

# Missed Ischemic Stroke Diagnosis in the Emergency Department by Emergency Medicine and Neurology Services

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**Background and Purpose**—The failure to recognize an ischemic stroke in the emergency department is a missed opportunity for acute interventions and for prompt treatment with secondary prevention therapy. Our study examined the diagnosis of acute ischemic stroke in the emergency department of an academic teaching hospital and a large community hospital.

**Methods**—A retrospective chart review was performed from February 2013 to February 2014.

**Results**—A total of 465 patients with ischemic stroke were included in the analysis; 280 patients from the academic hospital and 185 patients from the community hospital. One hundred three strokes were initially misdiagnosed that is 22% of the included strokes at the combined centers. Fifty-five of these were missed at the academic hospital (20%) and 48 were at the community hospital (26%,  $P=0.11$ ). Thirty-three percent of missed cases presented within a 3-hour time window for recombinant tissue-type plasminogen activator eligibility. An additional 11% presented between 3 and 6 hours of symptom onset for endovascular consideration. Symptoms independently associated with greater odds of a missed stroke diagnosis were nausea/vomiting (odds ratio, 4.02; 95% confidence interval, 1.60–10.1), dizziness (odds ratio, 1.99; 95% confidence interval, 1.03–3.84), and a positive stroke history (odds ratio, 2.40; 95% confidence interval, 1.30–4.42). Thirty-seven percent of posterior strokes were initially misdiagnosed compared with 16% of anterior strokes ( $P<0.001$ ).

**Conclusions**—Atypical symptoms associated with posterior circulation strokes lead to misdiagnoses. This was true at both an academic center and a large community hospital. Future studies need to focus on the evaluation of identification systems and tools in the emergency department to improve the accuracy of stroke diagnosis. (*Stroke*. 2016;47:668-673. DOI: 10.1161/STROKEAHA.115.010613.)

**Key Words:** community hospitals ■ diagnosis ■ diagnostic error ■ dizziness ■ stroke

The failure to recognize an ischemic stroke in the emergency department (ED) is a missed opportunity for acute interventions and for prompt treatment with secondary prevention therapy. Current guidelines recommend intravenous recombinant tissue-type plasminogen activator (r-tPA)  $\leq 4.5$  hours in select patients, and recent data have shown that patients with large vessel occlusion may benefit from early recanalization with stent-retrieval devices.<sup>1-4</sup> In addition, patients with missed strokes may not be monitored appropriately for neurological progression of stroke syndromes or stroke-related complications. Swift diagnosis is critical to offer treatments and achieve the best long-term outcomes. Despite this, a subset of acute ischemic strokes go unrecognized in the ED.

The clinical and radiographic patterns of stroke patients with a missed diagnosis have not been well characterized. Our institution previously linked misdiagnosed strokes to nontraditional symptoms, such as nausea/vomiting, altered mental status, dizziness, and fall.<sup>5</sup> These symptoms are more common in posterior circulation strokes, and young patients  $<35$  years of age with posterior circulation strokes may be more frequently

misdiagnosed.<sup>6,7</sup> Furthermore, there are a significant subset of patients who present to the ED within the 30-day period before their stroke are discharged with a noncerebrovascular diagnosis.<sup>8</sup> Many patients with stroke are instead diagnosed with having another medical condition or stroke chameleon. The most common chameleons are hypertensive emergency, syncope, or infection.<sup>9-11</sup>

Our study examined the diagnosis of acute ischemic stroke in the ED of an academic teaching hospital and a large community hospital. Each hospital has a distinct process by which it evaluates acute ischemic stroke. We evaluated confirmed cases of stroke at these 2 centers, to find any common clinical and radiographic characteristics of missed strokes. We sought to determine whether the characteristics of missed strokes differ between the academic and community setting.

