

# Knowledge of Emergency Medical Service (EMS) personnel in diagnosing patients with cerebral stroke and the necessary measures during transfer to a hospital

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## Abstract

**Background:** Cerebral stroke is one of the leading causes of death and the most common cause of chronic disability in adults and the elderly. Because all emergency patients with cerebral strokes require appropriate treatment in a short time, Emergency Medical Service (EMS) personnel need to have the necessary knowledge to deal with these patients.

**Objective:** This study aims to examine the knowledge of Iranian EMS personnel in diagnosing patients with cerebral stroke and the necessary measures during transfer to the hospital.

**Methods:** This cross-sectional study was conducted in pre-hospital emergency centers in Iran in 2021. A researcher-made questionnaire containing 20 closed-ended questions with multiple-choice answers was used to assess the knowledge of the EMS personnel about cerebral stroke. The reliability and validity of the questionnaire were confirmed.

**Results:** The mean age of the 136 EMS personnel was 32.4±5.8 years old, and all of them were men. The total mean score of EMS knowledge regarding diagnosing patients with cerebral stroke and necessary measures during transfer to the hospital was 15.9±2.1 out of 20. According to the cut-off, the level of knowledge was estimated to be good. However, the knowledge level was poor and very poor in 2.2% (n = 3) and 1.5% (n = 2) of EMS personnel, respectively.

**Conclusion:** The current findings showed that the knowledge level of Iranian EMS personnel in the field of cerebral stroke is good and desirable. However, the knowledge of a very small percentage of EMS personnel is at a poor or very poor level. Due to the job sensitivity of these personnel, it is necessary for all of them to have concise knowledge about it and be able to use it properly.

**Keywords:** Stroke, Knowledge, Emergency Medical Service (EMS).

## Introduction

Today, strokes are the third leading cause of death after heart disease and cancer, and their incidence almost doubles after the age of 55 for each decade of age. Cerebral stroke is also the most common cause of chronic disability in adults and the elderly.<sup>1</sup> Cerebral stroke accounts for approximately 50% of all neurological disorders leading to hospitalization and is a major cause of mortality and morbidity worldwide, particularly in Eastern Europe and Asia.<sup>2</sup> In the United States, approximately 750,000 cerebral

strokes occur annually, 88% of which are ischemic strokes. 8–12% of these strokes result in death within 30 days. Among stroke survivors, a large percentage suffer from a disability, with stroke being the leading cause of disability in adults. Survivors often lose their function and impose a heavy economic and psychological burden on families and society.<sup>3</sup> Cerebral stroke is one of the most important causes of physical and cerebral disabilities. Due to the high costs of maintenance and care for these patients, the importance of prevention becomes apparent.<sup>4</sup>

Stroke and cerebral ischemia produce an increase in excitatory amino acid release, activation of their receptors, and calcium entry into the cell, as well as electrophysiological and metabolic abnormalities, lipid peroxidation, and other oxidative processes. Ischemia/reperfusion triggers a process called oxidative stress that exacerbates ischemic damage. Oxidative stress can lead to the formation of nitric oxide and superoxide, which can impair the production or metabolism of either, leading to pathological complications.<sup>5</sup> Additionally, patients with cerebral stroke are prone to other complications such as pneumonia, urinary tract infections, pulmonary embolism, deep vein thrombosis, and bedsores, which can be the cause of death for a stroke patient.<sup>6</sup>

The effects and complications of stroke or cerebral infarction in patients, such as postural dysfunction, loss of strength, sensory disturbances, cognitive problems, and impaired memory and thinking, are caused by the type of involved artery, its location and size, as well as the density of the brain injury. These effects lead to a decline in the quality of life for patients.<sup>7</sup>

It is crucial to provide fast and accurate services to patients with cerebral strokes. Primary prevention is still recognized as an important way to reduce the burden of many injuries and deaths that can be accessed through emergency care.<sup>8</sup> Emergency care should be understood as a complete system with independent components, including pre-hospital care, transportation, and inpatient care. Every component is important, and all of them must interact to have a lasting effect on the health of the community.

Today, pre-hospital Emergency Medical Service (EMS) personnel play an important role among caregivers because of their first contact with emergency patients. They are professionals who are able to prevent harm to the patient by following the principles of medical care.

