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ORIGINAL RESEARCH

Updated Protocol for Stroke Code Management in Prehospital Settings: The Iranian Comprehensive Stroke Code Management Program (ICSCM Phase II)

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Abstract: **Introduction:** Code stroke is a framework to reduce time and improve the quality of care in the prehospital setting. However, increased scene time, delays, and other barriers in the prehospital setting necessitate updating the current protocol. This study aimed to update the Iranian national code stroke protocol for the prehospital setting.
Methods: This study represents the results of the second phase of the Iranian Comprehensive Stroke Code Management Program, a mixed methods study. We used the Caspian scientific 10-step method to update this protocol, which included a literature review, critical appraisal, extraction of recommendations, face-content validity, the Delphi method, RAND method, expert panel, stakeholders, and publishing and printing. We divided the updated protocol into three stages (on scene, ambulance care, and on admission). **Results:** Twenty experts (55% nurses; mean age 40.7±9.1 years, experience 15.9±7.9 years) were enrolled. On-Scene focuses on rapid ABC (airway, breathing, circulation) assessment, BEFAST (balance, eyes, face, arm, speech, and time) criteria, blood glucose check, and on-scene time under 5 minutes. Ambulance Care Involving SAMPLER (Symptoms, Allergies, Medications, Past medical history, Last time the patient was seen normally, Events leading up to the emergency medical service call, and Risk factor) history-taking, maintaining oxygen saturation ≥94%, symptom/witness documentation, electrocardiography (ECG) for cardiac-stroke cases, master's degree (MSN)-led transport coordination, and neurology team alerts and in-hospital admission ensuring precise handover, 724 pager alerts, stroke code clocks, computed tomography (CT)-ready team, and protocol updates via joint committees. **Conclusion:** The main points were the stroke clock, pager 724, direct delivery to computed tomography scan, administering BEFAST, and reducing scene time. We recommend that each center to enhance the infrastructure and resources for implementation of these updates. In the next phase, we will implement and evaluate this protocol.

Keywords: Acute cerebrovascular accident; Emergency medical services; Prehospital emergency care; Clinical protocols; Stroke

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1. Introduction

The absolute number of people who have suffered a stroke has grown (1). Stroke mortality and its complications remain a serious concern (2). This issue centers on creating partnerships between emergency medical services (EMS) teams to quickly identify patients in need of acute stroke intervention and to connect them with the emergency department for faster care and treatment (3). To minimize delays in treating patients suspected of having a stroke, particularly those showing signs and symptoms related to the face, arm, and speech; the stroke code is designed (4). In Iran, this code, known as Code 724, is active seven days a week and 24 hours a day. When this code is activated, EMS rapidly transports these patients to the nearest stroke center, where a well-equipped medical team is ready to provide immediate care (5). Studies have demonstrated that accurate diagnosis, effective pre-hospital care, and timely transfer to the nearest stroke center for appropriate treatment are essential components of the stroke survival chain (6, 7). Even with considerable advancements in the quality and delivery of specialized stroke care, substantial spatial variations in EMS continue to be evident (4).

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Research on stroke care protocols in Iran highlights the need for enhanced efforts to improve responsiveness in prehospital and clinical settings (8). For instance, Poureskandari et al. identified critical gaps in prehospital emergency personnel's ability to assess stroke patients, particularly in recognizing candidates for thrombolytic therapy (5). While prehospital notification can modestly reduce treatment delays, these reductions remain insufficient to mitigate long-term neurological deficits, suggesting that more substantial time savings are necessary for meaningful functional recovery (9). Hanifi et al. further noted that prehospital delays for stroke cases often exceed in-hospital delays (10). Alarmingly, 45–86% of patients arriving within the therapeutic window missed thrombolytic therapy due to prolonged diagnostic processes, resulting in door-to-needle times for intravenous tPA administration ranging from 116 to 160 minutes (11). Although Meza et al. demonstrated that updated protocols can sustainably reduce door-to-needle times, they emphasized the importance of continuous protocol updating (12). Similarly, Shahjouei et al. advocated for revising national protocols and establishing data-driven monitoring systems to address disparities in stroke care. These findings collectively underscore the urgency of restructuring Iran's acute stroke management framework through updated protocols and standardized programs to optimize outcomes (11).

Revising the code stroke protocol for the prehospital context in Iran is a significant step toward ensuring that all patients have timely and effective access to a designated stroke reference center. It is evident that improvements in the survival chain framework require updates to prehospital protocols. Therefore, a scientific approach to these updates is vital. This study aimed to improve the national prehospital emergency organization protocol by utilizing firsthand, context-specific data. Given that the Iranian prehospital emergency organization depends on an offline protocol, these updates are essential in this context.

2. Methods

2.1. Study design and setting

The Iranian Comprehensive Stroke Code Management Program (ICSCM) is a mixed-method study that began in 2023 and is structured in three phases. The first phase focused on gathering qualitative data to identify both the facilitators and barriers affecting stroke code management in Iran. The second phase involved employing scientific methods to update the Iranian prehospital emergency national protocol based on the findings from the first phase. Finally, we will implement and evaluate this protocol in a quantitative study. This study presents the findings from the second phase. After collecting data in Phase I of the ICSCM, we invited various institutions, organizations, and centers specializing in stroke code management to share their expertise.

2.2. Initial Expert Panel; Brain Storming and Idea Generation

The initial meeting was conducted in a centralized format with the objective of engaging in brainstorming regarding the intentional selection of categories, subcategories, and codes for the design of the intervention. Prior to the meeting, the relevant codes, subcategories, and categories were distributed to the experts. The meeting took place both in person and online simultaneously at the conference hall of Ayatollah Rouhani Hospital in Babol, with participation from the National Emergency Organization, as well as professors and staff from the stroke code teams of Tehran, Isfahan, Babol, Golestan, and North Khorasan Universities of Medical Sciences. In light of the objectives associated with the "Comprehensive Stroke Code" category and its significant subcategories—namely, "eliminating barriers to the effective implementation of the existing protocol", " updating, disseminating, and implementing the protocol," "collaborative teamwork" and "joint committee for monitoring and coordination"—the necessity for designing an intervention in this domain was underscored.

2.3. Second Expert Panel: Prehospital Emergency Specialist Working Group

The purpose of this meeting was to identify and eliminate the barriers associated with the previous protocol, while also facilitating its update. Using a purposeful sampling method, we recruited 20 experts, including 11 nurses, 3 EMS professionals, 2 neurologists, 2 anesthesiologists, and 2 emergency medical specialists, to participate in the expert panel. After extensive discussions and consultations with experts, the procedural steps of this scientific method were established, drawing from prior experiences and research. We used step (CS10) method to update this protocol. This method can be used for updating the clinical protocol or instruction in health system. This method was presented by Alijanpour et al., in Babol, north of Iran (13, 14).

