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Use of ambulance services for patients with suspected stroke

ORIGINAL ARTICLE

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Background

In Norway, Emergency Medical Communication Centres (EMCCs) are responsible for ensuring appropriate medical assistance for time-critical illness and injury, while also prioritising the allocation of available ambulance resources. This study examined the relationship between EMCC dispatches for suspected stroke, the number of patients discharged with a stroke diagnosis, and the time to hospital admission and initiation of thrombolysis.

Material and method

We conducted a retrospective, descriptive study using anonymised data from the Norwegian Patient Registry and the Norwegian Stroke Registry for the period 2020–2023. We identified the number of EMCC dispatches for suspected stroke, the number of patients diagnosed with stroke, the proportion of stroke patients admitted to hospital within four hours of symptom onset, the proportion treated with thrombolysis, and the proportion receiving thrombolysis within three hours of symptom onset.

Results

EMCC dispatches for suspected stroke increased from 19,104 in 2020 to 29,426 in 2023, representing a rise of 10,322 dispatches (54 %). Over the same period, the number of patients diagnosed with stroke increased from 8934 to 8969 (35 cases; 0.4 %). The proportion of stroke patients admitted to hospital within four hours of symptom onset and the proportion treated with thrombolysis remained stable throughout the study period.

Interpretation

The increase in EMCC dispatches for suspected stroke during the study period was not due to a higher incidence of acute stroke in the population. The findings indicate that the increase was not associated with an increased proportion of stroke patients admitted to hospital within four hours, nor with an increased proportion of patients treated with thrombolysis or receiving thrombolysis within three hours.

Main findings

Between 2020 and 2023, EMCC dispatches for suspected stroke increased by 54 %. Over the same period, the number of patients diagnosed with stroke rose by only 0.4 %.

We found no evidence that the increased use of ambulance services improved key quality indicators for the treatment of stroke patients.

Emergency Medical Communication Centres (EMCCs) answer calls from the public to the medical emergency number 113, assess the need for urgent medical care and dispatch emergency services including ground ambulances,

ambulance boats and air ambulance services (1). Rapid and accurate identification of acute conditions by EMCCs reduces prehospital delays and can impact outcomes in time-critical conditions such as major trauma, myocardial infarction and stroke.

Assessing the need for urgent medical care by telephone is challenging (2). Calls concerning acute illness or injury are often complicated by callers' difficulty in providing accurate descriptions of events and clinical symptoms (3), which can lead to undertriage or overtriage. Undertriage is when an EMCC fails to dispatch appropriate or sufficient emergency resources, or when a call is given a lower priority (triage category) than warranted. Overtriage involves dispatching more emergency resources, or resources for a higher triage category, than necessary. A certain degree of overtriage is considered acceptable to minimise the risk of undertriage (2), but excessive overtriage can lead to overuse of emergency resources and increase the risk of incorrect prioritisation (4). Evidence on over- and undertriage by EMCCs is limited, and there is no consensus on acceptable thresholds (2).

Between 2018 and 2023, the number of calls to the medical emergency number 113 in Norway increased from 613,031 to 778,464 per year (27 %) (5). Over the same period, the total number of EMCC dispatches rose from 724,284 to 764,153 (6 %), and acute EMCC dispatches (suspected life-threatening illness or injuries) increased from 264,959 to 324,707 (22 %) (6). Both in Norway and across Europe, the proportion of older adults with complex healthcare needs is rising, while the shortage of healthcare personnel continues to grow (7, 8). Given the limited availability of ambulance services, appropriate prioritisation is needed to sustain service provision.

Stroke is a common condition in which the time from symptom onset to diagnosis and treatment has a critical impact on outcomes (9–12). Internationally, there is considerable variation in the sensitivity and specificity of stroke recognition by EMCCs for patients subsequently discharged with a stroke diagnosis (13). A recent Norwegian study reported high sensitivity for recognition of stroke (77 %), but a very low positive predictive value (PPV) (16 %) (14).

The aim of this study was to quantify the number of EMCC dispatches for suspected stroke and the number of patients discharged with a stroke diagnosis. We also investigated whether key quality indicators had changed, in terms of the proportion of stroke patients admitted to hospital within four hours of symptom onset, the proportion treated with thrombolysis, and the proportion receiving thrombolysis within three hours of symptom onset.

