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From Call to Diagnosis: Improving Stroke Triage in the Medical Dispatch Unit

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Abstract

Introduction. This study aimed to assess current stroke triage practices in the Medical Dispatch Unit (MPDJ) using the Croatian Emergency Call Reception Index, in order to identify areas for improvement in dispatcher training and caller awareness.

Methods. A retrospective analysis was conducted using data from the e-Hitna system of the Zagreb County Emergency Medical Institute for the year 2023. Triage categories "Headache" (A.18) and "Altered consciousness/paralysis" (A.25) were analyzed in relation to confirmed stroke diagnoses based on ICD-10 codes (G45–G45.9, I60–I69.9). Statistical analysis included chi-square and Welch's t-test.

Results. A statistically significant association was found between the triage category "Altered consciousness/paralysis" and confirmed stroke diagnosis ($\chi^2 = 11.82$; $p < 0.001$). Many stroke patients were initially categorized under non-specific symptoms. No significant sex difference was observed in triage allocation ($p = 0.9508$), while women were significantly older than men ($p < 0.001$).

Conclusion. Findings highlight the need for enhanced dispatcher education and public awareness on stroke symptoms. Improvements in stroke recognition protocols and follow-up with clinical outcomes are recommended to ensure more accurate and timely prehospital triage.

Introduction

The Medical Dispatch Unit (MPDJ) plays a critical role in the prehospital emergency care system, particularly in the recognition and triage of stroke cases. Stroke is a time-sensitive emergency in which every minute from the onset of symptoms to medical intervention can significantly impact patient outcomes (1). Dispatchers in the MPDJ serve as the first point of contact with emergency medical services, and their ability to recognize symptoms and make accurate triage decisions determines the speed of medical response and the eventual clinical outcome (2). Recognition of stroke during an emergency call is based on the assessment of symptoms described by the caller. The dispatcher must then quickly determine the urgency level and appropriate type of response (1). The effectiveness of this process can greatly influence the availability of reperfusion therapies, such as thrombolysis and mechanical thrombectomy, which are time-sensitive and require immediate intervention (3).

Furthermore, research indicates that public awareness of stroke symptoms significantly affects the timeliness of seeking medical help. Studies conducted in the United States and Canada have shown that public education campaigns can increase the proportion of individuals who recognize symptoms and promptly contact emergency services (4,5). Although early recognition of symptoms is considered crucial for timely hospital arrival, numerous challenges exist in practice regarding the identification of stroke signs among the general public. A British study showed that some citizens misinterpret or fail to recognize basic symptoms despite awareness campaigns such as the FAST test (6). A systematic literature review also highlights significant disparities in stroke knowledge among the general population, which affects response times and emergency call activation (7).

Therefore, the aim of this study was to examine the association between selected dispatch triage criteria and final stroke diagnoses in the Medical Dispatch Unit, to describe the distribution of stroke-related triage codes with respect to age, sex and caller type, and to identify potential areas for improving stroke recognition during emergency calls.

Theoretical Framework: Triage and Classification of Emergency Medical Calls

The Medical Dispatch Unit uses structured triage systems to ensure standardized and efficient assessment of call urgency. Since 2011, Croatia has implemented the Croatian Emergency Call Reception Index, developed based on the model of the Norwegian Index for Emergency Medical Assistance (8). This index defines the criteria and categories for emergency medical calls and ensures a uniform classification methodology across all counties (8,9). In contrast to strictly algorithmic systems such as the Medical Priority Dispatch System (MPDS), the criteria-based approach used in the Croatian Index allows dispatchers greater flexibility in decision-making based on symptoms reported by the caller (10). Studies conducted in Norway show that criteria-based triage systems can predict the need for emergency medical interventions with high specificity, though sometimes with limited sensitivity (11).

Methods and Protocols for Stroke Recognition

Various standardized protocols are used to recognize stroke during emergency medical calls. The most commonly used include the Advanced Medical Priority Dispatch System (AMPDS) and the Medical Priority Dispatch System (MPDS), while in Europe, national indexes such as the Danish Index and the Norwegian Index are also applied (3). Additionally, targeted stroke assessment tools such as the FAST test (Face-Arm-Speech-Time) and the Cincinnati Prehospital Stroke Scale enable rapid evaluation of neurological deficits (3,4). It is important to distinguish the criteria-based approach, such as the Croatian Emergency Call Reception Index, from strictly protocol-driven systems like MPDS or AMPDS. While the criteria-based approach allows dispatchers more discretion in interpreting and making decisions based on the caller's description of symptoms, protocol-driven systems are based on predefined algorithms that must be followed consistently without deviation. This flexibility in criteria-based systems introduces greater subjectivity and variability in triage decisions, which may lead to under-recognition of certain conditions, including stroke. Research shows that using structured protocols can improve stroke recognition rates (12). For example, the Madrid-Direct protocol, specifically developed for stroke, demonstrated improved outcomes in early identification and routing of patients to appropriate healthcare facilities (12). However, these protocols are not flawless - their sen-

sitivity ranges from 41% to 83%, while positive predictive values vary between 24% and 88% (1,12).