2.4. The First Step: Literature Review

This phase aimed to analyze various articles, clinical guidelines, and protocols to derive pertinent recommendations. The review encompassed studies such as systematic reviews, meta-analyses, clinical trials, and other relevant research pertaining to stroke code management, particularly in pre-hospital contexts. Only studies published between 2016 and 2024, which were accessible in databases such as PubMed/MEDLINE, Web of Science, Cochrane, CINAHL and Google Scholar were considered for inclusion. The keywords used were Stroke, Cerebrovascular accident, Ischemic stroke, Stroke Code, Code Stroke, Stroke Notification, SAMA Code, Pre-hospital, Emergency, Stroke care unit, and Hospitals. The search strategy employed in Google Scholar, utilizing specific keywords, is detailed in Table 1. Additionally, a comprehensive systematic search for stroke code management guidelines was conducted

on specialized websites, including the British Institute of Health and Care Excellence (https://www.nice.org.uk), the National Association of State Emergency Medical Services (https://nasemso.org/), and Pre-Hospital Emergency Protocols (https://www.emsprotocols.org/) (4). As shown in Figure 1, after eliminating duplicates using EndNote software (version: X9, Clarivate), a total of 12 articles, protocols, and clinical guidelines were evaluated. Out of these, two were discarded due to their irrelevance and impracticality (specifically, the system structure incompatibility of EMS in other countries with those in Iran), while one was excluded because of an ambiguous research methodology. Consequently, 9 articles, protocols, and clinical guidelines were enrolled in this study.

2.5. The Second Step: Critical Appraisal

To assess the quality of our studies, we used the criteria established by the Enhancing the Quality and Transparency of Health Research (EQUATOR) initiative, which aims to enhance the credibility and significance of published health research literature (15). We utilized the STROBE, PRISMA, SPIRIT, and AGREE frameworks to assess observational studies, systematic reviews and meta-analyses, research protocols, and clinical guidelines, respectively. Additionally, we referred to the accompanying Table 2 to ascertain the level of evidence and to grade the recommendations, following the methodology outlined in Karunarathna study (16).

2.6. The Third Step: Extraction of Recommendations

Following the assessment of the studies included in the review, the process of extracting recommendations was undertaken to identify and eliminate barriers, while updating the pre-hospital emergency protocol. This was achieved by utilizing the categories and subcategories established in the ICSCM Phase 1, alongside evidence gathered from scientific literature and the clinical experiences of the researcher. The integration of these findings is presented in Table 3. The recommendations extracted were organized, according to the researchers' clinical expertise, into three primary areas: measures to be implemented at the scene (6 recommendations), care provided during transport in the ambulance (6 recommendations), and assessments conducted upon arrival at the medical facility (7 recommendations) (Figure 2).

2.7. The Fourth Step: Face-Content Validity

A panel of five experts, comprising two PhDs in Nursing and three specialists in Emergency Medicine, was convened to assess face and content validity. The content validity index, as established by Waltz and Bassel, was employed to evaluate the validity. Experts were instructed to rate the relevance of each item using a four-point scale: irrelevant, requires substantial revision, relevant but needs revision, and completely relevant. The proportion of experts selecting options 3 and 4 was calculated by dividing the number of affirmative responses by the total number of experts. An index value below 0.7 was deemed unacceptable, while scores ranging from 0.7 to 0.79 warranted further review. Scores exceeding 0.79 were considered satisfactory (17). In the initial questionnaire, modifications were made not only to the text of certain recommendations, based on feedback from the participating professors during the face and content validity phase, but also to other aspects.

2.8. The Fifth Step: Delphi Method

In this research, the classical Delphi method was employed to facilitate informed decision-making. The selection of participants was guided by the researcher's prior experiences and utilized a purposeful sampling technique. The researchers extended invitations to those chosen to partake in the study via a formal invitation letter. Accompanying this letter was a questionnaire designed to gather expert opinions, which included specific recommendations. The questionnaire was subsequently distributed to 20 experts, all of whom possessed relevant experience and expertise in the care and treatment of stroke patients and expressed a keen interest in the research.

2.9. The Sixth Step: The RAND Method

The specialists were asked to evaluate each criterion on a scale from one to five across five distinct domains: 1) priority, 2) usefulness, 3) feasibility, 4) conceptuality and 5) individuals authorized to provide care. EMS personnel are categorized into three tiers of educational qualifications: associate's degree (18), bachelor's degree (BSN), and master's degree (MSN). The user guidelines are included in Appendix 1. Furthermore, experts were required to finalize and submit their assessments within a maximum timeframe of one month.

2.10. The Seventh Step: Analysis of Data

Data were entered into Excel software (version 2016, Microsoft) and mean scores were calculated. A cut point of 70% was established for the agreement among experts; any agreement below this cut point was to be discussed in an expert panel. During the expert panel, the views of participants regarding items with less than 70% agreement were taken into account, and a consensus was reached regarding these items. Following the input of scores into Excel 2016 and subsequent analysis, it was noted that one recommendation; "the assessment of large vessel involvement in stroke patients", garnered less than 70% consensus.

2.11. The Eighth Step: Expert Panel

Consequently, a meeting was convened that included representatives from EMS, including an emergency medicine specialist, a member of the National Emergency Medical Board, an education and research director, the vice chancellor of EMS, a quality enhancement expert, a communications and operations expert, and a stakeholder representative. The ex-

perts engaged in a discussion and the recommendation that received less than 70% agreement was removed.

2.12. The Ninth Step: Stakeholders

The protocol was disseminated in both printed and electronic formats to 135 Babol EMS personnel, who were invited to share their insights on the implementation process. Feedback was solicited through a Telegram group called "Angels of Rescue," where emergency medical colleagues documented challenges and suggested measurements related to decreasing the probable barriers in the administration of the protocol. The collected information was added to the protocol to decrease the ambiguity and increase the clarity of the protocol.

2.13. The Tenth Part: Publishing and Printing

The proof of protocol was sent to the experts. After approval of the experts, the final protocol was sent to the National Emergency Organization of Iran. Then this protocol was sent to Ayatollah Rouhani Hospital and prehospital emergency organization of Babol, in the North of Iran, for a pilot study. The methodology and results of ICSCM Phase II were used to prepare this manuscript.

3. Results

Twenty experts participated in the current study, 12 (60%) were male and 11 (55%) were nurses. Furthermore, 15 (75%) were employed in EMS. The mean age of participants was 40.65±9.13 years and their mean work experience was 15.9±7.93 years. The demographic characteristics of the participants are shown in Table 4. All 20 participants (100%) returned the filled-out questionnaire. We categorized the prehospital emergency protocol of stroke code management into three stages (on scene, inside the ambulance, and on admission). All groups (ADN, BSN and MSN) were allowed to perform all services, if any item required a specific group to perform, it was mentioned at the end of the recommendation.

3.1. On-scene

Actions that are performed by EMS at the scene of the patient's presence:

1) Patients with suspected acute stroke should undergo a rapid initial assessment of airway, breathing, and circulation (19).

2) The stroke scale should be used in the prehospital setting for any patients with acute neurological impairment, in order to rapidly assess and triage patients with possible stroke (20).

3) BEFAST criteria should be used instead of FAST criteria (B: balance in standing, E: eyes, F: face, A: arm, S: speech, and T: time) (21) (Only BSN and MSN).

4) Assess the patient's blood glucose level to distinguish stroke symptoms from hypoglycemia. The threshold for normal blood glucose is 70 mg/dL (22). If levels fall below this threshold, administer 50% dextrose via intravenous bolus in a large peripheral vein. For readings above 70 mg/dL, classify the case under code 724.

5) Routine normal saline administration is not universally recommended for patients. Intravenous (IV) access attempts should not prolong on-scene time (22).

6) On-scene time should be limited to under five minutes. Critical assessments—including ABC (airway, breathing, circulation), blood glucose measurement, and blood pressure evaluation—must be performed concurrently by two emergency service technicians (EMTs), with priority given to expediting patient transfer to the ambulance. Non-urgent interventions (e.g., IV therapy) should be deferred to the transport phase en route to the hospital (expert panel) (Appendix 2).

