



The Indonesian Journal of General Medicine

Comparing FAST and BEFAST in Acute Stroke Patients: A Systematic Review

¹Muhammad Iqbal, ¹Muhammad Rizal

¹Faculty of Medicine, Sultan Agung Islamic University, Semarang, Indonesia

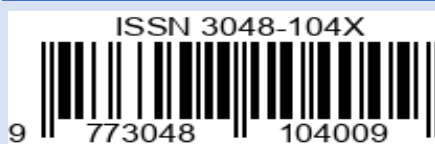
Correspondence : muh.iqbaldr9745@gmail.com

Article History :

Received date : 2023/12/25
Revised date : 2024/02/15
Accepted date : 2024/03/17
Published date : 2024/06/18



Copyright: © 2024 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (BY NC) license (<https://creativecommons.org/licenses/by-nc/4.0/>).



ABSTRACT

Background: Stroke leads to cerebral infarct, and time increases risk of infarct progression to healthy tissue. Further insult and secondary neuronal injury (such as hypoxia) can accelerate the progression of the infarct. The only definitive management strategies for ischaemic stroke are reperfusion and endovascular thrombectomy. **Methods:** This systematic review focused on full-text English literature published between 2014 and 2024 using the PRISMA 2020 guidelines. Editorials and review pieces published in the same journal as the submission without a DOI were not accepted. The literature was compiled using Medline, Science Direct, Scopus and Embase, among other online venues. **Result:** Five publications were found to be directly related to our ongoing systematic examination after a rigorous three-level screening approach. Subsequently, a comprehensive analysis of the complete text was conducted, and additional scrutiny was given to these articles. **Conclusion:** FAST is a useful screening tool for identifying stroke at call-taker level. FAST has acceptable sensitivity when used as a screening tool; however, specificity and diagnostic effectiveness are lacking.

Keyword: Stroke, FAST, BFAST, infarct, ischaemic.

INTRODUCTION

Stroke is one of the most common acute and severe diseases presented to an emergency department (ED). Stroke is a major global burden, with 10.3 million new strokes and 113 million disability-adjusted life years (DALYs) per year worldwide. It can be divided into transient ischemic attack (TIA), ischemic stroke (IS), hemorrhagic stroke (HS), and subarachnoid hemorrhage. Acute ischemic stroke (AIS) can have serious lifelong consequences. In contrast to HS, significantly improved survival in IS patients has been reported since the early 2000s. Therefore, early recognition of stroke is of utmost importance. Rapid recognition of stroke warning signs is a crucial factor in the acute treatment of stroke. Prehospital stroke scales are helpful to guide the prehospital selection of people suspected of having a stroke. The screening tools can develop to help the public recognize stroke early. Earlier and improved stroke detection by ED and ambulance may reduce treatment delays.^{1,2}

There are 130 billion neurons in the human brain. During a stroke, 1.9 million of these neurons die per minute. Each minute due to ischemia, the brain will age over 3 weeks, for every hour, over 3.5 years, and by the end of the stroke, the brain will have aged 36 years. As up to 70% of strokes are first encountered by the emergency medical services (EMS), the pre-hospital phase of stroke management is crucial, with studies showing that rapid pre-hospital treatment, transport and hospital notification reduce door-to-computed tomography (CT) and thrombolysis times and improve outcomes.³

Traditional paramedic teaching encourages using the 'FAST' (face, arm, speech, time) test, to assess for facial weakness, arm weakness and speech disturbances. This test is sensitive at detecting strokes occurring in the anterior circulation, but is less accurate at detecting strokes in the posterior circulation, which account for around 20% of ischaemic strokes. The posterior circulation supplies the cerebellum, brainstem and occipital cortex and so strokes in this part of the brain can present with vague, non-specific signs such as dizziness, visual disturbances, loss of balance and co-ordination, headache and nystagmus. These patients may be FAST negative on exam. This has the potential to delay diagnosis in the pre-hospital environment and therefore adversely affect patient outcomes and recovery. The purpose of this case report is to create an awareness of posterior circulation strokes and improve their identification in the pre-hospital phase of care.³