Challenges in Stroke Recognition

Dispatchers face numerous challenges in their work, including limited information available during calls, variability in symptom presentation, and caller uncertainty. They often have very limited time for assessment, and uncertainty in symptom recognition may result in incorrect triage decisions (2). Moreover, research has shown that dispatchers without medical training have a lower stroke recognition rate compared to those with a healthcare background (10). Although classic stroke symptoms are well known (e.g., unilateral weakness, speech disturbances), it is important to emphasize that stroke may also present with less specific symptoms such as dizziness, nausea, confusion, or general weakness. These atypical symptoms pose a particular challenge for dispatchers, especially when callers are not adequately informed or are unaware of the importance of accurately describing symptoms during the call. In practice, this highlights the necessity of educating not only dispatchers but also the general public, in order to reduce missed stroke cases during the early, critical phase of emergency calls. An additional problem is the lack of feedback to dispatchers regarding patient outcomes. Studies have shown that providing such feedback can significantly improve triage accuracy (13).

Overview of Previous Research

An analysis of previous studies indicates that the sensitivity of stroke recognition among dispatchers is relatively low and ranges from 18% to 83% (12). For example, a study conducted in Copenhagen found that only 66% of strokes were recognized during emergency calls, with a low positive predictive value (~30%) (14). Dispatcher education has proven to be one of the key factors in improving stroke recognition. A study conducted in the United Kingdom showed that specialized training increased the stroke recognition rate from 63% to 80% (15).

Stroke triage within the Medical Dispatch Unit represents a crucial step in the prehospital management of patients, and its effectiveness directly influences patient outcomes. Standardized protocols, dispatcher education, and public awareness campaigns about stroke are essential for improving symptom recognition and optimizing the allocation of emergency medical service resources. Nonetheless, further research is needed to develop more accurate triage tools and enhance the decision-making processes of dispatchers.

Aim

This study aimed to assess current stroke triage practices in the Medical Dispatch Unit (MPDJ) using the Croatian Emergency Call Reception Index, in order to identify areas for improvement in dispatcher training and caller awareness.

Methods

Study Design

This study was conducted as a retrospective analysis of data collected via the *e-Hitna* system for the period from January 1 to December 31, 2023. This one-year period was chosen to enable a comprehensive analysis that accounts for potential seasonal variations in the incidence of emergency medical conditions, including fluctuations in the occurrence of stroke throughout the year. It is important to note that, as of March 27, 2024, a revised version of the Croatian Emergency Medical Call Reception Index has been implemented, with restructured triage criteria that may affect data comparability in future analyses. In the revised Index, several criteria within chapters A.18 and A.25 were reworded, regrouped and assigned different urgency levels, which limits direct comparability of triage patterns before and after this change. For this reason, the year 2023 was selected for analysis to ensure consistency within a single triage framework, enabling uniform interpretation of the data. The study analyzed data from the Medical Dispatch Unit (MPDJ) of the Emergency Medical Institute of Zagreb County, aiming to examine the association between selected triage criteria and final diagnoses.

Data Source

The data used in this research were extracted from the *e-Hitna* system and include all emergency calls received by the MPDJ during the observation period. General call statistics were analyzed (number, type, urgency level), along with assigned triage chapters

according to the Croatian Emergency Medical Call Reception Index. Particular attention was given to data within the following two triage categories:

- Chapter 18: Headache (triage criteria A.18.01 – A.18.07)
- Chapter 25: Altered consciousness/paralysis (triage criteria A.25.01 – A.25.09)

The analysis included all criteria within these predefined ranges (A.18.01–A.18.07 and A.25.01–A.25.09), as they represent the core high-priority triage codes routinely used in MPDJ practice for the recognition of potentially time-critical neurological presentations. Criteria outside these ranges (A.18.08–A.18.10 and A.25.10–A.25.11) were not included, as they correspond to infectious, abdominal, metabolic, traumatic or other non-neurological presentations and therefore fall outside the analytical scope of this study. A detailed overview of all included and excluded criteria, together with justifications, is provided in Supplementary Table S1.

For each observed triage criterion, the primary patient diagnoses were analyzed in detail according to the International Classification of Diseases (ICD-10) for each call and correlated with the selected triage criteria. Cumulative data were also reviewed regarding the type of caller (family member, healthcare professional, bystander) in relation to the selected triage criteria, with the aim of evaluating the potential influence on triage card selection. As caller type data are not available at the individual ICD diagnosis level, this analysis was limited to the triage category level.

Subsequently, the patients' primary diagnoses were analyzed based on the following ICD-10 codes:

- G45–G45.9 – Transient ischemic attacks
- I60–I69.9 – Cerebrovascular diseases (stroke, intracerebral and subarachnoid hemorrhage, stroke sequelae)

Patient diagnoses were reviewed using medical records, and the triage criteria selected at the time of the emergency call, together with the intended purpose of the dispatch, were subsequently examined. Although patients typically do not call for themselves, and symptoms are interpreted by the caller, an analysis of age and gender differences among patients with stroke was conducted to identify potential variations in triage patterns. The focus of the research remains on the analysis of reported symptoms and their influence on triage card selection.

