

Prehospital and in-hospital factors that influence acute stroke management in the emergency department: A literature review

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21 Prehospital and in-hospital factors that influence acute stroke management in the emergency department: A literature review

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Abstract

Background: Effective emergency response plays a crucial role in ensuring patient safety, particularly in the management of acute stroke cases in Emergency Department (ED). Timely correct care is essential to mitigate adverse outcomes in stroke patient. 11

Purpose: To investigate pre and in-hospital factors that influence acute stroke management in the ED.

Method: A literature review method was employed to gather and analyze information from Scopus, Science Direct, and Google Scholar using the keyword stroke AND "Emergency Department" in the 2019-2024 period. As much as 333 articles are identified. A total of 10 articles that met the criteria were included in the study. The selected articles are then systematically reviewed and analyzed.

Results: Factors that can affect prehospital delay consist of the use of Emergency Medical Services (EMS), patient characteristics, and geographical barriers. The factors that affect in-hospital delay are communication with ED staff and ED officer knowledge. 13

Conclusion: To improve the management of stroke patients, the participation of various parties is needed, not only within the hospital, but also the role of policy holders in the prehospital.

Keywords: Acute Stroke; Emergency Department; In-Hospital; Prehospital.

INTRODUCTION

Acute stroke cases present a critical medical challenge where timely intervention is pivotal in mitigating severe outcomes like irreversible brain injury or fatality. Rapid access to specialized emergency care, encompassing well-equipped ambulances staffed with skilled medical professionals, stands as a cornerstone in facilitating swift and effective responses to such emergencies.

The integration of cutting-edge technologies within these emergency vehicles not only expedites crucial medical assessments but also enables immediate initiation of advanced therapies such as thrombolytic treatment even before hospital admission (Herpich & Rincon, 2020).

Moreover, swift access to emergency medical care can reduce the time needed to initiate critical

medical interventions, such as thrombolysis or endovascular procedures, which are crucial in managing ischemic strokes. This not only affects short-term outcomes for patients but also minimizes long-term brain damage and enhances the chances of optimal recovery (Torbey, Bösel, Rhoney, Rincon, Staykov, Amar, Varelas, Jüttler, Olson, & Huttner, 2015). Therefore, a well-integrated and coordinated system between emergency services and stroke care facilities is the cornerstone in ensuring that every second is invaluable in saving lives and improving the quality of life for those affected by acute stroke.

However, in many regions, especially in rural areas or developing countries, the availability of emergency facilities is often a challenge. Limited access to rapid medical transportation, medical infrastructure constraints, and a shortage of trained medical personnel can significantly affect patient safety in managing acute stroke cases. Therefore, a deeper understanding of these factors can provide crucial insights in designing strategies to improve emergency infrastructure and optimize healthcare resource management in various global contexts. Thus, this research aims to identify the factors that contribute to stroke management delay in Emergency

Departement (ED), making a valuable contribution to efforts in enhancing emergency systems and emergency medical care overall.

6 RESEARCH METHOD

This study is a literature review design, conducting a systematic review by selecting relevant articles aligned with the research objectives. Research begins by identifying the purpose and question of the study. The research question in this study is "What 11 prehospital and in-hospital factors that influence the management of stroke patients in the ED?"

The next step is to identify the literature that fits the research question. We searched for literature from the internet on 3 search engines, namely Scopus, Science Direct, and Google Scholar using the keyword stroke AND "Emergency Department" in the 2019-2024 period and was a research or original article. As many as 333 articles are identified. Articles that are not in English, incomplete, do not contain full text, research for 11 general diseases, and review articles are excluded. A total of 10 articles that met the criteria were included in the study. The selected articles are then systematically reviewed and analyzed.