Insufficient knowledge on stroke among the general public may lead to serious consequences. Several screening tools, including the Cincinnati Prehospital Stroke Scale (CPSS), Face, Arm, Speech Test (FAST), Los Angeles Prehospital Stroke Screen (LAPSS), Melbourne Ambulance Stroke Screen (MASS), Medic Prehospital Assessment for Code Stroke (Med PACS) and Recognition of Stroke in the Emergency Room score (ROSIER), which are characterized by simple, structured, and easy-to-use stroke recognition scores, have been developed to help the public identify if a person is having an acute stroke so as to facilitate rapid access to

medical care. Among these scales, the FAST provides the highest sensitivity with 85%. However, the available stroke recognition scores have a huge variety of length and complexity, which complicates choosing the optimal score in the emergency setting. Furthermore, it is truly difficult to compare the reported diagnostic accuracies of recognition scores. The FAST fails to detect 40% of those with posterior circulation events, especially those with ataxia and visual disturbances. A previous study showed that “FAST” failed in 14% of AIS patients.^{1,4}

Within educational campaigns, two commonly employed mnemonic aids are FAST (Face-Arm-Speech-Time) and BEFAST (Balance-Eyes-Face-Arm Speech-Time). The FAST mnemonic, although widely recognized, can still overlook up to 14% of stroke cases, particularly those involving common posterior circulation symptoms. While this has led to the adoption of BEFAST mnemonic by many centers, having consistency in public messaging remains paramount. This discrepancy highlights the need to delve into the patterns of mnemonic utilization.^{5,6}

Conventional noncontrast CT can be implemented at the prehospital level in specialized MSUs. A noncontrast CT scan has enough sensitivity to exclude hemorrhagic stroke such as subarachnoid hemorrhage or ICH. The Alberta Stroke Program Early CT Score (ASPECTS) was designed to determine middle cerebral artery (MCA) infarct severity using a noncontrast head CT scan. One point gets subtracted from the maximum score of 10 for any sign of early ischemia in each of the 10 predefined

zones (ranges 0–10). A patient with a high Rapid Arterial Occlusion Evaluation/NIHSS and normal looking brain or ASPECTS greater than 6 means that infarction may not have set in and that revascularization strategies may be implemented. Early signs of infarction on CT or lower ASPECTS are usually associated with poor prognosis and hemorrhagic conversion. Timing to CT and reporting of preliminary data should be under 20 minutes according to current guidelines. A CT-angiography (CT-A) can effectively detect LVO and provide useful information about the patient’s vascular anatomy and stroke etiology. Based on its rapid acquisition, many institutions now incorporate CT-perfusion (CT-P) technology to assess cerebral blood flow (CBF) by quantitative analysis of thresholds in time-to-maximum (T-max) transit and cerebral blood volumes. Quantification of ischemic “core” (CBF < 30%) and estimation of “penumbra” or tissue at risk (T-max > 6 s) can provide immediate information for treatment decision-making. Clinical trials have shown that perfusion mismatch ratios of core/penumbra greater than 1.8 may indicate the eligibility for EVT.⁷

A key role in acute ischemic stroke management is emphasizing the essential role of a multi-disciplinary team, therefore, increasing the efficiency of recognition and treatment. Neuroimaging and neuroradiology have evolved dramatically over the years, with multiple approaches that provide a higher understanding of the morphological aspects as well as timely recognition of cerebral artery occlusions for effective therapy planning. Regarding the treatment

matter, the pharmacological approach, particularly fibrinolytic therapy, has its merits and challenges. Endovascular thrombectomy, a game-changer in stroke management, has witnessed significant advances, with technologies like stent retrievers and aspiration catheters playing pivotal roles. For select patients, combining pharmacological and endovascular strategies offers evidence-backed benefits. The aim of our comprehensive study on acute ischemic stroke is to efficiently compare the current therapies, recognize novel possibilities from the literature, and describe the state of the art in the interdisciplinary approach to acute ischemic stroke. As we aspire for holistic patient management, the emphasis is not just on medical intervention but also on physical therapy, mental health, and community engagement.^{8,9}

METHODS

Protocol

The Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) 2020 standards were scrupulously followed by the work's author. The purpose of this was to make sure the study satisfied all the requirements. The chosen technique was carefully designed to ensure the accuracy and dependability of the investigation's findings.

Criteria for Eligibility

This study does a thorough evaluation of the last 10 years worth of literature on the comparing FAST and BFAST in acute stroke patients. This study intends to improve and provide light on patient treatment procedures through a thorough examination of data. The primary

goal of this paper is to highlight the significance of the noteworthy topics that have been identified across the literature.