Ethics

The research was conducted in accordance with applicable ethical principles and data protection regulations. The data used in the analysis were extracted from the *e-Hitna* system without access to any personally identifiable patient information. All records were anonymized prior to analysis and processed exclusively in aggregate form.

According to Croatian national regulations and institutional policy, retrospective analyses of fully anonymised operational EMS data that do not involve direct contact with patients or any influence on patient care are exempt from the requirement for formal ethics committee approval. The dataset used in this study meets all criteria for this exemption.

Written permission for the use of e-Hitna system data for scientific purposes was obtained from the Director of the Emergency Medical Institute of Zagreb County. The study was conducted in compliance with GDPR and the principles of the Declaration of Helsinki.

Statistics

Statistical analysis was performed using descriptive statistical methods to present the distribution of triage categories, the frequency of specific symptoms, and the age distribution of patients. Differences between categorical variables were analyzed using the chi-square test (χ^2), while differences in means between two independent groups were assessed using Welch's t-test due to potential inequality of variances between groups. For contingency tables with small expected cell counts, Fisher's exact test was additionally calculated to verify the chi-square results. The level of statistical significance was set at $p < 0.05$. Descriptive analyses were conducted using Microsoft Excel (with the Analysis ToolPak add-in), while inferential statistical tests (χ^2 test and Welch's t-test) were calculated using the online tool Social Science Statistics (https://www.socscistatistics.com/tests/).

Results

General Statistics of Received Calls

During the observed period from January 1 to December 31, 2023, the Medical Dispatch Unit (MPDJ) of the Emergency Medical Institute of Zagreb County received a total of 60,120 calls. These calls were categorized into four main groups: interventions, consultations, other calls, and nuisance calls (as shown in Table 1).

Table 1. **Categories of calls received by MPDJ ZZHM ZŽ in 2023**

Type of Call	Number of Calls	Percentage (%)
Interventions	26 927	44.79%
Consultations	12 199	20.29%
Other	20 767	34.54%
Nuisance	227	0.38%
Total	**60 120**	**100.00%**

The majority of calls resulted in emergency medical interventions (n = 26,927; 44.79%), while consultation calls totaled 12,199 (20.29%). Other calls—including administrative and non-urgent medical inquiries—accounted for 34.54% (n = 20,767). Nuisance calls, such as prank or inappropriate calls, made up 0.38% of the total (n = 227).

Urgency Level of Intervention Calls

In 2023, out of the 26,927 calls that led to medical interventions, the highest proportion was classified as Priority II (yellow category), accounting for 59.81% of all interventions (n = 16,105). Priority I (red category), which denotes life-threatening conditions, was assigned in 31.46% of cases (n = 8,471). Priority III (green category), which includes less urgent conditions, comprised 8.73% of all interventions (n = 2,351), as shown in Table 2.

Most calls were assigned Priority II (yellow category), indicating a high urgency level, though not immediately life-threatening. At the same time, the significant share of Priority I (red category) calls suggests that over one-third of patients were assessed as being in a life-threatening condition already during emergency call triage.

Table 2. **Distribution of urgency levels for intervention calls in 2023**

Priority	Category (Color)	Number of Calls	Percentage (%)
Priority I	Red	8,471	31.46%
Priority II	Yellow	16,105	59.81%
Priority III	Green	2,351	8.73%
Total	–	**26,927**	**100.00%**

Distribution of Intervention Calls by Triage Chapters

The analysis of intervention call distribution according to selected triage chapters from the Croatian Emergency Call Reception Index reveals significant differences in the frequency of individual categories, as shown in Table 3. The highest number of intervention calls was recorded under the category "Unclear Problem" (n = 6,586; 24.47%), which includes calls where symptoms are not clearly defined but still require medical assessment. This was followed by "Respiratory Disorders" (n = 3,995; 14.83%) and "Chest Pain / Heart Disease" (n = 2,508; 9.31%), highlighting a high proportion of patients presenting with potential cardiovascular and respiratory emergencies. Within the scope of particular interest for this study, the category "Altered Consciousness / Paralysis" included 1,974 calls, while "Headache" was the leading symptom in 278 cases. These categories are crucial for analyzing the association between triage criteria and final diagnoses of cerebrovascular incidents.

Table 3. **Distribution of intervention calls by triage chapter in 2023**

Triage Chapter	Number of Calls	Percentage (%)
Unclear Problem	6,586	24.47%
Respiratory Disorders	3,995	14.83%
Chest Pain / Heart Disease	2,508	9.31%
Abdominal / Back Pain	2,330	8.65%
Psychiatry / Suicide	1,294	4.81%
Altered Consciousness / Paralysis	1,974	7.33%
Wounds / Fractures / Minor Injuries	1,521	5.65%
Convulsions	451	1.67%
Headache	278	1.03%
Other Chapters	5,990	22.24%
Total	**26,927**	**100.00%**

The results highlight the need to improve stroke symptom triage. The relatively low proportion of calls categorized under "Altered Consciousness/Paralysis" and "Headache" in comparison to the actual incidence of cerebrovascular events indicates potential shortcomings in recognizing key stroke symptoms during the emergency call phase.

