In addition to motor rehabilitation, stroke often affects cognitive functions, including memory, attention, language, and executive function. Cognitive rehabilitation aims to restore or compensate for these impairments through targeted exercises and therapies. AI can enhance cognitive rehabilitation by providing personalized, adaptive exercises that challenge specific cognitive functions.

8. **AI-driven Cognitive Training Programs:** AI-based cognitive training programs can assess the cognitive strengths and weaknesses of stroke patients and create tailored exercises designed to improve specific areas of cognitive function. For example, AI systems can offer games or tasks that focus on improving memory, attention, or problem-solving skills. These systems track a patient's performance in real-time, adjusting the difficulty of tasks and exercises as needed [13].
9. **Neuroplasticity and Cognitive Recovery:** AI helps stimulate neuroplasticity the brain's ability to reorganize and form new connections after injury by providing patients with exercises that engage different cognitive areas. By continuously adapting exercises to match the patient's cognitive capacity, AI maximizes the chances of recovery and improvement. In addition, the feedback from AI systems encourages patients to persist with their rehabilitation, which is crucial for long-term success.

Review on Artificial Intelligence in Post-Stroke Cognitive and Speech Rehabilitation

AI has emerged as a powerful tool in post-stroke rehabilitation, particularly in cognitive and speech recovery.

Speech and language deficits are common following a stroke, affecting communication abilities. Traditional speech therapy typically requires one-on-one sessions with a therapist, but AI-driven solutions offer scalable alternatives that can be used at home or in remote settings. AI-powered speech recognition systems are particularly beneficial in providing immediate feedback to patients on their pronunciation, fluency, and articulation.

Speech rehabilitation applications use natural language processing algorithms to assess speech patterns and identify areas for improvement. Additionally, AI-based systems can track a patient's progress over time, providing valuable insights into the effectiveness of different speech therapies [14,15].

One promising approach is the development of speech therapy apps that leverage AI to guide users through exercises. These applications are increasingly accessible, allowing stroke survivors to practice speech exercises independently, potentially increasing therapy adherence. Furthermore, AI can integrate multimodal feedback, such as visual cues and auditory prompts, to enhance learning and improve speech outcomes [16].

However, several challenges remain. One major concern is the quality and reliability of AI-driven systems. The accuracy of AI algorithms in predicting cognitive and speech recovery is still an evolving field, and errors in diagnosis or therapy customization could hinder patient recovery. Additionally, the integration of AI tools into clinical practice requires rigorous validation through clinical trials to ensure their safety and efficacy [17].

Ethical issues also arise, particularly regarding patient privacy and data security. AI systems often require access to sensitive patient data, such as medical records, brain scans, or speech recordings, which must be protected from misuse or breaches. Ensuring transparency in AI decision-making processes is crucial to gain patients' and clinicians' trust [18].

Other limitations include

1. **Data Dependency:** AI systems require large datasets to train and refine their algorithms, and these datasets often need to be diverse and representative of the population. In the context of stroke rehabilitation, obtaining such data can be challenging due to variability in stroke types, severity, and patient demographics. Limited or biased datasets could lead to suboptimal AI performance, affecting treatment outcomes [19].
2. **Generalizability:** AI models trained on specific datasets may struggle to generalize to other patient populations. Stroke rehabilitation is a highly individualized process, and a one-size-fits-all approach may not be effective. AI systems need to be able to adapt to the unique cognitive and speech deficits of each patient, which can be a significant challenge given the heterogeneity of stroke-related impairments [20].
3. **User Engagement and Motivation:** While AI-based solutions such as mobile applications or virtual environments have the potential to increase accessibility, they are still heavily reliant on user engagement. Stroke survivors may face challenges in interacting with AI tools due to cognitive impairments, physical limitations, or low motivation, which could affect the effectiveness of these interventions [21].
4. **Clinical Integration:** The integration of AI into clinical practice is a complex process. Healthcare providers may be hesitant to adopt AI-driven solutions due to concerns over their reliability, validation, and regulatory approval. Moreover, training clinicians to use AI systems effectively is essential but can be time-consuming and resource-intensive [22].
5. **Ethical Concerns:** As with any technology that handles sensitive patient data, AI systems in rehabilitation raise significant ethical concerns. These include data privacy, informed consent, and the potential for algorithmic biases. Ensuring that AI applications are used ethically and transparently is vital for their widespread acceptance in clinical settings [23].