Material and method

This study is a descriptive, retrospective registry study based on anonymised data from the Norwegian Patient Registry and the Norwegian Stroke Registry. All calls from the public to the medical emergency number 113 in Norway are received and assessed by one of the 16 EMCCs, which are staffed by nurses or ambulance personnel with extra training (1). All EMCCs use the Norwegian

Index for Medical Emergency Assistance, a Criteria-Based Dispatch (CBD) protocol (15). The index is based on predefined criteria and comprises a start page with questions on vital functions, such as consciousness and respiration, as well as 41 symptom-specific criteria. Each criterion details relevant symptoms, the recommended emergency medical response and triage category, and provides guidance on first aid to be administered. Some criteria are non-specific, for example, 'Unspecified problem', while others are more diagnosis-specific, such as 'Chest pain' or 'Possible stroke/impaired consciousness'. Triage categories are classified as acute/red (manifest physiological or vital function failure), urgent/yellow (assessment needed for potential physiological or vital function failure), and routine/green (non-urgent conditions). The criteria for assessing stroke symptoms is shown in Figure 1 of the appendix (in Norwegian).

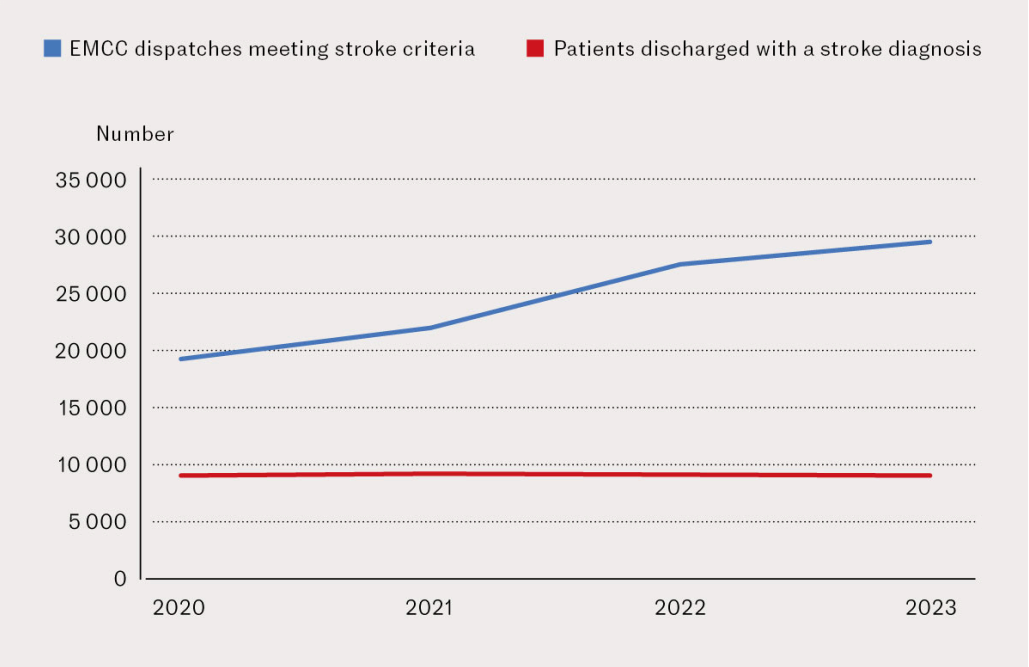

Figure 1 Number of EMCC dispatches for suspected stroke and number of patients discharged with a stroke diagnosis in Norway, 2020–2023, based on data from the Norwegian Patient Registry and the Norwegian Stroke Registry.

Norway's Acute Medical Information System (AMIS) functions both as an electronic patient record and as a dispatch management tool for EMCCs, and it reports anonymised incident data to the Norwegian Patient Registry. Incident data include the relevant criteria and triage category. For this study, data from 2020 to 2023 were extracted from a reporting system provided by the Norwegian Patient Registry. We identified all incidents in which EMCC operators had dispatched an ambulance based on a stroke criterion. The dataset was extracted using version 4 of the Norwegian Index for Medical Emergency Assistance.

As EMCC Oslo used version 3 of the index until 1 April 2022, the corresponding stroke criteria from version 3 were applied to data from this centre prior to 2022. A conversion table is provided in Table 1 of the appendix. To focus the study on calls where EMCC operators made independent assessments of the patient's condition, only incidents recorded via the medical emergency number 113 were included.