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RESEARCH RESULTS

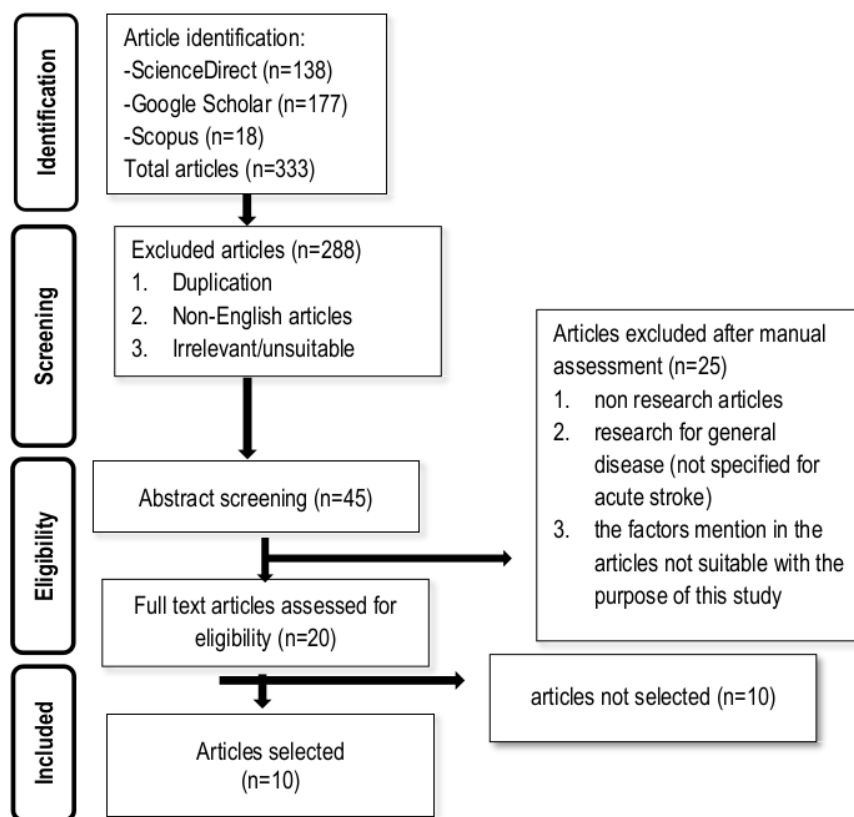


Figure PRISMA flow diagram

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Table Summary of the selected articles

(Author, Year (Country))	Purpose	Method	Results
(Alabdali et al., 2020) (United Kingdom)	To analyze whether patient using EMS had shorter stroke team activation, CT scan, and intravenous thrombolytics than patient arrived with private transportation.	10 Prospective cohort study Single center	Patients arrived with EMS significantly have shorter time to stroke team activation. No statistical differences in CT scan time and iv thrombolytics time
12 (Bhaskar et al., 2019) (Inggris)	To identify factors associated with prehospital delay at a comprehensive stroke center	Retrospective cohort study Single center	8 Identified factors that associated with prehospital delay are patient aged 55-64 and 65-74 years; belonging to Polynesia, South Asia and Mainland Southeast Asia; and not using ambulance.
(Georgakakos et al., 2022) (Australia)	2 To identify trends in rural-urban stroke mortality and identify factors associated with rural-urban stroke case fatality disparities	10 Retrospective cohort study Multicenter	24 Rural stroke patients had higher mortality than non-rural patients. Patient rurality associated with mortality.
(Le et al., 2020) (Netherlands)	14 To describe factors associated with time between stroke symptom onset and ED arrival (time to ED)	Retrospective cohort study Single center	16 Average time to ED was 15.0 hours. Female, drug abuse, and diabetes significantly associated with longer time to ED.
(Li et al., 2019) (USA)	To identify EMS providers knowledge about stroke identification, stroke time window, and comprehensive stroke center. Also identify barriers EMS providers face to provide optimal stroke care.	Observational study Multicenter	5 96% EMS providers use Cincinnati Prehospital Stroke Scale to identify stroke, 11% correctly identify stroke time window for iv thrombolytics, 5, 7% correctly identify comprehensive stroke center. Barriers in providing prenotification: short transport time, information being lost in dispatch, not having direct communication with ED staff.