## Methods

### Study Design

A retrospective chart review was performed on all patients with a discharge diagnosis of ischemic stroke during a 1-year period from

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February 2013 to February 2014. Two separate hospitals were included in the study. One is a large academic teaching hospital with nearly 1600 patient beds. It is affiliated with a medical school, has a neurology residency program, is a certified stroke center, and sees >1000 acute stroke codes in the ED each year. A neurology resident is typically the first responder to acute stroke codes. The other hospital is a regional referral community hospital with 665 patient beds. It is also a certified stroke center and sees around 200 acute stroke codes in the ED each year. An ED physician initially leads the stroke codes until a neurologist is available. Both the hospitals use electronic medical records.

Patients were initially identified from the discharge billing codes (*International Classification of Diseases Ninth Revision* codes 433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, and 436). Subjects were then included in the study if they were >18 years of age, admitted to the hospital with a primary discharge diagnosis of stroke, and had an ischemic stroke confirmed on computed tomography or magnetic resonance imaging. Patients were excluded if they had a clinical transient ischemic attack without imaging correlation, primary intracerebral hemorrhage, were transferred from an outside hospital after a stroke diagnosis was already suspected, or if they had a venous infarct. Imaging findings were confirmed by a radiologist.

All patient charts were reviewed by a neurologist. Demographic data, stroke risk factors, and medications were recorded at baseline. Initial stroke signs and symptoms were extracted from the neurologist's consultation note. If this was not available, an ED physician's evaluation was used. At the academic center, neurology and ED notes were written by residents, with an attending physician cosignature. At the community hospital, all notes were written by an attending physician.

A symptom was considered present if the patient complained about it or if it was found on initial examination. Initial National Institutes of Health Stroke Scale (NIHSS) scores were abstracted from the charted examination if it was not formally recorded. The stroke location of anterior versus posterior circulation was determined from the computed tomography or magnetic resonance imaging. Any questions about stroke location were forwarded and reviewed by a stroke neurologist.

Informed consent was not obtained by the patients, but all patient identifying information was removed before analysis. The study protocol was approved by the local institutional review board.

## Outcomes

The primary outcome was missed stroke. A stroke was "missed" if practitioners in the ED did not initially consider stroke in the differential, or the diagnosis was delayed causing the patient to miss the therapeutic window for thrombolytic therapy. A stroke was also considered missed if ED physicians consulted neurology for a possible stroke diagnosis, and neurology felt that the patient did not have a stroke and admitted the patient to a medicine service.

Other analyses included signs and symptoms that were associated with strokes misses, as well as stroke anatomic location and its relationship to stroke misses. Anatomic locations were divided into anterior circulation and posterior circulation. A stroke was considered anterior if it stemmed from the internal carotid artery or one of its branches. A posterior stroke was part of the vertebral artery vascular territory. If a patient had a mixed anterior and posterior circulation stroke then they were included in the anterior category.

## Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics (version 21) software package. All tests were 2-sided, and a *P* value was considered significant if it was <0.05. Logistic regression models were computed by first including all variables with a significant *P* value from univariate analysis, excluding those variables that were present in <5% of the population. This exclusion was done to avoid unstable models. Then a backward selection was performed, removing variables one-by-one until all remaining variables had a *P* value of <0.4. Basic demographic data were included in all regression

models, which is the standard practice of the authors of this article. The variables such as age, sex, and race were, therefore, included in all models regardless of *P* value.

## Results

A total of 465 patients with ischemic stroke were included in the analysis; 280 patients from the academic hospital and 185 patients from the community hospital. The average age of all patients was 72 years, and the patients were predominately white (Table 1). Systolic blood pressure was elevated among all groups, and 75% of all patients with stroke had a history of hypertension. Initial NIHSS score ranged from 0 to 33 with a mean of 7 at the academic hospital. At the community hospital, initial NIHSS score ranged from 0 to 27 with a mean of 6.

## Missed Strokes

One hundred three strokes were initially misdiagnosed, which is 22% of the included strokes at the combined centers. Fifty-five of these were missed at the academic hospital (20%). The remaining 48 were at the community hospital (26%, *P*=0.11). Thirty-three percent of missed cases of ischemic stroke presented within a 3-hour time window for r-tPA eligibility. An additional 11% presented between 3 and 6 hours of symptom onset for consideration of endovascular therapy. A greater percentage of missed strokes arrived at the academic hospital (28/55 or 51%) compared with the community hospital (17/48 or 35%) in time for consideration of lytics or endovascular therapy (*P*<0.001).