The Norwegian Stroke Registry is a national quality register for stroke. All Norwegian hospitals treating patients with acute stroke are required to report on adult patients discharged with a diagnosis of acute stroke (ICD-10 codes I61 – Intracerebral haemorrhage, I63 – Cerebral infarction and I64 – Stroke, not specified as haemorrhage or infarction). Data from the period 2020–2023 were included in the analysis. The number of patients discharged with a stroke diagnosis, by hospital, is presented in Table 2 of the appendix.

Each EMCC is responsible for a geographic area and its associated ambulance services; however, these areas do not always align with the catchment areas of acute hospitals. To enable comparison, we defined which hospitals fall within each EMCC area. The breakdown is shown in Table 3 of the appendix.

To assess changes in quality indicators related to the treatment of stroke patients, we examined the following: the proportion of patients with acute stroke admitted to hospital within four hours of symptom onset, the proportion treated with thrombolysis, and the proportion receiving thrombolysis within three hours of symptom onset (16).

To compare the number of patients discharged with a stroke diagnosis and the number of incidents meeting stroke criteria per 100,000 population, the population denominator was calculated based on the municipal-level catchment areas of hospitals and EMCCs (17). The Regional Committee for Medical and Health Research Ethics (REK South-East) concluded that the project did not require ethical approval under the Norwegian Health Research Act.

Results

The number of EMCC dispatches for suspected stroke increased from 19,104 in 2020 to 29,426 in 2023, representing a rise of 10,322 dispatches (54 %). Over the same period, the number of patients diagnosed with stroke rose from 8934 to 8969 (35 cases; 0.4 %). The number of EMCC dispatches meeting stroke criteria relative to patients discharged with a stroke diagnosis is shown in Figure 1. During the study period, all EMCCs except for one showed an annual increase in dispatches for suspected stroke. From 2020 to 2023, the increase in these dispatches ranged from 13 % to 90 %, while EMCC Finnmark recorded a 5.9 % decrease. Changes broken down by EMCC are illustrated in Figure 2, and in Table 4 of the appendix.

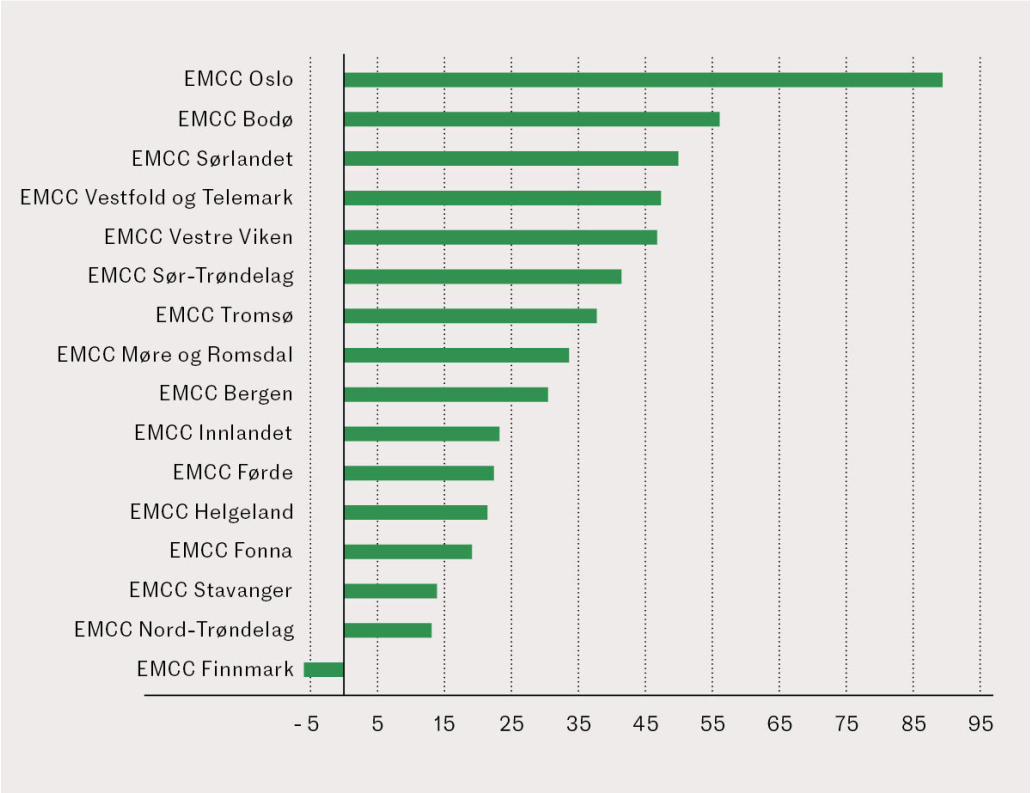

Figure 2 Percentage change in the number of EMCC dispatches for suspected stroke from 2020 to 2023, by EMCC.