3.2. Inside the ambulance

All assessments conducted in the ambulance's patient compartment should adhere to the following:

1) SAMPLER can be used in the past medical history (Symptoms, Allergies, Medications, Past medical history, Last time the patient was seen normally, Events leading up to the emergency medical service call, and Risk factor) (expert panel).

2) In stroke patients, supplemental oxygen should be maintained with the goal of achieving a blood oxygen saturation of ≥ 94% (23).

3) It is recommended that emergency medical personnel gather information from the patient, family members, or other witnesses regarding the suspected stroke event. This includes details such as the presentation of symptoms, the time of onset or recognition of symptoms, the sequence of events, any accompanying conditions, current medications (especially anticoagulants), and any previous formal or informal recommendations that may impact care)(expert panel).

4) Routine electrocardiography (ECG) is not recommended for all stroke patients. However, for those exhibiting both cardiac symptoms and stroke, it can be done if there is no delay in transferring to the treatment center (22)(Only BSN and MSN).

5) Senior EMS clinicians should implement strategies to minimize transport time to the treatment center, such as prioritizing the shortest, least congested route while maintaining safe transport speeds)(expert panel)(Only MSN).

6) Dispatch coordination, consultation for ongoing care, and patient transfer to the treatment center should be managed by specialized neurology dispatch teams to ensure streamlined access to treatment)(expert panel) (Appendix 3).

3.3. Hospital admission

1) Emergency medical professionals should make sure that all information is accurately recorded in the patient's emergency medical system records and promptly provided to the receiving hospital during stroke code notification and upon admission)(expert panel).

2) All departments are active during the day and neurology

residential site, triage, computed tomography (CT) scan, and emergency department are active during the night) (expert panel).

3) It is recommended to use a stroke code clock, which measures workflow times, as an easy way to increase time management awareness among the hospital team (24) (Only MSN).

4) Establish a joint stroke committee and hold regular meetings (integration of qualitative and literature review)(25). Time monitoring and standard care in stroke should be supervised by the joint committee with feedback between prehospital and hospital stroke code directors (expert panel).

5) The emergency medical staff should deliver the stroke patient with stable hemodynamic to the person responsible for the stroke code in the CT scan. The CT scan should be equipped with a resuscitation trolley, staff trained in cardiopulmonary resuscitation and a free bed for code 724)(expert panel) (Only BSN and MSN).

6) Removing barriers to the accurate implementation of the protocol based on interviews, updating the stroke protocol in the pre-hospital emergency department considering the decreasing age, and launching a specialized dispatch (26).

7) Protocol should be updated in stroke code management (integration of qualitative result and literature review)(22) (Appendix 4).

4. Discussion

This study seeks to revise and contextualize the existing national prehospital protocol for stroke code management through a systematic, evidence-based approach, emphasizing the pivotal role of EMS systems in optimizing outcomes for stroke survivors.

Pre-hospital emergency personnel, as frontline providers, must be capable of quickly assessing clinical situations and initiating prompt, life-saving interventions (27). EMS staff need a level of permission to provide care. In Iran, this permission was available as an offline protocol. If EMS staff need further implementation, they should consult with an online general physician or medical specialist according to each center. We need an updated protocol by a multidisciplinary expert panel to enhance the stroke survival chain. Research has shown that the combination of different member types within expert groups greatly impacts their effectiveness in shaping a policy (28, 29). A diverse composition within expert groups can enhance their collective knowledge and credibility in stroke care. The differing expertise and viewpoints of nurses, EMS professionals, neurologists, and medical specialist likely lead to distinct recommendations. By incorporating professions, the group benefits from complementary knowledge, which can result in more thorough and balanced recommendations. However, it is crucial to recognize that the professional experiences of group members may introduce specific biases or priorities into the recommendations. We tried to be transparent about the group composition so that readers can take this context into account. Multidisciplinary approach according to context were considered in this study.

There are significant variations in stroke code implementation across countries. According to a study by Shahjouei et al. in Iran, improving stroke code management requires an organized and comprehensive stroke program tailored to the context (11). High-income countries typically have more frequent protocol updates based on ongoing research. For instance, the U.S. and Germany regularly revise their guidelines to incorporate new evidence-based practices. In contrast, lower-income countries may face challenges in keeping their protocols up-to-date due to resource constraints. The U.S. has established a stroke code protocol and an extensive system for both pre-hospital and in-hospital stroke treatment (30).

Considering these points, we aimed to update the Iranian prehospital protocol. First, we had to examine other protocols, such as the National Model EMS Clinical Guidelines (version 3, March 2022) by National Association of State EMS Officials (NASEMSO). It was suggested that the blood glucose cut-point be set at 60 mg/dl (4), but in the current updated protocol, the experts have increased this cut-point to 70 mg/dl. Because blood glucose levels between 60 and 70 mg/dl, are too borderline to judge between hypoglycemia and stroke. In our experience, when people have blood glucose levels of 60 to 70 mg/dl, the EMS staff use dextrose 50% to differentiate between stroke and hypoglycemia. Another difference between this protocol and the National Model EMS Clinical Guidelines is in the SAMPLE history. In the updated protocol, we suggest SAMPLER. This new acronym differs from SAMPLE in two abbreviations. The "L" abbreviation stands for "last seen normally," while "R" refers to the "risk factor of stroke." Furthermore, the National Model EMS Clinical Guidelines state, "Do not treat hypertension." In Germany and some parts of the US, mobile stroke units equipped with CT scanners enable more precise diagnosis and targeted blood pressure management in the field. However, current protocols, according to infrastructure experts, allow EMS staff to administer sublingual Captopril to patients with extremely high blood pressure (systolic blood pressure (SBP) > 220 mmHg, diastolic blood pressure (DBP) > 120 mmHg). We know that Labetalol is the choice for these patients, but there is no consensus among national emergency organizations in Iran regarding the administration of this drug in a prehospital setting. We have added to the protocol in the recipient hospital, which operates 24 hours a day (all departments are active during the day, and the neurology residential site, triage, CT scan, and emergency department are active at night) for the first time in Iran. EMS are an integral component of stroke centers, playing a vital role in rapid transportation of stroke patients to designated facilities. Based on stroke statements and guidelines, the average time between call to EMS and ambulance arrival should be less than eight minutes, with the application of alternatives such as air ambulance when it takes more than one hour

to access the medical center. In India, inconsistent training among EMS personnel leads to varying levels of proficiency in stroke recognition and response. Additionally, systemic roadblocks such as traffic congestion and inadequate ambulance services can delay patient transfers, impacting treatment outcomes. India's National Stroke Care Program focuses on urban tertiary centers, but pre-hospital delays persist. In big cities with many cars but poor traffic infrastructure, the ambulance service might be severely delayed. Very few patients with stroke arrive by ambulance in low-income and middle-income countries (LMICs) (12% in northwest India, 30% in south India, 17% in Tunisia, and none in Ghana and Nigeria). Most patients prefer to use their own vehicles to seek medical help; in Lebanon, 85% of patients with stroke arrived at hospital by private transport (31). In China, the ongoing multifaceted campaign utilizing the Stroke 1-2-0 program has been linked to reduced prehospital delays and enhanced rates of timely arrival and ambulance response for stroke patients (32). In Iran, the swift transport of patients poses significant challenges (11). The previous protocol did not emphasize scene time, leading to an increase of this time to more than 20 minutes (33). In this updated protocol, it is emphasized that EMS staff should keep scene time less than 5 minutes. Meza et al. found that the updated protocols led to a significant and sustained reduction in door-to-needle times and recommended establishing mechanisms for monitoring outcomes and facilitating continuous improvement (12). In the United States, the American Heart Association's Get with The Guidelines® – Stroke program has implemented an Additional Time Tracker functionality. This tool allows hospitals to monitor key time targets such as door-to-stroke team notification, door-to-brain image, and door-to-IV tissue plasminogen activator (tPA) time (34). Monitoring time is a key factor, and we consider time as another update in this protocol. Every center should establish a joint committee of prehospital and hospital staff to hold meetings and supervise the timing and outcomes for stroke survivors. The need for equipped resuscitation in the CT scan department for direct delivery of patients by EMS has been considered for the first time. The stroke code clock is also included in the Iranian stroke code protocol for the first time. The previous protocol did not consider who was allowed to provide each type of care. In Iran's EMS, we have a multidisciplinary team with various levels of degrees. This was the first time this issue was addressed.