Association Between Triage Categories and Stroke Diagnosis

The association between triage criteria and primary stroke diagnoses was analyzed across a total of 278 calls categorized under the triage chapter "Headache" (A.18.01 – A.18.07) and 1,974 calls within the chapter "Altered Consciousness/Paralysis" (A.25.01 – A.25.09). From the total number of calls within these triage chapters, only those meeting the stroke-relevant criteria listed in Supplementary Table S1 were included in the analysis, while calls assigned to non-specific or non-neurological criteria within A.18 and A.25 were excluded.

Within the "Headache" chapter (Table 4), 26 out of 278 calls met specific criteria (A.18.01 – A.18.07). Among these, a stroke diagnosis was confirmed in 2 cases (7.69%), while in the remaining 24 cases (92.31%) other diagnoses were established.

In the "Altered Consciousness/Paralysis" chapter (Table 4), 1,154 of the 1,974 received calls involved specific criteria (A.25.01 – A.25.09). Of these, 1,120 calls with assigned final diagnoses coded according to ICD-10 were analyzed. Stroke (ICD-10 codes: G45–G45.9, I60–I69.9) was confirmed in 461 cases (41.16%), while other diagnoses were established in 659 cases (58.84%). The difference of 34 calls (between the number of observed criteria and analyzed diagnoses) arose from cases for which no ICD-10 diagnosis was subsequently recorded.

The higher prevalence of primary stroke diagnoses within the "Altered Consciousness/Paralysis" chapter compared to the "Headache" chapter suggests that headache alone is not a sufficiently specific predictor of stroke. The relatively low proportion of confirmed strokes in the "Headache" category (7.69%) compared to "Altered Consciousness/Paralysis" (41.16%) indicates the potential overestimation of headache severity as a primary indicator of stroke during emergency medical calls.

Statistical Analysis of the Association Between Triage Categories and Stroke Diagnosis

A Chi-square test, as shown in Table 5 and Table 6, was conducted to examine the association between the initially selected triage chapters ("Headache" and "Altered Consciousness/Paralysis") and the primary diagnosis of stroke. The results indicated a statistically significant difference between the two categories ($\chi^2 = 11.82$; $p < 0.001$), confirming that patients triaged under "Altered Consciousness/Paralysis" were significantly more likely to receive a primary diagnosis of stroke compared to those initially categorized under "Headache".

Yates' correction, which reduces the likelihood of overestimating values in tests with small sample sizes, also showed a statistically significant difference ($\chi^2 = 10.47$; $p = 0.001$).

The association between triage category and final stroke/TIA diagnosis remained statistically significant when tested with Fisher's exact test ($p < 0.001$).

Table 4. **Distribution of stroke diagnoses according to triage criteria**

Triage Criteria	Calls Meeting Triage Criteria	Transient Ischemic Attacks (G45-G45.9)	Cerebrovascular Diseases (I60-I69.9)	Other ICD-10 Diagnoses	Total ICD-10 Diagnoses Analyzed*
Headache (A.18.01 – A.18.07)	26	0	2	24	26
Altered Consciousness/ Paralysis (A.25.01 – A.25.09)	1,154	101	360	659	1,120

*The difference between the total number of calls meeting triage criteria (1,154) and those with analyzed ICD-10 diagnoses (1,120) is due to missing diagnoses in some cases.

Table 5. **Distribution of stroke diagnoses by triage criteria**

Triage Criteria	Stroke (G45-G45.9, I60-I69.9)	Other ICD-10 Diagnoses	Total
Headache (A.18.01 – A.18.07)	2	24	26
Altered Consciousness/Paralysis (A.25.01 – A.25.09)	461	659	1,120
Total	**463**	**683**	**1,146**

Taken together, these results confirm a strong association between triage chapter and stroke diagnosis, highlighting challenges in recognizing stroke in patients reporting headache as their primary symptom during emergency medical calls.

Table 6. **Chi-square test results for association between triage criteria and stroke diagnosis**

Statistical Test	Value	*p*-value
Chi-square (χ^2)	11.82	< 0.001
Chi-square with Yates' correction	10.47	0.001

The primary diagnosis of stroke was confirmed considerably more often in patients triaged under the "Altered Consciousness/Paralysis" chapter, while it appeared significantly less frequently in the "Headache" category.

These results indicate that headache as a primary symptom of stroke is relatively rarely confirmed as an accurate indicator, whereas "Altered Consciousness/Paralysis" proves to be a much more reliable predictor. This suggests that, in cases where headache is the main symptom, there may be an overestimation of its severity, while in other cases stroke may go unrecognized if additional neurological symptoms—such as paralysis or altered consciousness—are absent.

Education of dispatchers and the general public on recognizing atypical symptoms of stroke could contribute to more accurate urgency assessment and reduce the risk of stroke being overlooked during emergency medical calls.