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(Puri et al., 2019) (India)	To analyze the effectivity of stroke education to ED staff in stroke care improvement.	9	Prospective (before-after) study Single center	observational	Stroke education to ED staff is effective in increase acute stroke care
(Tanaka et al., 2019) (Japan)	To describe frequency and characteristics patients who receive iv thrombolytic therapy; to identify factors associated with door to needle time.	7	Retrospective cohort study Multicenter		The frequency of iv thrombolytics in Japan increase from 1.8% in 2005 to 9.5% in 2015; Door to needle time gradually decrease from 105 minutes in 2005 to 61 minutes in 2015; Factors associated with DNT are activation of code stroke systems, onset, pretreatment with antithrombotic agent, and year of treatment.
(Tennyson et al., 2019) (USA)	To analyze door to stroke team activation target time in patients who arrive with EMS without pre-notification compare with patient arrived with private transportation.	17	Prospective cohort study Single center		Stroke patient who arrived with EMS without pre-notification are less likely to meet the national DTA goal than patients arrive with other transportation.
(Terecoasă et al., 2022) (Canada)	To describe the pre-hospital delays in patient with acute stroke and identify factors associated with it.	15	Prospective study Single center	observational	31.6% patient arrived within 4.5 hours after stroke onset, 4.4% between 4.5-6 hours from the onset, 28.7% more than 24 hours after onset. Factors associated with pre hospital delays: private transportation usage, living alone, and living in rural area.
(Xirasagar et al., 2019) (United Kingdom)	To explore the reason of use or not use EMS transport in acute stroke patients.		Cross sectional observational study Single center		Factors associated with EMS usage: prior familiarity with stroke, indicating possible stroke, and bystander discouragement to call 911.

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DISCUSSION

Each moment in the acute stroke response timeline holds immense significance, influencing the trajectory of patient care and outcomes. The seamless transfer of critical medical information from the ambulance to hospital-based teams facilitates informed decision-making and timely interventions (Psychogios, Behme, Schregel, Tsogkas, Maier, Leyhe, Zapf, Tran, Bähr, & Liman, 2017). This real-time exchange of data, coupled with the utilization of telemedicine technologies, empowers healthcare professionals to initiate precise treatment strategies promptly, aligning with evidence-based practices and individual patient profiles. Moreover, the establishment of clear pathways for patient transport and admission ensures that stroke victims swiftly access specialized care environments equipped to deliver advanced therapies and comprehensive rehabilitation services.

The use of EMS has an effect on acute stroke management in ED. EMS transport patients resulted in significantly shorter time to stroke team activation than other transport mode. However, the use of EMS is not related to the time of the CT scan and the time of intravenous thrombolytic administration (Alabdali et al., 2020). This is in line with other research which states that one of the causes of pre-hospital delay in stroke management is not EMS/ambulance (Bhaskar et al., 2019). A study revealed that the use of EMS in stroke patients was influenced by a previous family history of stroke. The patient or bystander already knows the signs and symptoms that lead to a stroke. So they choose to use EMS to get faster treatment (Xirasagar et al., 2019). This indicates that public knowledge about stroke and EMS is one of the factors that can determine the speed of treatment of stroke patients in the prehospital (Langhorne, Audebert, Cadilhac, Kim, & Lindsay, 2020).

EMS personnel's knowledge of stroke is also important. The speed and accuracy in identifying stroke patients and carrying out appropriate stroke management actions can optimize stroke management in hospitals and improve patient

outcomes. Appropriate pre-hospital actions by EMS officers include sending prenotification to the intended ED and taking the patient to a hospital that has adequate stroke facilities (Li et al., 2019). Prenotifications sent by EMS personnel are important for preparing the stroke team and expediting care when the patient arrives at the ED. EMS personnel's knowledge of the appropriate stroke destination hospital is another important thing. Patients who are sent to hospitals without comprehensive stroke facilities can result in lengthening the patient's time to receive definitive stroke therapy. It can also be fatal for patients as reported in several developing countries (Adegoke & Ajuluchukwu, 2019; Olusegun, Akande, Otrfanowei, Nwoye, Olopade, & Ajuluchukwu, 2021).

The availability of state-of-the-art ambulances equipped with advanced diagnostic tools and therapeutic options signifies a paradigm shift in acute stroke management. These mobile units serve as crucial extensions of hospital capabilities, enabling seamless continuity of care from the initial emergency response through to specialized treatment settings. By harnessing technologies like portable CT scanners or telemedicine capabilities, emergency medical teams can swiftly diagnose stroke types and severity, crucially informing decisions on the most appropriate interventions (Phipps & Cronin, 2020). Moreover, the deployment of trained personnel adept in early neurological assessment and rapid initiation of therapeutic protocols enhances the prospects of favorable patient outcomes.