A review of civilian helicopter programs in the United States shows that the primary factor in reducing emergency patient mortality was not the speed of transportation but the management of care by helicopter medical staff.<sup>9</sup> Therefore, the correct operation and success of the pre-hospital EMS depend on various factors, such as

the ability of the responsible persons, trained personnel, equipment, and coordination and communication systems.

In recent decades, cerebral stroke has become a medical emergency, and early detection of stroke symptoms and rapid activation of the medical system are essential. Time is of the essence in providing care and treatment for patients with cerebral strokes. On the other hand, with the advent of time-dependent thrombolytic therapy for ischemic stroke, the speed of transportation to the hospital and rapid initial pre-hospital diagnosis are of particular importance.

Pre-hospital EMS is the most important factor in reducing delayed hospitalization for stroke patients. Therefore, having an efficient pre-hospital EMS for cerebral stroke is an important goal of social health. In fact, a lot of time is lost outside the hospital in identifying the symptoms of a stroke, either due to delays in notification or transportation. Evidence shows that training EMS personnel on cerebral stroke signs and symptoms is one of the important factors in increasing the quality of treatment for these patients.<sup>10,11</sup>

## Objectives

Due to the lack of sufficient and comprehensive information in the field of knowledge of pre-hospital EMS personnel about cerebral stroke in Iran, this study aimed to investigate this issue.

## Methods

This cross-sectional study was performed in pre-hospital emergency centers in Iran in 2021. The study population was all pre-hospital EMS personnel. The researcher created a questionnaire with 20 closed-ended questions and multiple-choice responses to test knowledge of cerebral stroke. This questionnaire asked eight questions about stroke symptoms such as symmetrical or asymmetric weakness of the limbs, speech disorder, orientation disorder or memory disorder, and severe headache. Six questions were asked about the necessary measures when dealing with a patient with cerebral stroke, including the need to measure blood sugar or pulse, and six questions about vital signs, including the onset of

symptoms under 3 hours, systolic blood pressure less or more than 180–220, and the stability of vital signs before reaching the hospital.

The scoring weight of each question was 1 point, and a total score of 20 was considered. The questionnaire had a range of scores from 0 to 20, with the following levels of knowledge based on the score: 0-8 (very low), 8.1-10 (low), 10.1-15 (moderate), 15.1-18 (good), and 18.1-20 (very good). The validity and reliability of this questionnaire were confirmed, and Cronbach's alpha was 0.88.

At the beginning of the questionnaire, demographic data such as age, gender, field, and degree were recorded. The questionnaire was distributed online and on social media to pre-hospital EMS personnel. They had a maximum of 20 minutes to complete the questionnaire and were not allowed to consult or search the Internet or books while completing the questionnaire. The study removed incomplete questionnaires submitted by pre-hospital EMS workers. In the end, the correct answers to the questions were explained to them, and a researcher-made educational pamphlet was sent to them.

### Statistical analysis

Continuous variables were expressed as the mean±SD, and categorical variables were presented as a percentage and frequency. The chi-square test was used to assess the connection between variables and knowledge level. All statistical analyses were performed with SPSS (version 16.0, SPSS Inc., Chicago, IL, USA). A "P-value" less than 0.05 was considered significant.

### Ethical considerations

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval was obtained. The study did not interfere with the process of providing medical services and care by EMS, and all participants signed an informed consent form.

### Results

In the present study, a researcher-made questionnaire was completed online by 136 pre-hospital EMS personnel in 2021. The mean age was 32.4±5.8 years (range: 24-47 years), and all of them were men. Most pre-hospital EMS

personnel (74%) have an associate's or bachelor's degree in emergency medicine or nursing, and 26% have a master's degree in general medicine.

The total mean score obtained by pre-hospital EMS personnel was 16.8±3 out of 20, indicating a good level of knowledge. There was no significant relationship between this total score and the level of education ( $p=0.47$ ), field of study ( $p=0.24$ ), or age groups ( $p=0.29$ ). As shown in Table 1, 120 people (59%) had a good or very good level of knowledge.