Association Between Selected Triage Criteria and Stroke Diagnosis

The association between primary diagnoses indicative of possible stroke (ICD-10: G45-G45.9, I60–I69.9) and selected triage criteria within the chapters "Headache" (A.18.01 – A.18.07) and "Altered Consciousness/Paralysis" (A.25.01 – A.25.09) was analyzed. The results were compared with other triage criteria not directly associated with suspected stroke (Table 7-9).

Among the calls resulting in a primary stroke-related diagnosis, the "Headache" and "Altered Consciousness/Paralysis" criteria were selected in 463 cases. Of these, 101 cases were diagnosed as transient ischemic attack (G45–G45.9), and 362 as cerebrovascular diseases (I60–I69.9).

In the group of calls where other triage criteria were applied, a primary stroke diagnosis was assigned in 356 cases, of which 78 were classified as transient ischemic attack (G45–G45.9) and 278 as cerebrovascular diseases (I60–I69.9).

Table 7. **Distribution of stroke diagnoses by selected and other triage criteria**

Stroke Diagnosis	Headache and Altered Consciousness/ Paralysis Criteria	Other Triage Criteria
Transient Ischemic Attacks (G45–G45.9)	101	78
Cerebrovascular Diseases (I60–I69.9)	362	278
Total	**463**	**356**

Statistical Analysis of the Association Between Selected Triage Criteria and Stroke Diagnosis

A chi-square test was used to examine the association between the selected triage criteria ("Headache" and "Altered Consciousness/Paralysis") and the final stroke diagnosis. The statistical significance of the difference between two groups of tri-

Table 8. **Distribution results based on selected triage criteria and final stroke diagnosis**

Triage Criteria Used in MPDJ	Confirmed Stroke	No Stroke Diagnosed	Total
Headache/Altered Consciousness/Paralysis	463	683	1,146
Other Criteria	356	25,359	25,715
Total	**819**	**26,042**	**26,861**

age criteria was analyzed: selected criteria ("Headache" and "Altered Consciousness/Paralysis") versus all other triage criteria.

The results of the chi-square test showed an extremely high level of statistical significance (χ^2 = 5649.92; $p < 0.001$), clearly indicating a significant difference between the choice of triage criteria and the final diagnosis of stroke. Notably, 356 patients (43.5%) out of a total of 819 confirmed stroke diagnoses were not initially identified by dispatchers using specific criteria ("Headache" or "Altered Consciousness/Paralysis"), but were assessed using other, less specific criteria.

Table 9. **Chi-square test results for association between selected triage criteria and stroke diagnosis**

Statistical Test	Value (χ^2)	*p*-value
Chi-square (χ^2)	5649.92	< 0.001
Chi-square with Yates' correction	5636.73	< 0.001

Table 9 confirms a highly statistically significant difference between the selected triage criteria ("Headache" and "Altered Consciousness/Paralysis") and other criteria in relation to the assignment of a final stroke diagnosis ($p < 0.05$).

These findings highlight the urgent need for further dispatcher training on the early recognition of stroke symptoms, as well as a review and enhancement of existing triage criteria to improve stroke detection accuracy during emergency medical calls.

Analysis of Criteria Associated with Stroke Diagnosis

An additional analysis was conducted to examine the triage criteria selected in cases where the final primary diagnosis was a stroke (ICD-10 codes: G45–G45.9, I60–I69.9). The aim of the analysis was to identify the most frequently used triage criteria and to explore potential discrepancies in symptom perception between callers and emergency medical dispatchers.

Table 10 presents the distribution of triage criteria used for patients who were ultimately diagnosed

Table 10. **Most Frequently Used Triage Criteria in Confirmed Stroke Diagnoses**

Criterion	Description	Calls (I60–I69.9)	Calls (G45–G45.9)
A.05.08	Suspected red criterion (no additional data immediately available)	44	15
H.25.03	Sudden confusion/somnolence without known cause	27	11
H.25.04	Prolonged confusion/somnolence	24	1
H.05.01	Exhausted patient (unreliable/unclear data)	22	1
A.01.03	Unconscious adult, breathing	20	4
H.25.05	Sudden paralysis, rapidly resolves	19	11
H.05.10	Other yellow criterion (no appropriate criterion available in the Index)	15	8
H.05.06	Sudden dizziness with apparent physical weakness	14	6
H.05.09	Suspected yellow criterion (no additional data immediately available)	9	1
A.27.02	Severe difficulty breathing	7	1
A.05.09	Other red criterion (no appropriate criterion available in the Index)	5	2
A.09.04	Chest pain or discomfort – with breathing difficulty	4	1

Table 11. **Nonspecific Criteria Used in Confirmed Stroke Cases**

Criterion	Description	Calls (I60–I69.9)	Calls (G45–G45.9)
A.05.02	Conscious, weakness and near-syncope	1	1
H.14.06	Immunosuppression and fever	2	1
H.23.09	Back pain, partial loss of sensation in the legs	0	1
H.05.12	Communication difficulties and unclear situation	1	1
A.27.03	Barely able to speak due to breathing difficulty	1	2

with either cerebrovascular disease (I60–I69.9) or transient ischemic attack (G45–G45.9).