Of all missed cases of ischemic stroke at the academic hospital, 20 of 55 (35%) were seen by neurology in the ED but early diagnosis was still missed. Nine (45%) of these cases missed by neurology were presented within the time window for r-tPA, and an additional 3 (15%) were presented within 6 hours for endovascular therapy. In comparison, of all the accurate diagnoses, 213 of 225 (95%) were seen by neurology in the ED (*P*<0.001).

An acute stroke code protocol was initiated in the ED for 38% of all included patients. For missed strokes, only 8% were triaged as stroke codes. This is in comparison with accurate diagnoses, where 46% presented as stroke codes (*P*<0.001, Table 1). Patients who are out of the time window for intervention or clinical trial, and patients where acute cerebrovascular event is not part of the initial differential diagnosis, would not have an acute stroke code protocol initiated in the ED.

The initial NIHSS score was not recorded and not able to be abstracted from the charted examination in 10 patients at the academic hospital and 60 patients at the community hospital. All 10 of the patients at the academic hospital with uncharted neurology examinations were missed strokes. Therefore, 18% of the misses at the academic hospital did not have charted neurological exams. At the community hospital, 65% of patients without a documented neurology examination ended up having missed strokes. Of all the missed strokes at both hospitals, 40% of them were missing neurological examinations that included elements of the NIHSS, compared with 8% of the accurately diagnosed strokes (*P*<0.001).

In univariate analysis, the following signs and symptoms were associated with a missed stroke diagnosis (Table 2; Figure): headache, nausea/vomiting, dizziness, seizure, syncope, and difficulty walking. Conversely, these initial symptoms led to

**Table 1. Baseline Characteristics**

	Academic Hospital			Community Hospital			Combined Data			
	Missed Strokes (n=55)	Not Missed (n=225)	P Value	Missed Strokes (n=48)	Not Missed (n=137)	P Value	Total (n=465)	Missed Strokes (n=103)	Not Missed (n=362)	P Value
Mean age, y	71	72	0.674	72	74	0.553	72.3	71.5	72.6	0.543
Female, n (%)	25 (45)	127 (56)	0.142	24 (50)	77 (56)	0.458	253 (54)	49 (48)	204 (56)	0.114
White, n (%)	36 (65)	152 (68)	0.766	33 (69)	108 (79)	0.158	329 (71)	69 (67)	260 (72)	0.341
Initial SBP, mean	155	154	0.716	169	165	0.479	159	161	158	0.370
Former stroke, n (%)	21 (38)	39 (17)	0.001	11 (23)	28 (20)	0.717	99 (21)	32 (31)	67 (19)	0.006
HTN, n (%)	45 (82)	172 (76)	0.392	37 (77)	96 (70)	0.352	350 (75)	82 (80)	268 (74)	0.247
DM, n (%)	21 (38)	60 (27)	0.091	21 (44)	33 (24)	0.010	135 (29)	42 (41)	93 (26)	0.003
Afib/flutter, n (%)	12 (22)	63 (28)	0.353	5 (10)	24 (18)	0.244	104 (22)	17 (17)	87 (24)	0.106
HL, n (%)	22 (40)	90 (40)	1	22 (46)	60 (44)	0.807	194 (42)	44 (43)	150 (41)	0.816
CAD, n (%)	20 (36)	68 (30)	0.379	9 (19)	28 (20)	0.801	125 (27)	29 (28)	96 (27)	0.741
Current cancer, n (%)	3 (5)	17 (8)	0.588	6 (13)	5 (4)	0.026	31 (7)	9 (9)	22 (6)	0.340
Hypercoagulable, n (%)	5 (9)	15 (7)	0.531	4 (8)	5 (4)	0.194	29 (6)	9 (9)	20 (6)	0.234
Current smoker, n (%)	19 (35)	76 (34)	0.914	8 (17)	16 (12)	0.376	119 (26)	27 (26)	92 (25)	0.870
Heavy alcohol, n (%)	5 (9)	8 (4)	0.080	4 (8)	9 (7)	0.681	26 (6)	9 (9)	17 (5)	0.115
Illicit drug use, n (%)	3 (5)	7 (3)	0.401	1 (2)	0 (0)	0.09	11 (2)	4 (4)	7 (2)	0.251
Code in ED, n (%)*	5 (9)	129 (57)	<0.001	3 (6)	39 (28)	0.002	176 (38)	8 (8)	168 (46)	<0.001