To the best of our knowledge, this comprehensive program represents the first multidisciplinary effort to systematically update Iran's prehospital stroke code management protocol. This updated protocol integrates critical elements informed by evidence-based practices and context-specific data collected during initial field evaluations.

5. Limitations

The limitation of this study was that there are few expert professors in the field of pre-hospital emergency in Iran and most of them are active in the hospital field. The strengths of this study were more attention to the stakeholders in this study and inviting EMS staff who are active at the patient's bedside. Furthermore, the research unit of Babol prehospital center has specialized in the field of stroke using scientific methods.

6. Conclusions

Stroke clock, pager 724, direct delivery of patients to the CT scan department with an equipped resuscitation trolley, administering BEFAST criteria for the diagnosis of patients, decreasing scene time, and identifying who is allowed to provide each type of care were the highlighted updates in this protocol. According to this updated protocol, we recommend that each center enhances its infrastructure and resources to facilitate the feasibility and implementation of these updates. This protocol will be trained, implemented, and evaluated in the north of Iran for a pilot study. In the future, the effects of this protocol will be presented.

7. Declarations

7.1. Acknowledgments

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7.2. Author Contribution

The study concept and idea was developed and refined by professor Nayeri and Dr. Alijanpour. Dr. Bahramnejad assisted in the refining of the study design and materials. Dr. Shafie and Dr. Mowla contributed to writing of the protocol. All authors reviewed and approved the final manuscript.

7.3. Funding

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7.4. Ethics and dissemination

This study has been approved by the Ethic Committee of Tehran university of medical sciences (IR.TUMS.FNM.REC.1401.036). Written informed consent was obtained from all participants.

7.5. Competing interests

No conflict of interest.

7.6. Data availability

The datasets used and/or analyzed during the current study are available from the first author on reasonable request by email (sh.alijanpour@mubabol.ac.ir)

7.7. Using artificial intelligence chatbots

During the preparation of this work the authors used DeepSeek-V3 and Grammarly's AI in order to check and correct grammatical errors during the manuscript writing process. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

References

1. Djalalinia S, Saeedi Moghaddam S, Rezaei N, Rezaei N, Mansouri A, Abdolhamidi E, et al. National and subnational patterns of mortality from stroke in the Iranian population (1990–2015): Complementary results from the NASBOD study. International Journal of Stroke. 2020;15(2):132-48.
2. Alijanpour S, Alimohamadi N, Khafri S, Rokni MA, Khorvash F. Caspian nursing process: Impactions on new-onset constipations in admission, discharge, and follow-up of acute stroke patients. J Iranian Journal of Nursing Midwifery Research. 2022;27(6):509-16.
3. Kolls BJ, Ehrlich ME, Monk L, Shah S, Roettig M, Iversen E, et al. Regionalization of stroke systems of care in the stroke belt states: The IMPROVE stroke care quality improvement program. American Heart Journal. 2024;269:72-83.
4. National Association of State EMS Officials (NASEMSO). National Model EMS Clinical Guidelines 2022 [Available from: https://nasemso.org/projects/model-ems-clinical-guidelines/.
5. Poureskandari M, Ala A, Sadeghi-Hokmabadi E, Rahmani F, Amin M, Vahdati SSJEJoEM. Evaluation of Pre-hospital Stroke Diagnosis Agreement with Emergency Diagnosis. 2023;22(3):161-6.
6. Nazar E, Esmaily H, Yousefi R, Jamali J, Ghandehari K, Hashtarkhani S, et al. A Spatial Variation Analysis of In-Hospital Stroke Mortality Based on Integrated Pre-Hospital and Hospital Data in Mashhad, Iran. 2023;26(6):300.
7. Asna Ashari Amiri M, Rezai M, Mohammadi F, Vaziri S, Tabibzadeh Dezfooli SA. Accuracy of Prehospital Emergency Service in Activating Acute Stroke Code. Journal of Mazandaran University of Medical Sciences. 2023;33(224):163-9.
8. Hassankhani H, Soheili A, Vahdati SS, Mozaffari FA, Fraser JF, Gilani N. Treatment delays for patients with acute ischemic stroke in an Iranian emergency department: A retrospective chart review. Annals of emergency medicine. 2019;73(2):118-29.
9. Sangari A, Akhoundzadeh K, Vahedian M, Sharifipour E. Effect of pre-hospital notification on delays and neurological outcomes in acute ischemic stroke. Australasian emergency care. 2022;25(2):172-5.
10. Hanifi N, Dinmohammadi M, Ghadimi N. Factors affecting pre-hospital and in-hospital delays at time-to-treatment and complications in stroke: A prospective cohort study. 2020.
11. Shahjouei S, Bavarsad-Shahripour R, Assarzadegan F, Rikhtegar R, Mehrpour M, Zamani B, et al. Acute management of stroke in Iran: Obstacles and solutions. 2017;16(2):62.
12. Meza HT, Inda IS, Ponz MS, Ara J, Moreno JM. Impact of a series of measures for optimisation hospital code stroke care on door-to-needle times. Neurologia. 2023;38(3):141-9.
13. Alijanpour S, Alimohamadi N, Khafri S, Khorvash F. New-onset constipation after stroke: Caspian nursing process projects. Journal of Holistic Nursing Midwifery. 2022;32(1):29-39.
14. Mousazadeh Y, Nasr A, Alimohammadi N, Isfahani MN, Alijanpour S. Development and domestication of a clinical guideline for pharmacological pain management of trauma patients in prehospital setting. Archives of Trauma Research. 2019;8(2):110-7.
15. Altman DG, Simera I, Hoey J, Moher D, Schulz K. EQUATOR: reporting guidelines for health research. The Lancet. 2008;371(9619):1149-50.
16. Karunarathna I, Kusumarathna K, Jayathilaka P, Rathnayake B, Bandara S, Abeykoon M, et al. Understanding Evidence Levels in Evidence-Based Medicine: A Guide for Healthcare Professionals. 2024.
17. García-Peña C, Pérez-Zepeda MU, Robles-Jiménez LV, Sánchez-García S, Ramírez-Aldana R, Tella-Vega P. Mortality and associated risk factors for older adults admitted to the emergency department: a hospital cohort. BMC Geriatr. 2018;18(1):144.
18. Hashemi-Domeneh B, Zamani N, Hassanian-Moghaddam H, Rahimi M, Shadnia S, Erfantalab P, et al. A review of aluminium phosphide poisoning and a flowchart to treat it. Arh Hig Rada Toksikol. 2016;67(3):183-93.
19. Ashcraft S, Wilson SE, Nystrom KV, Dusenbury W, Wira CR, Burrus TM, et al. Care of the patient with acute ischemic stroke (prehospital and acute phase of care): update to the 2009 comprehensive nursing care scientific statement: a scientific statement from the American Heart Association. Stroke. 2021;52(5):e164-e78.
20. Wiyarta E, Fisher M, Kurniawan M, Hidayat R, Geraldi IP, Khan QA, et al. Global Insights on Prehospital Stroke Care: A Comprehensive Review of Challenges and Solutions in Low-and Middle-Income Countries. Journal of Clinical Medicine. 2024;13(16):4780.
21. 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. Frontiers in neurology. 2022;12:765069.
22. Glober NK, Sporer KA, Guluma KZ, Serra JP, Barger JA, Brown JF, et al. Acute stroke: current evidence-based recommendations for prehospital care. Western Journal of Emergency Medicine. 2016;17(2):104.