To ensure the quality of the included information in this study, strict inclusion and exclusion criteria are applied. To be eligible for inclusion, papers must have been published in the English language between 2014 and 2024. Editorials, submissions without a DOI, previously published reviews, and duplicate journal entries are some of the exclusion criteria.

Search Strategy

The keywords used for this research is "Comparing FAST and BFAST in acute stroke patients". The Boolean MeSH keywords inputted on databases for this research are: *("Stroke"[MeSH Subheading] OR "Risk factor"[All Fields] OR "Prevalence" [All Fields]) AND ("Management"[All Fields] OR "Teraphy"[All Fields]) AND ("FAST"[All Fields]) OR ("BFAST" [All Fields])*

Data retrieval

The writers thoroughly evaluated the abstract and title of each manuscript before beginning this systematic review in order to assess each one's significance. Just articles that met the inclusion criteria and aligned with the article's objectives were selected for further examination. Ultimately, a definitive result was obtained from a consistent pattern found over several analyses. Only full-text, English-language submissions were acceptable. Content that satisfied all pre-established inclusion criteria and directly related to the study's subject matter was included after the most stringent

screening procedure. Studies that failed to satisfy these requirements were frequently ignored, and their conclusions were not taken into consideration. A thorough analysis was conducted on a plethora of information discovered throughout the research process, including titles, authors, publication dates, locations, study methodologies, and parameters.

Quality Assessment and Data Synthesis

The research that was reported in the titles and abstracts of each article was independently assessed by the authors in order to determine which papers needed additional investigation. Going over each document that satisfied the pre-established requirements to be included in the review was the following stage. The selection of an article for inclusion in the review was based on the evaluation procedure's results. By accelerating the selection of articles for further evaluation, this criterion was able to accomplish the goal of facilitating a thorough analysis of previous research and the factors that qualified them for the review.