In addition to technological advancements, the strategic positioning of these ambulances within broader emergency medical service networks plays a pivotal role in optimizing response times and outcomes for acute stroke patients. Collaborative efforts between emergency medical services, hospitals, and stroke care specialists ensure a coordinated approach, where every minute saved in transit translates into potentially lifesaving interventions at the hospital (Furie & Jayaraman, 2018). Moreover, ongoing advancements in mobile

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healthcare technologies continue to refine the capabilities of ambulances, offering real-time data transmission and remote consultation options that further enhance diagnostic accuracy and treatment precision.

Ultimately, the evolution of ambulance-based acute stroke care represents a synergistic convergence of medical expertise, technological innovation, and systematic integration within emergency healthcare frameworks (Kobayashi, Czlonkowska, Ford, Fonseca, Luijckx, Korv, de la Ossa, Price, Russell, & Tsiskaridze, 2018). By continually enhancing the readiness and capabilities of these mobile units, healthcare providers strive not only to expedite critical interventions but also to redefine standards of care in acute stroke management, ultimately improving patient outcomes and quality of life.

The importance of rapid and efficient access to emergency medical care has been a primary focus in efforts to improve stroke patient outcomes. Good emergency facilities encompass not only the presence of ambulances equipped with appropriate medical equipment but also effective coordination between emergency centers, hospitals, and their stroke units (Furie & Jayaraman, 2018). This coordination ensures that patients promptly receive accurate diagnosis and appropriate care according to established stroke management protocols.

Several studies have reported that patient characteristics can affect prehospital delay in stroke patients. Age over 55 years, female gender, and certain races such as Polynesia, South Asia, and mainland southeast Asia races have been associated with prehospital delay (Bhaskar et al., 2019; Le et al., 2020). This is because cultural differences have an impact on the different concepts of health and illness. As a result, in certain cultures they still use self treatment efforts that they can do themselves at home.

Patient's social history also contribute to pre hospital delay. Patients who live alone have also been reported to be one of the factors causing prehospital delay (Terecoasă et al., 2022). This is due to the

absence of bystanders who can provide immediate assistance. So that often patients who live alone are found too late and receive treatment too late. Likewise, patients with drug abuse (Le et al., 2020). They often live separately from their social environment and family.

Comorbid diseases and patient medical history can also affect pre-hospital delay. Diabetic patients are significantly associated with a long time from the last time they were seen normal (stroke onset) to coming to the ED (Le et al., 2020). Diabetes causes clinical symptoms that appear atypical. Patients and their families think that the symptoms experienced are only due to temporary increases in blood sugar as is often experienced by patients. Diabetic patients who suffer from stroke tend to die or experience severe disability. This happens because chronic hyperglycemia causes damage to cerebrovascular structure and function. In addition, it is also due to their low therapeutic response to intravenous tissue plasminogen activator (Maida, Daidone, Pacinella, Norrito, Pinto, & Tuttolomondo, 2022).

Patients from rural areas have higher stroke mortality than patients who are not from rural areas. The more rural, the higher the mortality (Georgakakos et al., 2022). Other studies have shown that stroke patients living in rural areas are associated with pre-hospital delays (Terecoasă et al., 2022). A study in Brazil reported an increase in emergency cases in areas with significant geographic barriers. Geographical barriers disrupt access to and from health services. As a result, emergency cases that require immediate treatment are late in getting the treatment they need. Therefore, the role of the government is needed to analyze existing geographic barriers and efforts to overcome these barriers (Isaacso Joiner, & Kozhumam, 2021 ; Zachrison, Nielsen, De La Ossa, Madsen, Cash, Crowe, Odom, Jauch, Adeoye, & Richards, 2023).

A primary challenge in managing acute stroke is ensuring that necessary resources and infrastructure are available in various regions, both urban and rural. Continuous investment in the development and maintenance of emergency facilities, along with

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ongoing training for medical personnel, is essential to enhance their ability to quickly and efficiently respond to every stroke case that occurs (Xian, Smith, Zhao, Peterson, Olson, Hernandez, Bhatt, Saver, Schwamm, & Fonarow, 2014). Consequently, these efforts will not only increase overall patient safety but also reduce long-term burdens on the healthcare system as a whole.