23. Mead GE, Sposato LA, Sampaio Silva G, Yperzeele L, Wu S, Kutlubaev M, et al. A systematic review and synthesis of global stroke guidelines on behalf of the World Stroke Organization. International Journal of Stroke. 2023;18(5):499-531.
24. Fousse M, Grun D, Helwig SA, Walter S, Bekhit A, Wagenpfeil S, et al. Effects of a feedback-demanding stroke clock on acute stroke management: a randomized study. Stroke. 2020;51(10):2895-900.
25. Ospel JM, Dmytriw AA, Regenhardt RW, Patel AB, Hirsch JA, Kurz M, et al. Recent developments in prehospital and in-hospital triage for endovascular stroke treatment. Journal of NeuroInterventional Surgery. 2023;15(11):1065-71.
26. Boulanger J, Lindsay M, Gubitz G, Smith E, Stotts G, Foley N, et al. Canadian stroke best practice recommendations for acute stroke management: prehospital, emergency department, and acute inpatient stroke care, update 2018. International Journal of Stroke. 2018;13(9):949-84.
27. Moezzi M, Mozafari J, Barzegari H, Motlagh AH. Knowledge level of pre-hospital emergency staff about acute stroke and indications of code 724. Entomology Applied Science Letters. 2021;8(2-2021):9-15.
28. Christensen J, Hesstvedt S. The influence of expert groups: a citation analysis. Journal of European Public Policy. 2024;31(5):1259-94.
29. Chandratre S, Soman A. Preparing for the interviewing process during Coronavirus disease-19 pandemic: Virtual interviewing experiences of applicants and interviewers, a systematic review. PLoS One. 2020;15(12):e0243415.
30. Zhelev Z WG, Henschke N, Fridhandler J, Yip S. . Prehospital stroke scales as screening tools for early identification of stroke and transient ischemic attack. . Cochrane Database of Systematic Reviews. 2019(4):Art. No.: CD011427. DOI: 10.1002/14651858.CD011427.pub2.
31. Pandian JD, Kalkonde Y, Sebastian IA, Felix C, Urimubenshi G, Bosch J. Stroke systems of care in low-income and middle-income countries: challenges and opportunities. The Lancet. 2020;396(10260):1443-51.
32. Yuan J, Li M, Liu Y, Xiong X, Zhu Z, Liu F, et al. Analysis of Time to the Hospital and Ambulance Use Following a Stroke Community Education Intervention in China. JAMA Network Open. 2022;5(5):e2212674-e.
33. Medical Management of Acute Stroke - Code 724 Babol: Vice- Chancellor's Office in Treatment Affairs, Babol University of Medical Science; 2025 [Available from: https://darman.mubabol.ac.ir/page/?id=1369.
34. Malycha J, Bonnici T, Clifton DA, Ludbrook G, Young JD, Watkinson PJ. Patient centred variables with univariate associations with unplanned ICU admission: a systematic review. BMC Med Inform Decis Mak. 2019;19(1):98.

Table 1: PICOS model search lines in Google Scholar

PICOS	Definition
Problem	('Stroke' OR 'CVA' OR 'Cerebral Stroke' OR 'Cerebrovascular accident' OR 'Cerebrovascular Accident, Acute 'Cerebrovascular Stroke' OR 'Stroke, Acute' OR 'Stroke, sub-acute' OR 'Stroke, chronic' OR 'Vascular Accident, 'Brain OR Ischemic stroke'.)
Intervention	(Stroke Code' OR 'Code Stroke' OR 'Stroke Notification' OR 'SAMA Code' OR 'Code 724' OR 'Balance Eye Face Arm Speech Time' OR 'Face Arm Speech Time' OR 'Stroke Car' OR 'Cincinnati Prehospital Stroke Scale' OR 'Prehospital Acute Stroke Severity scale' OR' Recognition of Stroke' OR' Prehospital Care' OR' Prehospital Management' OR' Empowerment' OR' Training' OR 'Education' OR Protocol' OR 'Guideline' OR' Assessment' OR 'Implement' OR 'Intervention')
Comparison	('Pre-hospital' OR 'Emergency' OR 'Rehabilitation unit' OR 'Stroke care unit' OR 'Hospitals')
Outcome	(Diagnose OR 'Impairment' OR 'Handicap' OR 'Disability' OR 'quality of life' OR 'Golden Time')
Study design	('Intervention Study' OR 'Cohort Analysis' OR 'Retrospective study' OR 'Prospective study' OR 'Crossover Trial' OR 'Case control study' OR 'Randomized Trial' OR 'Major Clinical study' OR 'Cohort' OR Systematic review' OR 'Protocol' OR 'Guideline' OR 'Randomized controlled trial' OR 'Evidence-based Recomendation')

Table 2: Grades of recommendation and level of evidence

Grade	Level	Type of Study
A	1a	Systematic review of (homogeneous) randomized controlled trials
A	1b	Individual randomized controlled trials (with narrow confidence intervals)
B	2a	Systematic review of (homogeneous) cohort studies of "exposed" and "unexposed" subjects
B	2b	Individual cohort study / low quality randomized control studies
B	3a	Systematic review of (homogeneous) case-control studies
B	3b	Individual case-control studies
C	4	Case series, low-quality cohort, or case-control studies
D	5	Expert opinions based on non-systematic reviews of results or mechanistic studies

Appendix 1: Instruction of grading

Dimension	Definition	Grading
Priority	In this section, please read each recommendation carefully. In the next column, indicate the priority or importance of each recommendation according to the following guide and using a 5-point Likert scale.	1: In my opinion, doing this care is not necessary at all. 2: In my opinion, this care is not necessary. 3: In my opinion, doing this care is relatively necessary. 4: I think it is necessary to do this care. 5: I think it is absolutely necessary to do this care.
Utility	The meaning is the degree of usefulness of each recommendation.	1: The disadvantages of the service are expected to be much greater than its benefits. 2: The disadvantages of the service are expected to be greater than its benefits. 3: The disadvantages and benefits of the service are equal, or the expert cannot make a judgment for the described service. 4: The benefits of the service are expected to be greater than its disadvantages. 5: The benefits of the service are expected to be much greater than its disadvantages.
Feasibility	This item refers to the ability to provide care based on the context and available equipment.	Specify the maximum feasibility with a score of 5 and the minimum with a score of 1.
Conceptuality	Refers to how easily the information in each line can be understood by healthcare providers.	Rate comprehensibility, with a score of 5 indicating complete comprehensibility and score of 1 showing complete lack of comprehensibility. Based on the average score of all experts, the item will be edited.
Persons authorized to provide care	Since this guide is intended for all types of patient caregivers, please specify in the last column the special groups that you believe are qualified and authorized to provide the service. If there are multiple groups you have in mind, please specify them, and prioritize as needed.	For example, we can define groups according to education; Associate degree of nursing (18), bachelor of science of nursing (BSN), master of science of nursing (MSN).