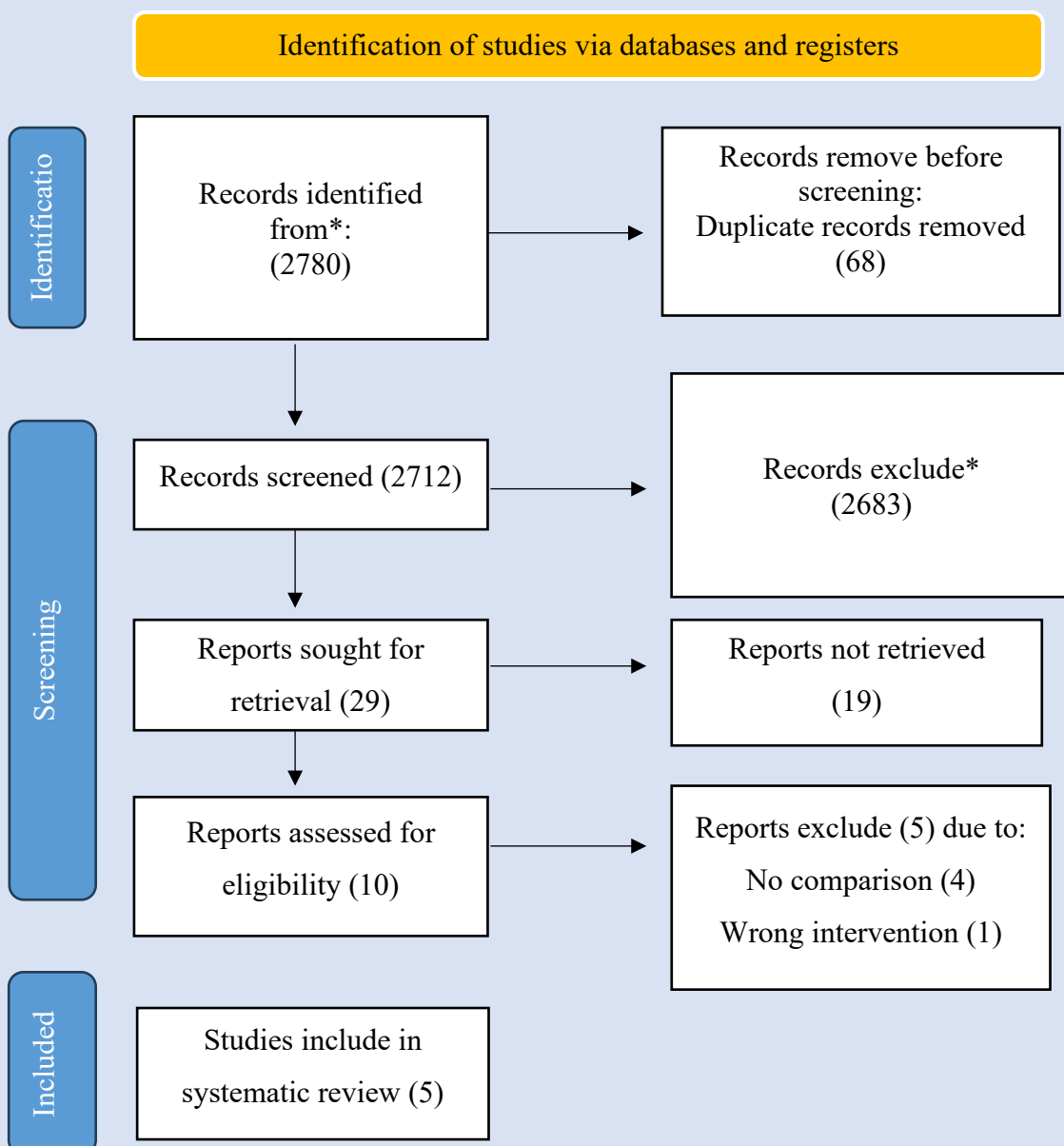


Figure 1. Article search flow chart

RESULT

Using reputable resources like Science Direct, PubMed, and SagePub, our research team first gathered 2780 publications. A thorough three-level screening strategy was used to identify only five papers as directly relevant to our ongoing systematic evaluation. Next, a thorough study of the entire text and further examination of these articles were selected. Table 1 compiles the literature that was analyzed for this analysis in order to make it easier to view.

Table 1. The literature included in this study

Author	Origin	Method	Sample Size	Result
Ammar, FE et al., 2020¹⁰	US	We retrospectively analyzed all stroke alert activations at a single academic medical center between 2012 and 2016. We classified the triggering symptom as: focal neurologic deficit, aphasia, dysarthria, ataxia/vertigo/dizziness, alteration of consciousness, acute confusion, or headache. BE-FAST was applied retrospectively, and patients were classified as BE-FAST positive or negative. The final	1965	Of 1965 stroke alerts, 489 were among inpatients. The mean age was 63 ± 16.1 years; 57% of patients were women (n = 1121). Acute ischemic stroke was diagnosed in 29% of all the activations (n = 567), transient ischemic attack in 12% (n = 232), intracranial hemorrhage in 8 % (n = 160) and noncerebrovascular in 51% (n = 1006). When comparing inpatient with community-onset stroke alerts, the sensitivity of BE-FAST for diagnosing acute ischemic stroke was 85% versus 94% (P = .005), with a specificity of 43% versus 23% (P < .001), respectively. However, when evaluating in-patients with an intact level of consciousness separately, BE-FAST sensitivity for diagnosing acute ischemic stroke was 92% compared to 94% in the community (P = .579). Among in-patients with acute ischemic stroke who were (1) candidates for reperfusion therapy and (2) diagnosed with

		diagnosis was classified as acute ischemic stroke, transient ischemic attack, intracranial hemorrhage or noncerebrovascular diagnosis.		acute large vessel occlusion, the sensitivity of BE-FAST was 83% and 94%, respectively.
Ekkert, A et al., 2023¹¹	US	We conducted a retrospective analysis of the data from 500 subjects admitted to the tertiary stroke centre's emergency department between 2018 and 2020 due to PCS. Demographic and clinical factors were analysed among three groups: the RT group, the group with no RT because of absolute contraindications (ACI), and the group with no RT because of relative contraindications (RCI).	500	Of the patients, 202 (40.3%) were female. The median NIHSS was four (4), and the subjects' median age was 69 (18). RT was performed on 120 (24%) subjects. FAST symptoms (OR—5.62, 95% CI [2.90–12.28]) and higher NIHSS (OR—1.13, 95% CI [1.09–1.18]) at presentation, atrial fibrillation (OR—1.56, 95% CI [1.02–2.38]), hypertension (OR—2.19, 95% CI [1.17–4.53]) and diabetes (OR—1.70, 95% CI [1.06–2.71]) increased the chance of RT. Late arrival was the most prevalent ACI for 291 (58.2%) patients. FAST-negative subjects (OR—2.92, 95% CI [1.84–4.77]) and males (OR—1.58, 95% CI [1.11–2.28]) had a higher risk of arriving late. Because of RCI, 50 (10%) subjects did not receive RT; the majority were above 80 and had NIHSS ≤ 5.

