

Special Article

State of the Art of Artificial Intelligence in Patient and Family-Centered Care During Critical Illnesses: The Stroke Care Trajectory as an Exemplar

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Abstract

Background: Artificial intelligence (AI) has far-reaching implications for clinicians, and for the potential of to advance critical care trajectories. Patient and family-centered care emphasises respect for patient/family members' values, preferences and expressed needs.

Aims: This discursive paper aims to elucidate the transformative role of AI in the stroke care trajectory, presents unique implications using the stroke care trajectory as an exemplar in the context of patient and family centered care.

Design: Discursive paper

Methods: A literature search was used to produce consistent data from peer-reviewed studies and grey literature. Specific focus was on AI, stroke, and patient/family-centered care.

Discussion: Despite the potential of AI-based interventions in stroke rehabilitation are becoming clearer, there is lack of patient perspectives and consideration of their preferences in AI design and implementation phases. Consequently, this explains the deep concerns on low rate of utilization and privacy concerns pointed out on use of AI in online patient portals.

Conclusion: Incorporating patient and family perspectives into the development and implementation of AI in stroke care is essential for achieving successful outcomes. While patients may express a range of attitudes toward AI, their involvement, along with that of their families, can significantly enhance the effectiveness of AI-driven interventions. This is expected to address concerns, fostering trust, and ensuring clear communication can help create a collaborative environment that prioritizes patient-centered care in the context of advancing technologies.

Key words: patient-centered care; family-centered care; AI, stroke, Machine learning, algorithms

Introduction

Artificial Intelligence (AI) is acknowledged as systems with intelligent behaviour that potentially analyse their environment and take actions with some degree of autonomy with a primary goal of achieving specific tasks. Machine Learning (ML) is a segment of AI (Shafik, 2024). The primary goal of

technology in healthcare is to improve the health status of individuals and populations through use in public health planning, implementation in clinical practice, delivery, and evaluation of social and health services. For instance, in the stroke care trajectory, AI is used to deliver both individual-level and population-level domains by aligning services

to that which supports diagnosis, treatment, and discovery of new drugs. In the same respect, AI has a fundamental role in population health (Feng et al., 2023). In the stroke care trajectory, AI could play a significant role because much of the global increase in life expectancy from 1990 to 2021 (0.72 change in years) has been driven by efforts towards reduction of death due to stroke (Institute for Health Metrics and Evaluation, 2024). The rationale is that stakeholders (including persons with interest in stroke, patients, patients' families, clinicians, researchers, students, and service providers) can best design ethically robust AI solutions that can improve individual and societal well-being. While AI has received substantial transdisciplinary attention, the role of AI in the stroke care trajectory has not been emphasized.

Every 3 minutes 17 seconds, someone dies of a stroke in the US – one in eight stroke patients dies in the first 30 days and 25% die in the first year. Stroke is the leading cause of disability globally accounting for 160.4 million disability Adjusted Life Years globally (Tsao et al., 2023). Stroke is also a leading health expenditure domain. Cost analyses showed that in 2021, stroke costed the EU \$110 billion (Luengo-Fernandez et al., 2020); and a 44% increase in costs is foreseen by 2040, yet some countries are expected to see rises in stroke-related costs by 100% (Stroke Alliance for Europe, 2024). Traditional stroke management is often hampered by the complex and heterogeneous nature of the condition. Recent advancements in AI present new opportunities for enhancing stroke care through improved diagnostics, personalized treatment, and enhanced rehabilitation protocols.

Patient and family-centered care (PFCC) underscore the essence of patient-centred care; care that is respectful of patients/family members' values, preferences and expressed needs; coordinated and integrated; and involvement of the patients/their families in provision of information, communication, and education (Kiwauka et al., 2019a). Whilst AI has promoted access to information, it has far-reaching implications in the context of PFCC.

This paper aims to elucidate the current and potential roles of AI in patient and family-centered care using the stroke care trajectory as an exemplar

Potential role of AI in the stroke care trajectory

Stroke is a complex and multifaceted condition characterized by significant heterogeneity. Due to a wide variety of features each stroke patient presents unique challenges in terms of diagnosis, treatment, and management. Understanding stroke heterogeneity involves recognizing variations in stroke types, risk factors, clinical presentations, and patient responses to treatment. The issues of complex and high values of data in the healthcare trajectory presents a promising arena for AI (Isoviita et al., 2019).

In research on the application of artificial intelligence (AI) in stroke care, there are promising opportunities to address these complexities, enabling more precise diagnosis and personalized treatment approaches. Endovascular thrombectomy is a benchmark in the current state of the art of acute stroke management – however, that requires parameter choices, such as presentation time; patient's clinical status, and imaging features (Bendszus et al., 2023). Over the past few years, objective applications of AI in stroke care have paid particular attention to radiological assessment. Traditionally, the machine learning approach has provided research-based techniques in radiology studies. More recently, Feng et al (2023) in their meta-analysis demonstrated that use of machine learning has considerable accuracy in predicting the time of onset of stroke. Researchers have mostly used the C-index to report on accuracy of machine learning models – on the other hand, the use machine learning in image segmentation and texture extraction techniques remain a non-trivial area for further investigation (Baltso et al., 2024; Feng et al., 2023; Wang et al., 2024).