The number of EMCC dispatches meeting stroke criteria relative to patients discharged with a stroke diagnosis varied across EMCC areas by a factor of 1.5 to 5.2. The national average was 2.7. The distribution across EMCCs for 2023 is shown in Figure 3.

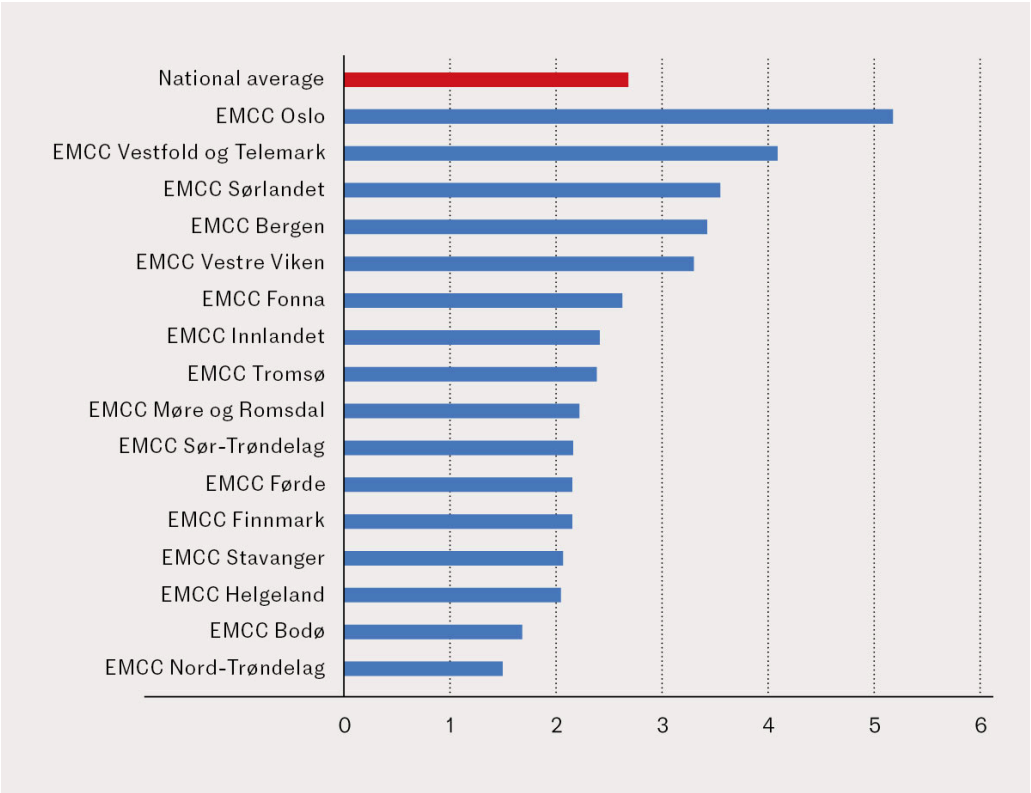

Figure 3 Number of EMCC dispatches for suspected stroke per patient discharged with a stroke diagnosis in 2023, by EMCC.

As shown in Table 1, data from the Norwegian Stroke Registry indicate that during the study period there were only minor changes in the proportion of patients with acute stroke who were admitted to hospital within four hours of symptom onset, patients treated with thrombolysis, and patients receiving thrombolysis within three hours of symptom onset.

Discussion

Between 2020 and 2023, we observed a substantial increase in the total number of EMCC dispatches for patients with suspected stroke, despite no change in the number of patients discharged with a stroke diagnosis. There was no evidence that this increased use of ambulance resources impacted on key quality indicators, in terms of the proportion of stroke patients admitted to hospital within four hours of symptom onset, patients treated with thrombolysis, and thrombolysis initiated within three hours of symptom onset.