Table 3: Integration of findings from the qualitative phase and the search of sources in the development phase of the study (continue)

Row	Qualitative Phase Result	Literature review		Integration
		Study	Main findings (source)	
1	Category:Comprehensive Stroke Code Program Subcategory: Specialized Teamwork	Wiyarta (2024) International Review	Different prehospital triage scales have different applications based on the severity of neurological deficit. There are several tools that prehospital emergency teams can use. These tools can range from simple stroke severity scales to mobile stroke units.	Considering a valid scale in identifying stroke patients.
2	Category:Comprehensive Stroke Code Program Subcategory: The need to establish a joint committee, monitoring, and coordination	Zachrison (2023) International Review	Timely feedback is an important part of the continuous improvement of diagnostic skills and treatment decisions. Lack of feedback may lead to incorrect decisions by physicians in the emergency department. Discrepancies between prehospital and hospital diagnoses are understandably common but can lead to further diagnostic errors. Identification of the patient by the prehospital emergency department is an essential first step before a stroke code is reported to the receiving emergency department. Analyses show that few prehospital emergency interventions fully comply with guideline recommendations.	Establishing a joint stroke committee and hold regular meetings.
3	Category:Comprehensive Stroke Code Program Subcategory: Removing barriers to the proper implementation of the current protocol, updating, communicating, and implementing the protocol, the need to set up a specialized dispatch.	Mead (2023) International Review and synthesis of resources by the World Stroke Organization	In stroke patients, supplemental oxygen should be maintained with the goal of achieving a blood oxygen saturation of ≥ 94%.	Considering specialized measures in pre-hospital emergency protocol.
4	Subcategory: Protocol Update, Communication, and Implementation	Chen (2022) China Systematic Review and Meta-Analysis	The findings of this study showed that FAST and BEFAST may be useful in the diagnosis of acute ischemic stroke. The diagnostic value of BEFAST in acute ischemic stroke was higher than that of FAST. Therefore, it may play an important role in the rapid diagnosis of this type of stroke.	Using BEFAST instead of FAST
5	Subcategory: Removing barriers to the proper implementation of the current protocol Update, communicate, and implement the protocol.	Li (2021) USA Retrospective cohort from American Heart Association's (AHA's) Get With the Guidelines-Stroke (GWTG-S) registry	The findings of this study showed that on-scene time accounted for 38.5% of the total pre-hospital time. Limiting on-scene functions to include blood glucose assessment and initiation of vascular access may reduce prehospital time.	Considering scene time in updating prehospital emergency protocols.
6	Category: Comprehensive Stroke Code Program	Ashcraft(2021) USA Scientific Statement and Clinical Guideline Review (Expert meeting based on American Heart Association guidelines)	Prehospital evaluation of a patient with suspected stroke by prehospital emergency personnel should include airway control, breathing, vital signs, initial neurological assessment, blood glucose, and cardiac monitoring.	Subcategory: Specialized Teamwork considering specialized measures in pre-hospital emergency protocol.
7	Category: Comprehensive Stroke Code	Fousse(2020) Germany Clinical Trial	This study showed that the use of a stroke clock that requires active feedback significantly improved acute stroke management measures. Therefore, it was a potential low-cost mechanism to simplify time-sensitive stroke treatment.	Subcategory: Protocol update, Communication, and Implementation paying attention to standard times in measuring outcomes.

Table 3: Integration of findings from the qualitative phase and the search of sources in the development phase of the study

Row	Qualitative Phase Result	Literature review		Integration
		Study	Main findings (source)	
8	Category: Comprehensive Stroke Code Subcategory: Removing barriers to the proper implementation of the current protocol, updating, communicating, and implementing the protocol Need to set up a specialized dispatch Category: Adapting to balanced national development. Subcategory: Stroke and emerging factors	Boulanger(2018) Canada Clinical Guide	The expanding role of emergency medical personnel; arrival at the emergency department without delay and the establishment of stroke code protocols by the local healthcare institution, triage, and risk assessment of recurrent stroke after transient ischemic attack/mild stroke, revised and suggested levels of urgency for investigations and initiation of management strategies proposed	Removing obstacles to the accurate implementation of the protocol based on interviews, updating the stroke protocol in the pre-hospital emergency department considering the decreasing age, and launching a specialized dispatch.
9	Category: Comprehensive Stroke Code Subcategory: Protocol Update, Communication, and Implementation	Glober(2016) USA Evidence-based recommendations	Protocols varied widely among emergency medical agencies in California. All recommended blood glucose assessment with a target level in the range of 60 to 80 mg/dL. Cardiac monitoring was recommended in 58% of cases.	Protocol update in implementation and process.

FAST: Face, Arms, Speech, Time; BEFAST: Balance, Eyes, Face, Arm, Speech, and Time.

Table 4: Distribution of demographic characteristics of experts in this study

Variables	Frequency (%)
Gender	
Male	12 (60)
Female	8 (40)
Degree	
Bachelor	8 (40)
Master of Science/ Doctor of Philosophy	8 (40)
Medical Specialist/fellowship	4 (20)
Discipline	
Nursing	11 (55)
Emergency Medical Technician	3 (15)
Anesthesia	2 (10)
Neurology	2 (10)
Emergency Medical Specialist	2 (10)
Department	
Prehospital Emergency	15 (75)
Hospital	5 (25)
Affiliation**	
Babol	15 (75)
Mazandaran	3 (15)
Tehran	2 (10)
Total	20 (100)