				Subjects with RCI who received the RT had a higher NIHSS (4 vs. 3, $p < 0.001$), higher hypertension (59 (92.2%) vs. 35 (77.8%), $p = 0.032$) and heart failure (23 (35.9%) vs. 7 (15.6%), $p = 0.018$) prevalence. There was a trend for less RT in females with RCI.
Pickham, D et al., 2018 ¹²	US	This was a prospective study of emergency response activations for presumed stroke in Santa Clara County, California. Emergency medical responders were trained in the Balance-Eyes-Face-ArmsSpeech-Time (BEFAST) scale and administered the scale on scene to all patients who were within 6 hours of onset of neurological symptoms. Each patient's final diagnosis	359	Three hundred fifty-nine patients were included in our analysis. Compared to nonstroke patients (n = 200), stroke patients (n = 159) more often scored positive on each of the five elements of the BEFAST scale ($p < 0.05$ for each). In multivariable analysis, only facial droop and arm weakness were independent predictors of stroke ($p < 0.05$). BEFAST and FAST scale accuracy for stroke identification was comparable (area under the curve [AUC] = 0.70 vs. AUC = 0.69, $p = 0.36$). Optimal cutoff for stroke detection was 1 for both scales. At this threshold, the positive predictive value (PPV) was 0.49 for the BEFAST and 0.53 for the FAST scale, and the negative predictive value (NPV) was 0.93 for BEFAST and 0.86 for FAST.

		(stroke vs. no stroke) was based on review of hospital records. We compared the performance of the BEFAST and FAST scales for stroke detection.		
Aroor, S et al., 2017¹³	US	Records of all patients admitted to the University of Kentucky Stroke Center between January and December 2014 with a discharge <i>International Classification of Diseases, Ninth Revision, Clinical Modification</i> code for acute ischemic stroke were reviewed. Those misclassified, having missing National Institutes of Health	858	Of 858 consecutive records identified, 736 met inclusion criteria; 14.1% did not have any FAST symptoms at presentation. Of these, 42% had gait imbalance or leg weakness, 40% visual symptoms, and 70% either symptom. With their addition, the proportion of stroke patients not identified was reduced to 4.4% ($P<0.0001$). In a sensitivity analysis, if face weakness, arm weakness, or speech impairment on admission examination were considered in addition to a history of FAST symptoms, the proportion missed was reduced to 9.9% ($P=0.0010$). The proportion of stroke patients not identified was also reduced (2.6%) with the addition of a history of gait imbalance/leg weakness or visual symptoms ($P<0.0001$).

		Stroke Scale data, or were comatose or intubated were excluded. Presenting symptoms, demographics, and examination findings based on the National Institutes of Health Stroke Scale data were abstracted.		
Dharmasaroja, P et al., 2024¹⁴	Thailand	Adult participants aged at least 40 years, without a history of stroke, were included, with exclusions limited to those unwilling to participate. Data were gathered from the survey during two community visits and through an electronic survey via Google Forms (Google LLC, Mountain	281	A total of 281 participants were included, with a mean age of 58 years and 60% (n=169) of participants having at least one vascular risk factor. Of the responders, 133 (47%) had good knowledge of stroke awareness. Older age (age > 50 years, OR 0.326, 95%CI 0.173-0.615, p-value = 0.001), higher education (> 6 years, OR 0.266, 95%CI 0.139-0.508, p-value < 0.001)), and being female (OR 0.474, 95%CI 0.252-0.891, p-value = 0.020) were related to good stroke knowledge. Participants with good knowledge of stroke awareness also had good knowledge of vascular risk factors (84%; n=112), knew that they should come to the

		View, California, United States). A pre-tested questionnaire was divided into three parts: symptoms of acute stroke, vascular risk factors, and response. Demographics were compared between participants with good and poor knowledge of stroke awareness.		hospital immediately (74%; n=98), and also correctly identified the emergency calling number (90%; n=119).
--	--	---	--	--

DISCUSSION

Stroke is one of the leading causes of death and disability worldwide. The early detection of stroke in the prehospital setting has the potential to improve stroke outcomes by decreasing delays in treatment. A variety of stroke assessment scales have been developed for both in-hospital and prehospital use. Stroke scales designed for the prehospital setting have a lower number of diagnostic criteria, easy-to-identify clinical signs and simplicity of implementation, making them applicable for use by first aid providers and lay persons. In 2015, the International Liaison Committee on Resuscitation (ILCOR) published a Consensus on Science with Treatment Recommendations (CoSTR), suggesting a benefit from the first aid use of stroke recognition scoring systems or scales for individuals with suspected acute stroke.^{15,16}