The most frequently used criteria for patients with a primary stroke diagnosis include those related to loss of consciousness (A.01.03), general signs of severe medical condition (A.05.08), and nonspecific symptoms such as confusion or dizziness (H.25.03, H.05.06). These findings suggest that stroke symptoms are often not recognized in their early stages and highlight the need for additional education of both callers and dispatchers.

Differences in Stroke Symptom Recognition

The analysis also showed that in some cases, callers reported nonspecific symptoms such as exhaustion, shortness of breath, or chest pain, which may result in insufficient suspicion of stroke during triage. Criteria such as "Sudden dizziness" (H.05.06) or "Sudden confusion/somnolence" (H.25.03) were found to be relatively common in cases of confirmed cerebrovascular disease but are not necessarily specific to stroke (as shown in Table 11).

The results of the analysis highlight a discrepancy between the symptoms reported by callers and the confirmed stroke diagnoses. The most commonly used criteria relate to general signs of severe medical conditions, whereas specific stroke symptoms such as paralysis or speech loss were reported in fewer cases. Callers sometimes focus on symptoms that are most subjectively noticeable to them, while stroke-specific symptoms may remain unreported or unrecognized.

These findings indicate the need for additional education on stroke symptom recognition among individuals calling emergency medical services. Timely recognition of key symptoms can improve patient outcomes and reduce the risk of delayed treatment.

Gender and Age Analysis of Triage Criteria

Gender and age analyses were conducted exclusively on patients with a confirmed stroke diagnosis (ICD-10: G45–G45.9, I60–I69.9). Within this subset of 819 patients, the triage criteria selected by dispatchers were examined to determine whether gender or age influenced the categorization of symptoms within the Croatian Emergency Call Reception Index. To assess the association between gender and assigned triage criteria, a chi-square (χ^2) test was performed using observed and expected values. Data from 419 men and 400 women were analyzed, as presented in Table 12.

The p-value from the χ^2 test was 0.951, indicating no statistically significant difference between men and women in the allocation of triage criteria ($p > 0.05$). These results suggest that gender does not influence the assignment of triage codes within the Croatian Emergency Call Reception Index, pointing to consistency in dispatcher assessment.

Table 12. **Distribution of triage criteria by gender in patients with confirmed stroke (n = 819)**

Triage category	Male (n = 419)	Female (n = 400)	Total
Headache (A.18.01–A.18.07)	1 (0.2%)	1 (0.3%)	2 (0.2%)
Altered consciousness/paralysis (A.25.01–A.25.09)	234 (55.9%)	227 (56.8%)	461 (56.3%)
Other criteria	184 (43.9%)	172 (43.0%)	356 (43.5%)
Total	**419**	**400**	**819**

Table 13. **Age Differences by Gender**

Gender	Mean Age	Standard Deviation (SD)	Number of Cases (n)
Male (M)	71.10	11.61	419
Female (F)	76.46	12.81	400

In addition to the gender distribution analysis, an age-related comparison was conducted (Table 13). It was found that female patients were, on average, older than male patients (M = 76.46, SD = 12.81 vs. M = 71.10, SD = 11.61). A Welch's t-test confirmed that the difference was statistically significant (t = -6.26, $p < 0.001$), indicating that female stroke patients were significantly older than their male counterparts.

Given the statistically significant age difference between genders, the finding is clinically relevant from an epidemiological perspective; however, it is unlikely to directly influence dispatcher decision-making, as triage assessments are based solely on caller-reported symptoms rather than patient demographics.

Discussion

The results of this study confirmed the importance of timely and accurate stroke triage within the Medical Dispatch Unit (MPDJ), highlighting key challenges in recognizing stroke symptoms based on information provided by the caller. Given that patients often do not call for themselves, but rather a third party reports the symptoms, the role of the dispatcher becomes crucial in decision-making based on the Croatian Emergency Call Reception Index. The study showed that certain triage criteria more frequently correlate with stroke diagnoses. However, in as many as 43.5% of stroke patients, the initial triage did not fall under the "Headache" or "Disturbance of Consciousness/Paralysis" categories but was classified under other, less specific criteria. This finding suggests the need to improve dispatcher assessment accuracy and optimize triage processes through further training for both dispatchers and the general public.

Dominant Triage Criteria in Stroke

Analysis of triage criteria distribution showed that stroke patients were most frequently categorized under the chapter "Disturbance of Consciousness/Paralysis" (A.25), with some cases classified under "Headache" (A.18), even though headache has rarely been shown to indicate stroke. This may point to imprecise symptom interpretation by either the caller or the dispatcher. A similar pattern was reported by Wenstrup et al. (3), who noted that structured triage protocols offer high specificity but variable sensitivity. This means that some symptoms may be misclassified, potentially resulting in missed stroke recognition and delays in patient care.