The results of a survey on EMS officers showed that the difficulty of communicating with ED staff was one of the obstacles faced in pre-notifying EMS officers to the ED. This causes in-hospital delays in stroke patient management (Li et al., 2019). Other studies have also reported similar things. Stroke patients who arrive using EMS without pre-notification tend to be unable to meet the door to activation of stroke team (DTA) time target (Tennyson et al., 2019). Hospitals are expected to develop a hospital stroke team. This team consists of various disciplines and has a clear emergency protocol (Waqas, Vakharia, Munich, Morrison, Mokin, Levy, & Siddiqui, 2019). The existence of this stroke team is expected not only to overcome communication barriers in the intrahospital, but also bridge communication since the patient is still in the prehospital.

In addition to optimal emergency facility availability, effective coordination between emergency services, hospitals, and medical teams is key to ensuring that patients receive timely and appropriate care. This includes clear and efficient communication to facilitate safe and swift patient transfers to stroke units in nearby hospitals (Bladin & Cadilhac, 2014). Synergistic cooperation among all parties involved, from initial field response to advanced medical facilities, is crucial in enhancing safety and clinical outcomes for patients experiencing acute stroke. Furthermore, the integration of emergency facilities into broader public health systems and medical services fosters enhanced coordination among paramedics, physicians, and hospital teams. This collaborative approach not only expedites the diagnosis and initial treatment of acute stroke but also ensures that patients receive customized care tailored to their specific needs from

the onset of the medical event (Jauch, Schwamm, Panagos, Barbazzeni, Dickson, Dunne, Foley, Fraser, Lassers, & Martin-Gill, 2021). By streamlining communication channels and standardizing protocols across emergency response networks, healthcare providers can optimize response times and clinical outcomes, thereby mitigating the potential for long-term complications and maximizing recovery prospects for stroke patients (Langhorne et al., 2020).

Beyond immediate medical interventions, the coordinated efforts of emergency responders and hospital staff contribute to a continuum of care that addresses both acute medical needs and long-term recovery goals (Rudilosso, Laredo, Vera, Vargas, Renú, Llull, Obach, Amaro, Urra, & Torres, 2020). This integrated approach extends beyond the emergency room, encompassing ongoing monitoring, rehabilitation therapies, and support services tailored to optimize functional outcomes and quality of life post-stroke. By prioritizing early intervention and holistic care frameworks, healthcare systems can effectively reduce the burden of stroke-related disabilities while empowering patients to achieve optimal recovery trajectories.

ED staff knowledge about stroke is a fundamental thing that must be considered in efforts to improve stroke patient care management in hospitals. Lack of staff knowledge about stroke can cause delays in stroke treatment in the ED. A study reported that education about stroke for ED staff was effective in improving stroke patient care in the ED (Puri et al., 2019). This is in line with another study in Japan which reported that a stroke team activation system developed in a hospital had an effect on door to needle time (DNT) (Tanaka et al., 2019).

The presence of well-trained and experienced medical personnel in handling emergency cases like acute stroke also determines patient outcomes. Medical team readiness in providing immediate interventions, accurate evaluations, and comprehensive early management can reduce critical treatment delays, thereby enhancing patient safety and prognosis (Kobayashi et al., 2018)

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In essence, the synergy between emergency facilities, public health systems, and medical services exemplifies a proactive strategy in acute stroke management (Kamal, Holodinsky, Stephenson, Kashayp, Demchuk, Hill, Vilneff, Bugbee, Zerna, & Newcommon, 2017). Through continuous refinement of protocols, integration of innovative technologies, and commitment to collaborative care models, healthcare providers can uphold standards of excellence in stroke response and treatment. By leveraging every second in the acute phase to its fullest potential, healthcare teams reaffirm their dedication to enhancing patient outcomes, fostering resilience, and promoting long-term well-being within the community.

CONCLUSION

Based on the results of the article review, it can be concluded that the factors that affect the management of stroke patients in ED are generally divided into factors in the pre-hospital and factors in the intra-hospital. Factors that can affect prehospital delay consist of the use of EMS, patient characteristics, and geographical barriers. Meanwhile, the factors that affect in-hospital delay are communication with ED staff and ED officer knowledge. To improve the management of stroke patients, the participation of various parties is needed, not only within the hospital, but also the role of policy holders in the prehospital.

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