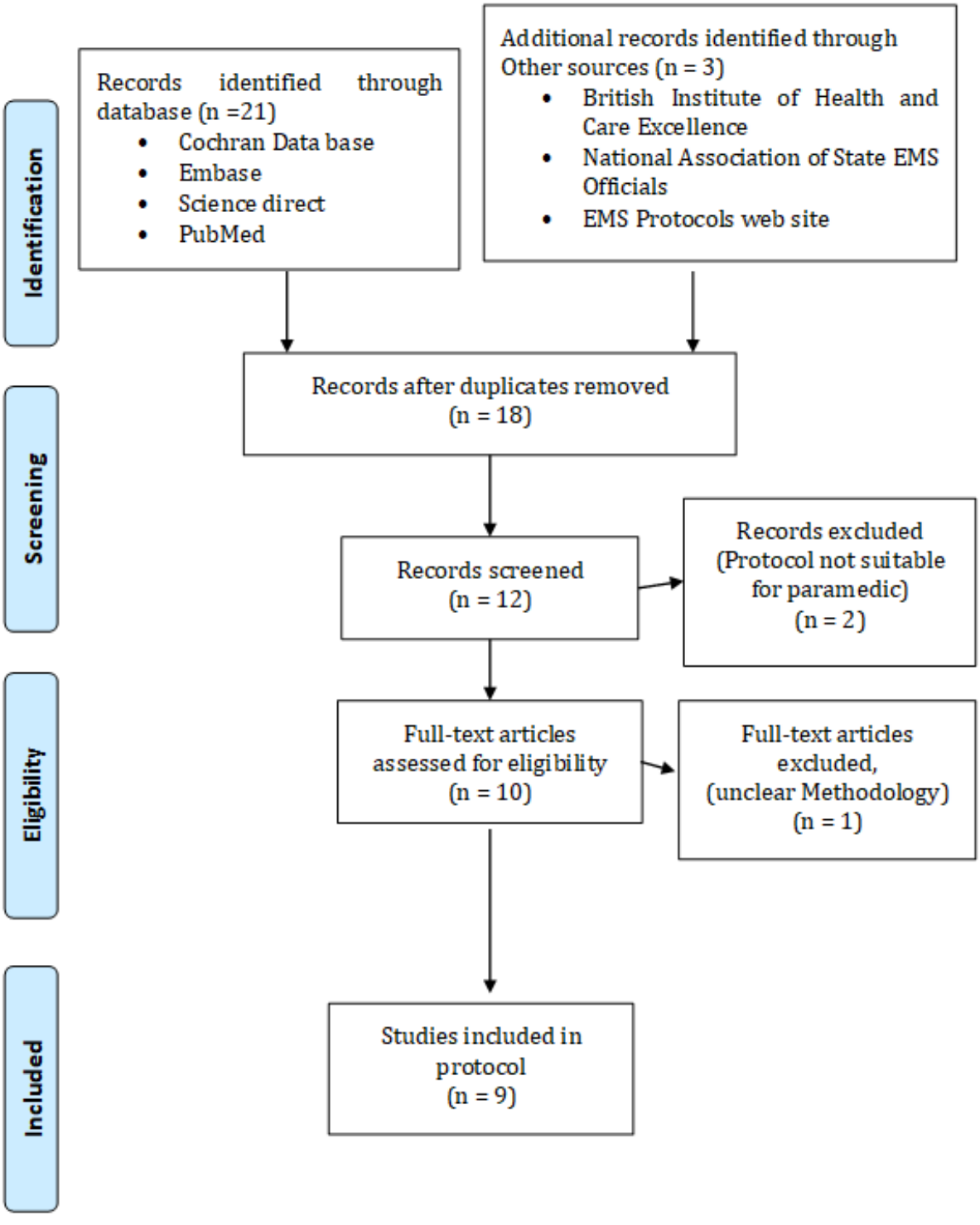

Figure 1: Flow Diagram of enrolling studies. EMS: Emergency Medical Services.

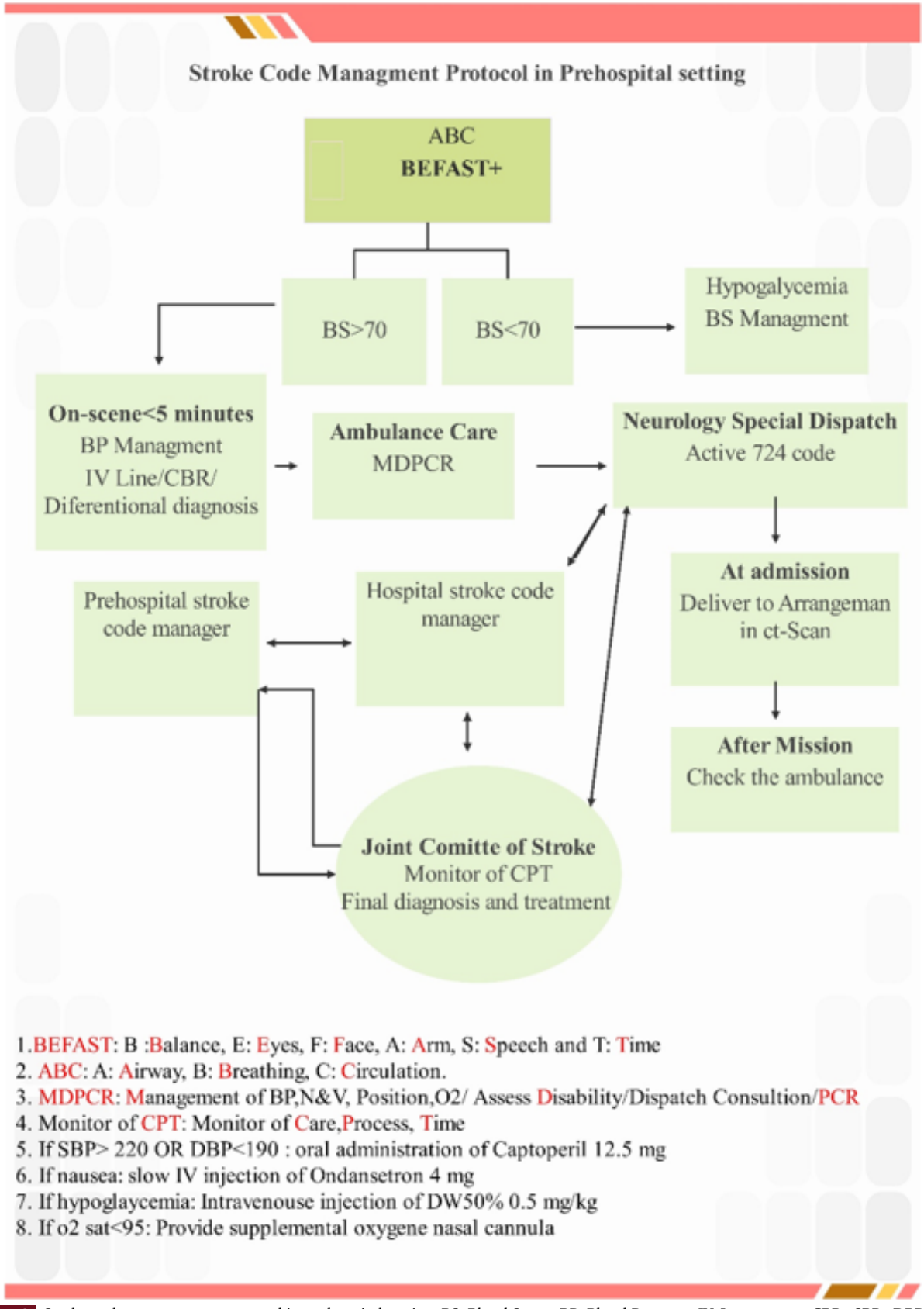

Figure 2: Stroke code management protocol in prehospital setting. BS: Blood Sugar; BP: Blood Pressure; IV: Intravenous; CBR: ;SBP: ;DBP: ; DW: ; O2 sat.

Appendix 2: The recommendation of experts for on-scene measures by pre-hospital emergency staff