It is particularly noteworthy that patients assigned criteria such as "Sudden speech difficulties" (A.25.05) and "Sudden paralysis, rapidly returning to normal" (H.25.05) had a significantly higher likelihood of being diagnosed with stroke compared to those initially reporting only a headache. This distribution of triage criteria highlights the need for more precise communication during calls and additional dispatcher education to identify subtle, less pronounced and noticeable signs of neurological deficit, even when not explicitly recognized by the caller as stroke symptoms.

Misinterpreted Symptoms and Triage Challenges

One of the key findings of this research is that some patients later confirmed to have suffered a stroke were initially triaged under unrelated categories such as "Unclear problem" or "Headache." This suggests that the information obtained during the call may be subjectively interpreted by the caller, making accurate dispatcher assessment more challenging. Additionally, inter-dispatcher variability in evaluating certain symptoms may further influence triage decisions. Jamtli et al. (2) report that dispatchers often face limited information during emergency calls, and their interpretation of symptoms can depend on their experience, training, and the clarity of the caller's description. In

addition to dispatcher-related factors, caller characteristics - such as the clarity of symptom descriptions, emotional state and level of health literacy - may substantially influence how stroke symptoms are communicated and interpreted during the call.

Studies have shown that the sensitivity of stroke recognition by dispatchers ranges from 18% to 83% (14), which aligns with this study's findings, where certain symptoms were not identified as indicative of stroke. A particular challenge lies in the fact that stroke symptoms can be atypical or non-specific, making correct triage decisions more difficult. For example, in some cases, callers reported symptoms such as dizziness, confusion, or chest pain—symptoms not necessarily considered stroke-related by dispatchers but which ultimately led to a cerebrovascular diagnosis.

Gender and Age Differences in Reported Symptoms

The results of the chi-square test (χ^2 = 0.005, p = 0.951) showed no statistically significant difference in the allocation of triage criteria between male and female patients. The notably high p-value further supports the conclusion that the patient's gender does not influence the dispatcher's decision when categorizing stroke within the Croatian Emergency Call Reception Index. These findings are consistent with previous research showing that dispatchers primarily base their decisions on the symptoms described by the caller rather than on the patient's demographic characteristics (4).

However, it is known that women more frequently present with atypical stroke symptoms such as nausea, faintness, and general weakness, which can make early recognition in the prehospital phase more difficult (16). Since dispatchers lack visual contact with the patient, their assessment fully relies on the information provided by the caller. This can lead to variability in symptom descriptions and potentially to underestimation of atypical stroke presentations in women. Although the results of this study did not indicate a significant difference in triage categorization by gender, further research is needed to examine whether unconscious bias may influence the triage assessment of symptoms in men and women.

The analysis of age differences revealed a statistically significant disparity between male and female patients (t = -6.26, p < 0.001). The average age of stroke patients was 71.10 years for men and 76.46 years for women, indicating that women tend to experience stroke at an older age. This pattern aligns with previous research suggesting that women are more likely to suffer strokes later in life, a trend attributed to longer life expectancy, delayed exposure to vascular risk factors, and differing hormonal influences (17). However, given that dispatchers do not see the patient and rely entirely on caller-reported symptoms, this age difference is unlikely to have a direct impact on real-time triage decision-making. In the context of emergency calls, the caller's interpretation and communication of symptoms represent a far more influential factor than demographic characteristics of the patient.

Nevertheless, since patients most often do not call emergency services themselves, and symptoms are typically reported by a third party, the key factor in stroke recognition is not necessarily the patient's age but the way in which the caller describes the symptoms. These findings are consistent with the claims of Jamtli et al. (2), who emphasize that the caller's subjective interpretation of symptoms can have a greater impact on dispatcher decisions than the patient's clinical presentation itself.

Limitations of the Study

Due to the retrospective design, the analysis was limited to data available within the *e-Hitna* system. This means it was not possible to control for the accuracy or completeness of symptom descriptions provided by callers during emergency calls. The subjective interpretation of symptoms by callers can significantly influence the dispatcher's final triage decision, which constitutes an important methodological limitation. Furthermore, the study did not include follow-up of hospital diagnoses or clinical outcomes, which would allow for a more accurate assessment of triage decision validity. Future studies should consider linking MPDJ data with final hospital diagnoses and patient outcomes to enable a more detailed evaluation and potential improvement of existing triage protocols. An additional limitation concerns the unequal size of the analysed groups, particularly the small number of cases in the Headache category compared with Altered Consciousness/Paralysis and other triage codes. This imbalance may reduce statistical power for some comparisons and increase the uncertainty around effect estimates, despite the use of appropriate tests (e.g., Welch's t-test and Fisher's exact test) to account for

these differences. In addition, multivariable modelling techniques, including logistic regression, could not be applied. Essential predictor variables such as age, sex and caller-related characteristics were available only for patients with confirmed stroke diagnoses, and not for the full set of emergency calls. Applying regression under such constraints would compromise the validity and interpretability of the results. For this reason, the analysis was limited to descriptive statistics and bivariate tests, which were methodologically appropriate given the structure of the available data.

Methodological Implications

The findings of this study may serve as a foundation for improving prehospital stroke triage within MPDJ operations. Identifying the most frequently used triage cards and comparing them with primary diagnoses provides insight into potential gaps in recognizing stroke during emergency medical calls. The results highlight the need to educate not only dispatchers but also the general public about stroke symptoms and the importance of clear, timely communication during emergency calls.