Each year, 795,000 people experience a new or recurrent stroke causing significant mortality and neurologic disability. On average, every 40 seconds, someone in the United States has a stroke, accounting for one of every 18 deaths in the U.S. Emergency medical services (EMS) plays a pivotal role in recognizing acute strokes and providing timely transport to hospitals with specific stroke treatment capabilities. The optimal prehospital management and stroke system organization continue to evolve. EMS care varies widely across the U.S. The Institute of Medicine report, "Emergency Medical Services at the Crossroads," notes that EMS needs more uniform

high-quality care and specific standards for evaluating that care.¹⁷

A frequent cause of failure to receive revascularization therapy within the required time window is a prehospital delay, either patient or system related. Patient delay is often associated with failure in symptom recognition or reluctance to respond acutely to symptoms. In system delay, much has improved in door-to-needle time at comprehensive stroke units but is still largely affected by missed symptom recognition by the health professionals at first contact. Stroke symptoms can be categorized as typical (e.g., hemiparesis, facial palsy, visual, or language disturbances) or atypical (e.g., headache, dizziness, confusion, or sensory symptoms), where the latter induce a significant risk of missing the stroke diagnosis.^{18,19}

Minimizing response time and implementing fast-track treatment of stroke is the key to reducing the impact of stroke on death and disability worldwide. Previous studies suggest that patients of female sex present a different profile of stroke symptoms on admission compared to the male sex. However, these studies focused on symptoms identified by health professionals and not those reported by the patients or bystanders. Symptoms recognized by health professionals may be different from those experienced and reported by the patient and bystanders potentially unaware of stroke-related symptoms. Knowledge is scarce on which acute stroke symptoms are reported by the patient or the bystander on admission. In this study, we have focused on the sex- and age-related differences in patient-reported symptoms which cause them to react and present to the prehospital health

system. Older patients (>80 years of age) seem to present more frequently with typical symptoms, such as aphasia and hemiplegia.¹⁸

Previous studies showed that various prehospital times in patients suspected of stroke were 33 min in the USA, 39 min at two hospitals in Rochester, New York, USA, 92–365 min in four countries in Europe and 372 min in Thailand. Prior knowledge towards stroke is one factor that can decrease prehospital delay in patients who had a stroke. The Face Arm Speech Time (FAST), which was established in 1999, is one of the widely used tools to educate people in the warning symptoms of stroke to ensure prompt management by going to a hospital as soon as possible. It can help people recognise the warning symptoms of stroke, increase the rate of thrombolytic therapy and emergency medical service; however, it may miss 11.1%–14.1% of patients who had a stroke who do not have typical symptoms in FAST. Delayed detection of stroke symptoms was significantly associated with delayed prehospital time. Concerning attitude towards stroke, most populations recognise that stroke is a preventable disease that requires urgent treatment. However, if the severity of the disease is severe or treatment is delayed, a disability and economic burden may result.^{20,21}

CONCLUSION

FAST is a useful screening tool for identifying stroke at call-taker level. FAST has acceptable sensitivity when used as a screening tool; however, specificity and diagnostic effectiveness are lacking. Further studies should be considered to determine call-taker as well as general

public knowledge of stroke risk factors and presentation.

REFERENCES

1. Chen X, Zhao X, Xu F, Guo M, Yang Y, Zhong L, et al. A Systematic Review and Meta-Analysis Comparing FAST and BEFAST in Acute Stroke Patients. *Front Neurol.* 2022;12(January).
2. Crause K, Stassen W. The accuracy of the FAST stroke assessment in identifying stroke at initial ambulance call into a South African private emergency call centre. *South African J Crit Care.* 2020;36(1):35–8.
3. Devlin S. Not so FAST: pre-hospital posterior circulation stroke. *Br Paramed J.* 2022;7(1):24–8.
4. Singhal V, Prabhakar H. Readiness of the Stroke Treatment in India – Still an Uphill Task! *Indian J Crit Care Med.* 2023;27(9):607–8.
5. Hogge C, Goldstein LB, Aroor SR. Mnemonic utilization in stroke education: FAST and BEFAST adoption by certified comprehensive stroke centers.