Artificial Intelligence in Intensive Care Unit (ICU) Monitoring, Telemedicine, and Remote Monitoring

ICU monitoring systems are designed to track patients' vital signs, laboratory values, and other critical data in real time to detect deteriorating conditions. Traditionally, ICU monitoring systems rely on manual interpretation by healthcare providers, which can be prone to human error due to the overwhelming volume of data and the complexity of critical care conditions. AI, however, offers a more efficient approach by automating data analysis and providing real-time predictions.

AI algorithms, particularly machine learning models, have been used to predict patient deterioration, such as acute respiratory failure, sepsis, or cardiac events, based on historical data. AI can also help to prioritize patient care by identifying those most at risk, ensuring that limited ICU resources are allocated to the patients who need them most [24].

AI-powered predictive analytics have been employed to identify patterns in patient data that are not immediately obvious to clinicians. For instance, deep learning algorithms can analyse ECG, pulse oximetry, and other physiological data to detect abnormal patterns that may signify impending complications, allowing clinicians to take preventative actions. These AI-driven tools have the potential to reduce adverse events in the ICU and improve patient survival rates ^[25].

Telemedicine has gained prominence as a means of extending healthcare services, especially in remote or underserved areas. AI plays a crucial role in enhancing telemedicine platforms by improving diagnostic accuracy, monitoring patients' conditions remotely, and enabling efficient communication between healthcare providers and patients.

AI-powered telemedicine platforms utilize machine learning algorithms to analyse patient data (such as images, video feeds, and health records) and provide diagnostic support in real time. For example, AI algorithms can be used to analyse radiological images during virtual consultations, assisting doctors in diagnosing conditions like pneumonia, fractures, or even strokes, particularly when access to specialists is limited ^[26].

In addition to diagnostic support, AI can assist in patient monitoring through wearable devices that collect real-time health data, such as heart rate, blood pressure, and oxygen saturation. AI systems can analyse this data remotely and alert clinicians to any abnormalities, enabling timely intervention and reducing the need for in-person visits. This is particularly important for patients with chronic conditions who require continuous monitoring, as AI-powered telemedicine systems can provide proactive care and reduce hospital readmissions ^[27].

Remote monitoring technologies have significantly improved patient management by allowing for continuous surveillance of patients outside of clinical settings. This is particularly valuable for patients with chronic diseases, post-surgical patients, and those recovering from critical illnesses. AI enhances remote monitoring by analysing data from a variety of sensors, wearables, and other medical devices to detect early signs of deterioration.

For instance, AI algorithms can be used to monitor vital signs and predict adverse events such as sudden cardiac arrest or respiratory failure. Moreover, AI-based monitoring systems can be integrated with telemedicine platforms, allowing for continuous, remote patient management without the need for frequent hospital visits ^[28].

AI has also enabled the development of mobile applications that provide real-time health assessments and advice. These applications use data from wearable devices and sensors, such as continuous glucose monitors or activity trackers, to provide patients with personalized health insights. By combining AI with patient-generated data, these apps can help patients manage their conditions effectively, reducing the burden on healthcare providers and improving patient engagement ^[29].

Despite its promising applications, AI in ICU monitoring, telemedicine, and remote monitoring faces several limitations:

1. While AI has the potential to greatly enhance ICU monitoring, telemedicine, and remote monitoring, several challenges must be addressed. One of the primary concerns is the quality and reliability of AI models. Many AI algorithms are trained on data from specific populations, which may limit their generalizability to broader patient groups. Inaccurate predictions or missed

detections can result in suboptimal care and negative outcomes for patients. Rigorous validation through clinical trials is necessary to ensure the safety and efficacy of AI-driven solutions ^[30].