Practical Implications and Recommendations

The findings of this study point to several key areas for improving stroke recognition in Medical Dispatch Units. First and foremost, dispatcher training should include specialized modules focused on identifying atypical stroke symptoms such as dizziness, nausea, and transient confusion. In addition, enhancing communication strategies—for example, through the implementation of specific questions regarding neurological deficits—could improve triage accuracy. In practice, dispatcher training should incorporate simulation scenarios based on real-life cases involving atypical stroke presentations. For example, workshops where dispatchers listen to real emergency call recordings and then discuss the appropriateness of the triage decisions made could significantly improve their ability to recognize atypical symptoms.

Furthermore, dispatchers should receive regular feedback from hospital staff on the final diagnoses of patients they triaged. This would enhance their clinical judgment and support continuous quality improvement.

Further research should examine the effectiveness of educational interventions and the potential implementation of additional diagnostic algorithms within medical dispatch systems, in order to reduce the number of unrecognized strokes. Additionally, raising public awareness about stroke symptoms could decrease the number of inaccurate symptom presentations, thereby facilitating the work of dispatchers.

Final Thought

Stroke triage within the Medical Dispatch Unit is a complex process in which callers and dispatchers—not patients—play a central role. The findings of this study demonstrated that certain triage criteria are more frequently associated with confirmed stroke diagnoses, while others remain underrecognized. These insights underscore the need to improve dispatcher education and communication strategies in order to enhance out-of-hospital stroke recognition and ensure timely intervention for affected patients.

Conclusion

The analysis provided insight into how stroke-related symptoms are categorized during emergency medical calls and highlighted the crucial role of dispatchers in early recognition. Triage criteria within the chapter "Altered Consciousness/Paralysis" (A.25) were most strongly associated with confirmed stroke diagnoses, whereas headache-related criteria rarely indicated stroke. A considerable proportion of stroke cases were initially assigned to less specific triage chapters, underscoring the challenges posed by caller-reported symptoms and the complexity of identifying neurological deficits in the prehospital phase.

These findings point to the need for enhanced dispatcher training focused on recognising atypical and unspecific stroke presentations, as well as continued public education to improve the accuracy of symptom reporting during emergency calls. Strengthening communication strategies, together with systematic feedback from hospital outcomes, may contribute to more accurate triage and reduce the likelihood of missed strokes. Improving dispatcher competencies and public awareness represents a key step toward optimizing prehospital stroke pathways and supporting timely intervention.

Author contributions

Conceptualization and methodology (SP); data curation and formal analysis (SP); investigation and project administration (SP); Supervision (BV); writing – original draft (SP); writing – review & editing (IP, BV). All authors have approved the final manuscript.

Conflict of interest

The authors declare no conflict of interest.

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Supplementary file

Table S1. **Included triage criteria from Chapters A.18 and A.25 (with justification)**

Chapter	Code	Description	Included	Justification
A.18	A.18.01	Ne reagira na protresanje i pozivanje	Yes	Included in analytical scope (A.18.01–A.18.07)
A.18	A.18.02	Abnormalno ili otežano disanje	Yes	Included in analytical scope
A.18	A.18.03	Iznenadna jaka, neuobičajena glavobolja	Yes	Included in analytical scope
A.18	A.18.04	Glavobolja + mučnina	Yes	Included in analytical scope
A.18	A.18.05	Glavobolja + paraliza	Yes	Included in analytical scope
A.18	A.18.06	Glavobolja + otežani govor	Yes	Included in analytical scope
A.18	A.18.07	Glavobolja + smušenost	Yes	Included in analytical scope
A.18	A.18.08	Temp >38.5 °C + ukočen vrat	No	Infectious etiology; outside analytical scope
A.18	A.18.09	Temp >38.5 °C + osip	No	Infectious etiology; outside analytical scope
A.18	A.18.10	Konvulzije	No	Seizure-related; outside analytical scope
A.25	A.25.01	Ne reagira na pozivanje	Yes	Included in analytical scope (A.25.01–A.25.09)
A.25	A.25.02	Otežano disanje	Yes	Included in analytical scope
A.25	A.25.03	Iskrivljenje lica	Yes	Included in analytical scope
A.25	A.25.04	Gubitak snage u ruci/nogi	Yes	Included in analytical scope
A.25	A.25.05	Poteškoće u govoru	Yes	Included in analytical scope
A.25	A.25.06	Smetenost; sumnja na moždani udar	Yes	Included in analytical scope
A.25	A.25.07	Nagla jaka glavobolja	Yes	Included in analytical scope
A.25	A.25.08	Slabost pri svijesti	Yes	Included in analytical scope
A.25	A.25.09	Hladni i oznojeni	Yes	Included in analytical scope
A.25	A.25.10	Abdominalna bol	No	Non-neurological; outside analytical scope
A.25	A.25.11	Ubrzan puls; slabost	No	Non-neurological; outside analytical scope