- Front Neurol .
2024;15(March):1–3.
6. Jones SP, Bray JE, Gibson JME, McClelland G, Miller C, Price CI, et al. Characteristics of patients who had a stroke not initially identified during emergency prehospital assessment: A systematic review. *Emerg Med J*. 2021;38(5):387–93.
 7. Herpich F, Rincon F. Management of Acute Ischemic Stroke. *Crit Care Med*. 2020;48(11):1654–63.
 8. Saceleanu VM, Toader C, Ples H, Covache-Busuioc RA, Costin HP, Bratu BG, et al. Integrative Approaches in Acute Ischemic Stroke: From Symptom Recognition to Future Innovations. *Biomedicines*. 2023;11(10):1–59.
 9. Chugh C. Acute ischemic stroke: Management approach. *Indian J Crit Care Med*. 2019;23:S140–6.
 10. El Ammar F, Ardelt A, Del Brutto VJ, Loggini A, Bulwa Z, Martinez RC, et al. BE-FAST: A Sensitive Screening Tool to Identify In-Hospital Acute Ischemic Stroke. *J Stroke Cerebrovasc Dis [Internet]*. 2020;29(7):104821. Available from: <https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.104821>
 11. Ekkert A, Milmantienė D, Jokimaitytė U, Jatužis D. Posterior Circulation Stroke Patients Receive Less Reperfusion Therapy Because of Late Arrival and Relative Contraindications: A Retrospective Study. *J Clin Med*. 2023;12(16).
 12. Pickham D, Valdez A, Demeestere J, Lemmens R, Diaz L, Hopper S, et al. Prognostic Value of BEFAST vs. FAST to Identify Stroke in a Prehospital Setting. *Prehospital Emerg Care [Internet]*. 2019;23(2):195–200. Available from: <https://doi.org/10.1080/10903127.2018.1490837>
 13. Aroor S, Singh R, Goldstein LB. BE-FAST (Balance, Eyes, Face, Arm, Speech, Time): Reducing the Proportion of Strokes Missed Using the

- FAST Mnemonic. Stroke. 2017;48(2):479–81.
14. Dharmasaroja P, Uransilp N. Stroke Awareness and Knowledge in the At-Risk Population: A Community-Based Study. Cureus. 2024;16(4):4–12.
15. Meyran D, Cassan P, Avau B, Singletary E, Zideman DA. Stroke Recognition for First Aid Providers: A Systematic Review and Meta-Analysis. Cureus. 2020;12(11).
16. Tapuwa D, Musuka M, Wilton S, Traboulsi M. Diagnosis and Management of Acute Ischemic Stroke: Speed is Critical. Cmaj [Internet]. 2015;187(12):887–93. Available from: <https://pubmed.ncbi.nlm.nih.gov/26243819/>
17. Glober NK, Sporer KA, Guluma KZ, Serra JP, Barger JA, Brown JF, et al. Acute Stroke: Current Evidence-based recommendations for prehospital care. West J Emerg Med. 2016;17(2):104–28.
18. Eddelien HS, Butt JH, Christensen T, Danielsen AK, Kruuse C. Sex and Age Differences in Patient-Reported Acute Stroke Symptoms. Front Neurol. 2022;13(March):1–9.
19. Jing Z, Renyu L. Calling for a rapid recognition and response program for stroke in China. Breast Cancer Res [Internet]. 2017;18(1):100–106. Available from: <http://dx.doi.org/10.1186/s13023-016-0543-7>
<http://dx.doi.org/10.1080/15384101.2017.1312236>
<http://breast-cancer-research.com/content/13/4/R73>
<http://dx.doi.org/10.1186/s13046-016-0410-3>
<http://dx.doi.org/10.1016/j.ajpath.2017.07.011>
<https://doi.org/10.1016/j.ajpath.2017.07.011>
20. Wanichanon W, Ananchaisarp T, Buathong N, Choomalee K. Knowledge and attitude towards stroke among the population of one rural community in southern Thailand: a survey. BMJ Open. 2024;14(2):1–10.
21. Chiu LQ, Quek DYJ, Salihan RB, Ng WM, Othman RB, Lee

CH, et al. ACT-FAST: A quality improvement project to increase the percentage of acute stroke patients receiving intravenous thrombolysis within 60 minutes of arrival at the emergency department. Singapore Med J. 2021;62(9):476–81.