There have been attempts for automated detection of early ischemic stroke changes. Such attempts are beneficial because they reduce the time required for endovascular thrombectomy intervention. More recently, a

meta-analysis led to recommendation that automated scoring be used in acute stroke management decisions particularly when selecting patients for endovascular intervention (Adamou et al., 2023). Despite the promising trend towards automated scoring, vital issues such as differing datasets used for training and validation phases across studies that have investigated automated scoring approaches (Adamou et al., 2023). This imposes far-reaching consequences during the evaluation of algorithm performance and underscores a critical requirement –technical robustness of the model developed because a ML model's technical robustness is partly gauged on the quality and size of the dataset used (ChanderBhanu et al., 2025; Inel et al., 2023; Javed et al., 2024; Wang et al., 2024).

Outcomes prediction is another area that has been substantially explored for establishing applications of AI in stroke care. Although the literature is still very little, results of a well-conducted meta-analysis demonstrated that ML models have high predictive potential in identifying stroke patients' risk of haemorrhagic transformation after thrombolytic therapy (Jiang et al., 2024). Of note, given the scanty literature, there are crucial knowledge gaps – there are no studies highlighting predictive potential of ML models in context of real-world non-academic settings. In the same respect, relatively simple techniques (e.g., robot-assisted upper limb rehabilitation; exercise-gamification; robot-assisted motion; arm-assisted robotic training; and virtual reality; (Mahmoud et al., 2023), have been used in randomized controlled trials of intervention on the application AI in stroke rehabilitation. Gamification and robot-assisted rehabilitation methods are widely currently studied because of their simplicity of implementation and availability of scale to measure effectiveness of AI-based interventions in this area (such as the Motor Activity Log; Stroke Impact Scale; Wolf Motor Function; Fugl-Meyer scale etc). However, several studies have not reported cost evaluation aspects, patients' experiences on safety-related issues and adherence to such methods (Mahmoud et al., 2023). Reporting patient experiences has far-reaching

implications in stroke care because recovery trajectories differ significantly among stroke patients, with some experiencing rapid improvements while others face long-term challenges. In addition, because AI-based techniques are yet to be applied in free-living settings, patient experiences will go a long way in nuancing the accuracy of such approaches in free-living settings. The potential of AI-based interventions in stroke rehabilitation are becoming clearer. A meta-analysis revealed that such interventions can be leveraged to enhance assessment of motor function recovery (Ambros-Antemate et al., 2022). However, the parameter choices used in the machine learning for assessment of motor function however remain elusive.

Implications for clinicians and directions for research and practice

Currently, the analysis of output information from stroke assessments is done by clinicians including neurologists, general physicians, physiotherapists, and nurses. As research on AI in healthcare continues to evolve, addressing the challenges of equitable and technologically robust AI will remain critical to ensuring that AI systems are patient centered. First, this will require interdisciplinary collaboration among researchers from various disciplines including nursing, neurology, radiology, genetics, and data science. Secondly, the extend of nurses' involvement in the development phase of AI systems is currently limited (O'Connor et al., 2022). In addition, little is reported on the role of nurses in AI implementation in clinical practice and impact evaluation (von Gerich et al., 2022). Given that nurses constitute the largest group in the healthcare workforce and spend the most time with patients and their families, their role in the design and deployment of AI systems in healthcare can no longer be overlooked. They play crucial role as a feedback loop between the clinical team and patients/families (who are the beneficiaries of most AI innovations (Megaro et al., 2023).

Furthermore, involving patients in the design of AI tools can ensure that these solutions address their specific needs and preferences. Engaging patients in all stages of AI systems' development and deployment can lead to

more effective and user-friendly AI applications. Despite the abundance of literature on AI systems in healthcare, it is difficult to provide any conclusion about patients' values and preferences in the context of AI in healthcare. Nevertheless, it appears that some scholars have suggested theoretical perspectives on AI that considers patients values (Balch et al., 2022). Lack of patient perspectives and consideration of their preferences in AI design and implementation phases might partly explain the deep concerns on low rate of utilization and privacy concerns pointed out on use of AI in online patient portals (Gkontra et al., 2023; Murdoch, 2021; Otokiti et al., 2022).

A considerable number of scholars engaged in AI techniques have already emphasised the essence of appropriate algorithm training with large and diverse data (Sahni et al., 2024). With respect to the stroke care trajectory, diverse datasets that encompass various patient demographics and clinical scenarios are required to ensure representative cultural contexts and the full spectrum of stroke presentations. Ultimately, it is essential to mitigate bias in AI models to ensure that they perform well across different populations. Continuous monitoring and validation of algorithms in real-world settings can help identify potential biases and allow for adjustments to improve fairness and equity (ChanderBhanu et al., 2025; Gkiolnta et al., 2025).