**Table 1.** Categorise of Knowledge level of pre-hospital EMS personnel (n=136)

Knowledge level	N (%)
<b>Very poor</b> (Score: 0-8)	2 (1.5 %)
<b>poor</b> (Score: 8.1-10)	3 (2.2 %)
<b>Moderate</b> (Score: 10.1-15)	11 (8.1 %)
<b>Good</b> (Score: 15.1-18)	75 (55.1 %)
<b>Very Good</b> (Score: 18.1-20)	45 (33.1 %)

The mean score obtained by pre-hospital emergency medical services (EMS) personnel for knowledge of clinical signs of stroke (questions 1–8) was 18.72.5 out of 20. There was no significant relationship between this score and educational level ( $p=0.25$ ), field of study ( $p=0.28$ ), or age groups ( $p=0.29$ ). The mean score obtained by pre-hospital EMS personnel for knowing the differential diagnosis of the illness and taking the necessary measures (questions 9 to 14) was 16.36 out of 20. There was no significant relationship between this mean score and the level of education ( $p=0.10$ ), field of study ( $p=0.14$ ), or age groups ( $p=0.47$ ). The mean score obtained by pre-hospital EMS personnel for knowledge of vital signs affecting patient treatment (questions 15 to 20) was 15.14.5 out of 20. There was no significant relationship between this mean score and educational level ( $p=0.34$ ), field of study ( $p=0.18$ ), or age groups ( $p=0.35$ ). As shown in Table 2, the highest score is related to knowledge of clinical signs of stroke (score 18.7; very good level), followed by knowledge of disease differential diagnosis and taking necessary measures (score 16.3; good level), and knowledge of vital signs affecting patient management (score 15.1; good level).

**Table 2.** Knowledge level of pre-hospital EMS personnel about stroke and necessary measurement

Knowledge level about:	Score (out of 20)	Level	Min-max
Clinical signs of stroke	18.7±2.5	Very good	10-20
Differential diagnosis of the disease and take the necessary measures	16.3±6	Good	0-20
Vital signs affecting patient management	15.1±4.5	Good	0-20
Total knowledge level	16.8±3	Good	4-20

## Discussion

The aim of this study was to determine the level of knowledge about cerebral stroke among 136 Iranian pre-hospital EMS personnel. To investigate the relationship between variables and knowledge level, the chi-square test was performed. However, poor and very poor levels of knowledge were reported in 0.6% (2 people) and 1.2% (4 people) of pre-hospital EMS personnel, respectively.

In comparable research done in the United States in 2008 by McNamara et al., the expertise of 988 pre-hospital EMS personnel in two groups of suburban and downtown crises was examined by telephone interview. 58% of suburban staff, compared to 66% of downtown staff, tended to follow the stroke protocol. Two-thirds of all participants believed that they had sufficient and appropriate knowledge about stroke; however, 90% of them considered it necessary to receive some training in the field of stroke.<sup>12</sup> The study by Crocco et al. presented a lower level of knowledge among 985 pre-hospital EMS personnel. The findings showed that almost all pre-hospital EMS personnel knew that stroke was damaging to the brain, but only 62% of them provided an accurate definition of transient ischemic attack.<sup>13</sup>

A stroke or cerebral infarction is associated with symptoms such as weakness or paralysis, numbness, loss of sensation, speech disorder, visual field disturbance, imbalance, and severe headaches.<sup>6</sup> In the current study, Iranian EMS personnel demonstrated a very good level of knowledge about the clinical symptoms of stroke. In a study by McNamara et al., 58% of suburban EMS personnel, compared to 61% of downtown pre-hospital EMS personnel, were able to identify four symptoms and four risk factors for cerebral stroke.<sup>12</sup> Crocco et al., found that speech disorders, weakness and paralysis, and altered degrees of consciousness were the three most prevalent symptoms reported by pre-hospital EMS personnel.<sup>13</sup> In the current study, Iranian EMS personnel demonstrated a