2. Another challenge is the integration of AI tools into existing healthcare systems. While AI can improve efficiency and decision-making, it requires robust infrastructure, technical expertise, and user training. Additionally, AI systems must comply with regulatory standards, such as those set by the Food and Drug Administration (FDA) in the United States, to ensure patient safety and data privacy ^[31].
3. Ethical concerns also arise with AI's use in healthcare. AI systems often rely on large datasets, including sensitive patient information, which raises concerns about data privacy and security. Ensuring that AI tools are transparent, explainable, and comply with ethical guidelines is essential to maintain trust between patients and healthcare providers. Moreover, the use of AI in decision-making processes raises questions about accountability, especially in the event of misdiagnosis or treatment failure. It is important to clarify the roles and responsibilities of clinicians and AI systems in patient care ^[32].
4. **Data Quality and Availability:** AI systems depend on large and diverse datasets to function effectively. In healthcare, however, data may be incomplete, noisy, or of low quality, which can impair AI model performance. Furthermore, patient data can be siloed across different institutions, making it difficult to build comprehensive datasets that capture the full spectrum of clinical conditions ^[33].
5. **Bias and Generalizability:** AI models trained on specific datasets may not perform well across different populations or healthcare settings. There is a risk of bias in AI models, particularly if training data disproportionately represent certain demographics or conditions. This can lead to inaccurate predictions or underrepresentation of certain patient groups ^[34].
6. **Clinical Integration and Workflow:** Integrating AI-driven tools into existing clinical workflows can be challenging. Healthcare providers may be reluctant to adopt AI systems due to concerns about workflow disruptions, reliability, and training requirements. Additionally, AI tools may require considerable computational resources, which could strain healthcare systems, particularly in resource-limited settings ^[35].
7. **Privacy and Security Concerns:** AI systems rely on access to sensitive patient data, which raises concerns about data privacy, security, and potential breaches. Ensuring that AI tools comply with strict privacy regulations such as the Health Insurance Portability and Accountability Act is essential to protect patient confidentiality ^[36].
8. **Overreliance on Technology:** There is a risk of overreliance on AI systems, which could result in clinicians neglecting their clinical judgment or failing to recognize limitations in the AI models. AI should complement, not replace, human expertise in critical care decisions ^[37].

Conclusion

The Role of Artificial Intelligence in Stroke

AI has emerged as a transformative tool in the diagnosis, treatment, and rehabilitation of stroke, offering significant advancements in several key areas of stroke care. From early detection and diagnosis to personalized rehabilitation, AI has the potential to enhance outcomes, reduce healthcare burdens, and improve patient quality of life.

In the acute phase, AI-powered systems can rapidly analyze medical imaging, such as CT scans and MRIs, to detect strokes and assess their severity with remarkable accuracy, sometimes even before a human radiologist can make a determination. Machine learning models have also been used to predict stroke outcomes and identify patients at higher risk for complications, facilitating earlier intervention and personalized treatment plans. Moreover, AI algorithms can assist clinicians in managing complex data streams from monitoring systems, improving decision-making in real-time.

In the rehabilitation phase, AI has played a crucial role by enabling personalized and adaptive rehabilitation therapies. By analyzing data from wearable devices, sensors, and patient feedback, AI systems can tailor interventions to individual patients, enhancing the effectiveness of therapies and ensuring more efficient recovery. Moreover, AI in speech and cognitive rehabilitation offers stroke survivors the opportunity to engage in therapy remotely, improving access to care and enhancing adherence to treatment regimens.

However, while AI holds great promise, its integration into stroke care is not without challenges. Data quality, model generalizability, and ensuring AI systems are properly validated for clinical use are ongoing concerns. Furthermore, ethical considerations related to privacy, transparency, and accountability must be addressed to ensure the responsible deployment of AI in stroke care.

Ultimately, the continued evolution of AI, combined with a collaborative approach among clinicians, engineers, and patients, will shape the future of stroke management. As these technologies mature, they are poised to significantly improve early stroke detection, optimize acute treatment protocols, and provide personalized, accessible rehabilitation for stroke survivors, leading to better overall outcomes and a more efficient healthcare system.

Abbreviations

AI: Artificial Intelligence
CT: Computerized Tomography
DL: Deep learning
FDA: Food and Drug Administration
ICU: Intensive Care Unit
ML: Machine learning
MRI: Magnetic Resonance Imaging
VR: Virtual reality

Declarations

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Conflict of Interest

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Ethical Clearance

Not Applicable

Trial details

Not Applicable

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