Future research should focus on integrating AI tools into clinical workflows and assessing their impact on outcomes. This includes studying how AI can complement the expertise of healthcare providers rather than replace it. Longitudinal studies that track stroke patients over time, collecting data on their clinical outcomes and responses to treatment. This information can inform the development of dynamic AI models that adapt to changing patient profiles. Long-term studies evaluating the effectiveness of AI interventions in stroke prevention and recovery are necessary. These studies can provide insights into the sustainability and reliability of AI applications over time (Javed et al., 2024; Murdoch, 2021).

Ethical concerns constitute a common barrier to utilization of AI (Otokiti et al., 2022). Investigating the ethical implications of AI use in stroke care, including data privacy and algorithmic bias. Longitudinal Studies: Long-term studies to evaluate the effectiveness of AI interventions in stroke prevention and recovery. Investigating the ethical implications of AI use in stroke care is crucial. Issues such as data privacy, algorithmic bias, and informed consent must be addressed to ensure that AI is used responsibly and equitably. Future trends will likely include transparency and explainability which ultimately helps clinicians and patients understand the rationale behind decisions. Transparency (e.g., model purpose, inputs, and operation are known and understood by end-users) can be implemented through citizen science approaches thus ensuring connection to the topic (that is AI in healthcare) in a meaningful way to the end-users (that is clinicians and patients). This will enhance the value of outputs due to their lived experiences (Hall et al., 2024; Javed et al., 2024).

Fairness, gender issues, and diversity are of major importance to AI in the stroke care trajectory – because stroke predominantly affects older people after 65 years (*Global Burden of Disease (GBD)*, n.d.). Because women live longer, there are more stroke events among women. In the same respect, people with lower socio-economic status such as lower education and income are disproportionately affected by stroke (Tsao et al., 2023). This underscores the importance of gender issues, fairness and diversity while considering AI in the stroke care trajectory. The consideration of diverse AI model training and testing datasets can help to safeguards equal rights and opportunities for all groups and strengthens the model's reliability and ethical integrity (Fabuyi, 2024; Içek et al., 2025; Luo et al., 2024; Muvva, 2025).

Implications of AI for Patient and Family-Centered care

The use of AI and patient experiences particularly during critical care situations remains largely unknown. Yet, AI possess

serious issues with respect to its acceptance and trust. Patient experiences with AI will shape their general acceptance in future healthcare applications (Richardson et al., 2022). Acceptance is likely to hinge previous interactions with established health and social technologies. Studies on patients and family members' perspectives on AI in health are also of less interest so far (Fritsch et al., 2022). This underscores the role of examining patient and their families' opinions and early engagement at all stages of design, development, and deployment of AI systems in health. Concerns on accuracy and reliability can lead to anxiety and reluctance of patient/families' engagement with AI systems in healthcare (Hall et al., 2024; Javed et al., 2024).

Patients and their families place much emphasis on human connection in healthcare. Patient-centered care illuminates the importance of patients' values and preferences. Thus, while patients may appreciate AI's potential, there are concern regarding healthcare professional-patient relationships (Allen et al., 2024). Whilst AI tool have enormous potential in health care, it is important that patients' interactions in the patient-healthcare relationship are not compromised by AI systems. In addition, the involvement of family members can enhance the effectiveness of AI-driven interventions by providing additional insights into the patient's needs and preferences (Allen et al., 2024; Hall et al., 2024).

PFCC emphasizes the need to involve patient and their families in information, communication, and education (Kiwanka et al., 2019b). As AI tools become more accessible in healthcare, patient and families need education on how AI systems are designed, work and their process of deployment. Informative resources can empower family members to actively participate at various stage of AI systems' design up to deployment. Engaging family members in these discussions can lead to more comprehensive care plans that align with the patient's values and lifestyle (Allen et al., 2024; Hall et al., 2024; Kiwanka, et al., 2019b).

Conclusion: Incorporating patient and family perspectives into the development and implementation of AI in stroke care is essential for achieving successful outcomes. While patients may express a range of attitudes toward AI, their involvement, along with that of their families, can significantly enhance the effectiveness of AI-driven interventions. Addressing concerns, fostering trust, and ensuring clear communication can help create a collaborative environment that prioritizes patient-centered care in the context of advancing technologies. Co-designing AI tool with the involvement of patients and families in the design and development of AI solutions can lead to tools that better meet their needs. Collaborative approaches ensure that patient perspectives are considered, resulting in more user-friendly and effective applications. Lastly, establishing mechanisms for patients and families to provide feedback on AI tools can inform ongoing improvements and adaptations. This feedback loop can enhance the technology's usability and relevance, ultimately benefiting patient care.

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