good level of knowledge in the differential diagnosis of cerebral stroke and taking the necessary measurements. In a study by McNamara et al., more than 93% of pre-hospital EMS personnel mentioned cardiac monitoring, oxygen administration, and blood glucose monitoring as necessary measures in the management strategy of a stroke patient.<sup>12</sup> In the study by Crocco et al., 75% of pre-hospital EMS personnel stated that monitoring blood glucose in patients with stroke was important and necessary.<sup>13</sup> It is important to measure blood sugar as much as possible when experiencing stroke symptoms. Severe and persistent hypoglycemia can lead to brain damage, so rapid and timely diagnosis and correction of hypoglycemia in patients with suspected strokes are important.<sup>14</sup> It is also important to identify people with hyperglycemia. Hyperglycemia is an independent risk factor that increases the mortality and morbidity of stroke. Hyperglycemia worsens cerebral edema and exacerbates post-ischemic injury. The effective mechanism involves increased anaerobic glycolysis leading to tissue acidosis as well as increased permeability of the blood-brain barrier. Recent studies have shown the importance of the timely initiation of insulin therapy to achieve normal blood sugar levels.<sup>15,16</sup>

In the present study, Iranian EMS personnel demonstrated an almost good level of knowledge about vital signs affecting patient management. In a study by McNamara et al., 80% of pre-hospital EMS personnel believed in controlling and monitoring blood pressure in patients with stroke while referring to the hospital. 57% of all participants were aware of the onset of thrombolytic therapy less than 3 hours after the onset of a stroke.<sup>12</sup> In a study by Crocco et al., 70% of prehospital EMS personnel stated that high blood pressure should be corrected before admission to the hospital, and only 29% of them knew that tPA should be prescribed to the patient within the first 3 hours after stroke.<sup>13</sup> In most people with ischemic stroke,

the blood flow to the brain is not completely cut off. Decreased blood flow causes a central area of brain tissue to stop working and clinical signs to appear. However, many cells (called the ischemic light shadow zone) around the nucleus enter a dormant phase. Although these cells are damaged, they have not yet been completely destroyed. These cells can survive in this state for several hours. Timely administration of tPA allows blood flow to return to these cells.

The use of tPA is not suitable for all stroke victims, particularly those with hemorrhagic strokes. Additionally, tPA increases the risk of bleeding in some people's brains. Physicians are currently working on developing blood tests to identify these individuals, making tPA treatment safer. In general, a person with bleeding wounds or high blood pressure is not a good candidate for this type of treatment. However, for many people, the potential benefits of tPA far outweigh the potential risks.<sup>17,18</sup>

In the present study, Iranian EMS personnel showed an acceptable level of knowledge about stroke. However, given that pre-hospital EMS personnel are the first group to deal with critically ill patients, more attention should be paid to their educational planning and quality control, as well as the quality of their ambulances and equipment. The study had some limitations, including the evaluation of only the knowledge of pre-hospital EMS personnel about stroke through 20 closed multiple-choice questions, which may not fully reflect their attitude and practice. Another limitation was the online distribution of questionnaires due to COVID-19 restrictions.

## Conclusions

The present findings indicate that the level of knowledge of pre-hospital EMS personnel about cerebral stroke is generally good and desirable. However, a very small percentage of samples demonstrated poor knowledge. Given the critical nature of their role in dealing with stroke patients, it is essential that all pre-hospital EMS personnel have accurate knowledge about stroke and are able to apply it effectively as needed. The researchers believe that continuous training and courses can have a positive effect on the knowledge of pre-hospital EMS personnel and consequently on their attitude and practice in dealing with

stroke patients, leading to improved EMS and reduced mortality and morbidity in these patients.

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## Competing interests

The authors declare that they have no competing interests.

## Abbreviations

Emergency Medical Service: EMS;

Coronavirus disease 2019: COVID-19.

## Authors' contributions

RS and SS were responsible for the study concept and design. RS led data collection. SS was responsible for the analysis and interpretation of data. RS wrote the first draft. SS provided comments on initial drafts and coordinated the final draft. All authors read and approved the final manuscript. All authors take responsibility for the integrity of the data and the accuracy of the data analysis.

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## Availability of data and materials

The data used in this study are available from the corresponding author on request.

## Ethics approval and consent to participate

The study was conducted in accordance with the Declaration of Helsinki. Institutional Review Board approval was obtained. The present study did not interfere with the process of diagnosis and treatment of patients and all EMS personnel provide an informed consent form.

## Consent for publication

By submitting this document, the authors declare their consent for the final accepted version of the manuscript to be considered for publication.

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