Recommendations	Agreement of authority					References
	Priority	Usefulness	Feasibility	Conceptuality	Permitted to provide the care	
Patients with suspected acute stroke should undergo a rapid initial assessment of airway, breathing, and circulation. (Evidence Level A) (Grade of Recommendation 1a)	100	96	95	94	ADN BSN MSN	Ashcraft S, Wilson SE, Nyström KV, Dusenbury W, Wira CR, Burrus TM, American Heart Association Council on Cardiovascular and Stroke Nursing and the Stroke Council. Care of the patient with acute ischemic stroke (prehospital and acute phase of care): update to the 2009 comprehensive nursing care scientific statement: a scientific statement from the American Heart Association. Stroke. 2021 May;52(5):e164-78
The stroke scale should be used in the prehospital setting for any patient with acute neurological impairment, in order to rapidly assess and triage patients with possible stroke. (Evidence Level D) (Grade of Recommendation 5)	94	95	91	88	BSN MSN	Wiyarta E, Fisher M, Kurniawan M, Hidayat R, Geraldi IP, Khan QA, Widyadharma IP, Badshah A, Pandian JD. Global Insights on Prehospital Stroke Care: A Comprehensive Review of Challenges and Solutions in Low- and Middle-Income Countries. Journal of Clinical Medicine. 2024 Aug 14;13(16):4780.
BEFAST should be used instead of FAST criteria. (Evidence Level A) (Grade of Recommendation 1a)	90	90	92	97	BSN MSN	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. 2022;12:765069.
Check the patient's blood sugar to differentiate between symptoms of stroke and hypoglycemia. The standard blood sugar level is 70 mg/dL. If the blood sugar is lower than this value, inject a vial of 50% dextrose into a large vein. If the blood sugar is higher than this cut-point, consider the patient as code 724. (Evidence Level C) (Grade of Recommendation 4)	96	96	97	98	ADN BSN MSN	Glober NK, Sporer KA, Guluma KZ, Serra JP, Barger JA, Brown JF, Gilbert GH, Koenig KL, Rudnick EM, Salvucci AA. Acute stroke: current evidence-based recommendations for prehospital care. Western Journal of Emergency Medicine. 2016 Mar;17(2):104.
Normal saline injections are not recommended for all patients. Attempts to establish an IV line should not exceed two on the scene. (Evidence Level C) (Grade of Recommendation 4)	88	85	92	95	ADN BSN MSN	Glober NK, Sporer KA, Guluma KZ, Serra JP, Barger JA, Brown JF, Gilbert GH, Koenig KL, Rudnick EM, Salvucci AA. Acute stroke: current evidence-based recommendations for prehospital care. Western Journal of Emergency Medicine. 2016 Mar;17(2):104.
If a stroke is confirmed at the scene, all subsequent actions should be focused on moving the patient to the ambulance and initiating the transfer. Any treatments that are not urgently required (such as IV therapy) can be administered while the patient is being transported to the hospital. (Evidence Level C) (Grade of Recommendation 4)	93	92	84	91	BSN MSN	Boulanger JM, Lindsay MP, Gubitz G, Smith EE, Stotts G, Foley N, Bhogal S, Boyle K, Braun L, Goddard T, Heran MK. Canadian stroke best practice recommendations for acute stroke management: prehospital, emergency department, and acute inpatient stroke care, update 2018. International Journal of Stroke. 2018 Dec;13(9):949-84.

Appendix 3: The recommendation of experts for inside ambulance measures by EMS staffs

Recommendations	Agreement of authority					References
	Priority	Usefulness	Feasibility	Conceptuality	Permitted to provide the care	
SAMPLER can be used in the past medical history. (Symptoms, Allergies: Medications, Past medical history, Last oral intake, The last time the patient was seen normally, Events leading up to the EMS call and Risk factor). (Evidence Level D); (Grade of Recommendation 5)	90	90	90	91	ADN BSN MSN	Research Team
It is not necessary to give oxygen to a stroke patient with a normal blood oxygen saturation level. (Evidence Level A); (Grade of Recommendation 1a)	84	84	89	90	ADN BSN MSN	Mead GE, Sposato LA, Sampaio Silva G, et al. A systematic review and synthesis of global stroke guidelines on behalf of the World Stroke Organization. Int J Stroke 2023;18(5):499-531,
It is recommended that emergency medical personnel gather information from the patient, family members, or other witnesses regarding the suspected stroke event. This includes details such as the presentation of symptoms, the time of onset or recognition of symptoms, the sequence of events, any accompanying conditions, current medications (especially anticoagulants), and any previous formal or informal recommendations that may impact care. (Evidence Level D); (Grade of Recommendation 5)	96	88	88	89	ADN BSN MSN	Research Team
ECG is not recommended for all stroke patients. For patients who have heart symptoms and stroke at the same time, it can be done if there is no delay in transferring to the treatment center. (Evidence Level C); (Grade of Recommendation 4)	85	87	88	96	BSN MSN	Glober NK, Sporer KA, Guluma KZ, Serra JP, Barger JA, Brown JF, Gilbert GH, Koenig KL, Rudnick EM, Salvucci AA. Acute stroke: current evidence-based recommendations for prehospital care. Western Journal of Emergency Medicine. 2016 Mar;17(2):104.
The senior medical emergency expert should consider taking necessary measures to reduce the time it takes to reach the treatment center. This includes choosing the nearest route with the least traffic and ensuring the patient is transferred at a safe speed. (Evidence Level D); (Grade of Recommendation 5)	93	95	87	93	MSN	Research Team
Direct transfer protocols should be established to facilitate the transfer of patients with suspected acute stroke who may be eligible for thrombolytics and/or EVT to the most suitable acute care hospital that can provide the necessary services for the diagnosis and treatment of acute stroke. (Evidence Level C); (Grade of Recommendation 4)	92	91	84	89	BSN MSN	Glober NK, Sporer KA, Guluma KZ, Serra JP, Barger JA, Brown JF, Gilbert GH, Koenig KL, Rudnick EM, Salvucci AA. Acute stroke: current evidence-based recommendations for prehospital care. Western Journal of Emergency Medicine. 2016 Mar;17(2):104.
Coordination for dispatch, consultation for further care and treatment measures, and transfer to the treatment center should be done with the involvement of specialized neurology dispatch. (Evidence Level D); (Grade of Recommendation 5)	86	90	79	90	MSN	Research Team

SAMPLER: Signs & symptoms, Allergies, Medications, Past Medical History, last meal, last seen normal, Events leading up to the present injury, and Risk factor; EMS: Emergency Medical Services; ECG: Electrocardiography; EVT: Endovascular Thrombectomy; ADN: Associate Degree in Nursing; BSN: Bachelor of Science; MSN: Master of Science.

Appendix 4: The recommendation of experts for on-admission measures by pre-hospital emergency staff

Recommendations	Agreement of authorities					References
	Priority	Usefulness	Feasibility	Conceptuality	Permitted to provide a car	
Emergency medical professionals should make sure that all information is accurately recorded in the patient's health records and promptly provided to the receiving hospital during stroke code notification and upon admission. (Evidence Level D) (Grade of Recommendation 5).	79	86	80	86	ADN BSN MSN	Research Team
Timely feedback is essential for continuously improving diagnostic skills and treatment decisions. Guiding feedback from hospitals to prehospital settings enhances compliance with guideline-based care, including the documentation of prehospital stroke assessments and the last known time. Get smarter answer from GPT-4o (Evidence Level D) (Grade of Recommendation 5).	84	86	82	86	BSN MSN	Zachrison KS, Nielsen VM, De La Ossa NP, Madsen TE, Cash RE, Crowe RP, Odom EC, Jauch EC, Adeoye OM, Richards CT. Prehospital stroke care part 1: emergency medical services and the stroke systems of care. Stroke. 2023 Apr;54(4):1138-47.
It is recommended to use a stroke code clock, which measures workflow times, as an easy way to increase time management awareness among the hospital team. (Evidence Level A) (Grade of Recommendation 1b).	83	86	71	84	MSN	Fousse M, Grün D, Helwig SA, et al. Effects of a feedback-demanding stroke clock on acute stroke management: a randomized study. Stroke. 2020;51(10):2895-2900
Time monitoring and supervision of care in stroke should be done by the joint pre-hospital and hospital emergency committee. (Evidence Level D) (Grade of Recommendation 5).	77	81	78	84	MSN	Research Team
The EMS staff should deliver the stroke patient with stable hemodynamic symptoms to the CT scan. The CT scan should be equipped with a resuscitation trolley, staff trained in cardiopulmonary resuscitation and a free bed for code 724. (Evidence Level D) (Grade of Recommendation 5).	91	93	87	92	BSN MSN	Research Team

ADN: Associate Degree in Nursing; BSN: Bachelor of Science; MSN: Master of Science; EMS: Emergency Medical Services; CT: Computed Tomography.