Almost all EMCCs reported increases in EMCC dispatches for suspected stroke, though with considerable variation between centres. EMCC Oslo showed the largest increase, dispatching more than five ambulances per patient ultimately diagnosed with stroke, while EMCC Nord-Trøndelag only dispatched 1.5 ambulances per diagnosed patient. The EMCC Oslo findings are consistent with a previous study at this centre, which showed a PPV for stroke recognition of 16 % (14). EMCC Bergen experienced approximately a 30 % increase in dispatches for suspected stroke, while the number of patients discharged with a stroke diagnosis in this area decreased by 5 % over the same period, consistent with an earlier study at this centre (18).

High sensitivity has been a central focus in most studies on stroke recognition in EMCC, as it is assumed to reduce prehospital delays and thereby increase the proportion of patients treated with thrombolysis (13). It is therefore notable that the proportion of stroke patients admitted to hospital within four hours of symptom onset remained stable. Similarly, although there was a slight increase in the proportion of cerebral infarction patients treated with thrombolysis in 2023, there was no corresponding increase in the proportion receiving treatment within three hours of symptom onset, the window during which thrombolysis is most effective (19).

Given that both the overall number of strokes and the number of patients admitted to hospital within four hours remained stable during the study period, neither the observed increase in EMCC dispatches nor the variations between EMCCs can be explained by changes in stroke incidence. Multiple factors are likely to influence EMCC operators' assessments and contribute to overtriage. The fact that EMCC Oslo had both the largest increase in EMCC dispatches for suspected stroke and the highest number of dispatches relative to the number of patients discharged with a stroke diagnosis makes it particularly interesting to consider potential underlying causes.

EMCC Oslo is the largest EMCC in Norway, serving a population of approximately 1.7 million. In 2023, more than 260,000 calls were made to the medical emergency number 113, in addition to a large number of other

enquiries. Previous studies have shown that workload at this centre has been high, leading to shorter assessment time intervals – the time interval from receipt of an emergency call to the decision on the appropriate emergency medical response. For instance, the assessment time interval for stroke patients not identified by the EMCC dispatchers was only 55 seconds. The high workload also meant that dispatchers rigidly followed the Norwegian Index for Medical Emergency Assistance without making independent clinical judgements, and that they rarely received feedback on whether their assessments of symptoms, severity and triage category were accurate (14, 20).

In the period 2020–2023, several research projects were undertaken to improve stroke recognition within both EMCC Oslo and the Ambulance Service in Oslo (14, 20, 21). Although it is difficult to demonstrate any definite association between these studies and the observed overtriage, it is likely that training and involvement in these research initiatives influenced operators' tendency to suspect stroke.

The Norwegian Stroke Registry is a quality register with high validity and reliability, but it does not include patients discharged with transient ischaemic attack (TIA). TIA is defined as a clinical event with sudden, ischaemia-related focal neurological deficits that fully resolve within 24 hours (22). EMCC dispatchers are rarely able to distinguish patients with TIA from those with other acute stroke symptoms, as EMCCs are typically contacted shortly after symptom onset. In most studies of stroke recognition at EMCCs, stroke patients are collectively defined to include both stroke and TIA, making it difficult to estimate the proportion of each (18, 23–25). Nevertheless, two Norwegian studies indicate that patients with TIA account for approximately 20 % of all patients with suspected stroke (14, 26).

Although the medical emergency number 113 is primarily used by the public to contact EMCCs, general practitioners (GPs) also use it to request ambulance services for patients they consider in need of urgent care. In a previous study verifying calls to EMCCs via 113, patients referred from GP offices accounted for approximately 8 % of all incidents meeting stroke criteria (14). This study does not assess the sensitivity of stroke recognition at EMCCs. Despite these limitations, it provides new and important insights into whether increased use of ambulance services leads to improvements in key quality indicators for the treatment of stroke patients. The identified limitations are likely consistent over time and therefore have minimal impact on the observed increase in EMCC dispatches. It is also possible to adjust for the limitations. This approach could likely be applied to other patient groups with diagnosis-specific quality registries that correspond to the Norwegian Index for Medical Emergency Assistance, providing a basis for future research.

Analysis of anonymised registry data revealed a substantial increase in EMCC dispatches in which EMCCs suspected stroke from 2020 to 2023, which cannot be explained by an increased incidence of acute stroke in the population. There was no evidence that this increase impacted on the proportion of stroke patients admitted to hospital within four hours of symptom onset, patients treated with thrombolysis, or thrombolysis initiated within three hours of

symptom onset. The findings therefore indicate a marked increase in resource use, without a corresponding improvement in key quality indicators for the treatment of stroke patients.

The article has been peer-reviewed.

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