Afib/flutter indicates atrial fibrillation or atrial flutter; CAD, coronary artery disease; DM, diabetes mellitus; HL, hyperlipidemia; ED, emergency department; HTN, hypertension; and SBP, systolic blood pressure.

\*Patient triaged as acute stroke code in ED.

an accurate stroke diagnosis: gaze preference, focal weakness including facial droop, focal numbness, aphasia, dysarthria, vision changes including hemianopia, and neglect.

Using binary logistic regression models, symptoms independently associated with greater odds of a missed stroke diagnosis were nausea/vomiting (odds ratio [OR], 4.02; 95% confidence interval [CI], 1.60–10.1), dizziness (OR, 1.99; 95% CI, 1.03–3.84), and a positive stroke history (OR, 2.40; 95% CI, 1.30–4.42). Conversely, certain symptoms were independently associated with a lower odds of a missed stroke diagnosis. These included focal weakness (OR, 0.396; 95% CI, 0.228–0.688), vision changes (OR, 0.377; 95% CI, 0.176–0.809), gaze preference (OR, 0.058; 95% CI, 0.007–0.452), and dysarthria (OR, 0.048; 95% CI, 0.288–0.004; Table 3).

### Stroke Location

Of all included strokes, 30% were in the posterior circulation and 70% in the anterior circulation. Thirty-seven percent of posterior strokes were initially misdiagnosed compared with 16% of anterior strokes ( $P<0.001$ ). In this population, posterior circulation strokes typically presented with difficulty in walking (41%), dizziness (34%), vision changes (31%), dysmetria (29%), headache (21%), and nausea/vomiting (16%, Table 4). Anterior circulation stroke symptoms included focal weakness (76%), dysarthria (42%), disorientation (34%), aphasia (34%), gaze preference (23%), lethargy (20%), and neglect (11%).

### Stroke Severity

The initial NIHSS was compared between missed and accurately diagnosed and between anterior and posterior

circulation strokes. At the academic center, the mean NIHSS score was 4.9 in missed stroke patients versus 7.3 in accurately diagnosed patients ( $P=0.042$ ). In the community hospital, the mean NIHSS was 2.8 and 6.4, respectively ( $P=0.076$ ). The NIHSS is classically skewed toward anterior circulation strokes. In our data, the mean NIHSS was 8.2 for anterior strokes versus 3.8 in posterior strokes ( $P<0.001$ ).

Patients from the academic center were also compared in terms of length of stay, discharge disposition, and readmission rates. Average length of stay was 6.9 days for misdiagnosed patients compared with 5.9 days for those correctly diagnosed ( $P=0.266$ , Table 5). Sixty-two percent of missed stroke patients were discharged home instead of to a long-term care facility. For accurately diagnosed patients, 56% were discharged home ( $P=0.465$ ). For readmission rates, 33% of misdiagnosed patients were readmitted at 60 days post discharge, compared with 17% of accurately diagnosed patients ( $P=0.012$ ).

### Discussion

Despite having certified stroke programs, >20% of acute ischemic strokes were missed in the ED in both the academic medical center and community regional referral hospital. Posterior circulation strokes were nearly 3× more likely than anterior strokes to be missed. The symptoms that were the biggest predictors of missed strokes—nausea/vomiting and dizziness—are frequently associated with posterior circulation strokes.

A significantly larger proportion of strokes were missed at the community hospital, but they also missed fewer strokes that presented within a clear time frame for intervention. Both the hospitals predominantly missed posterior circulation strokes, and they missed strokes that presented with atypical

**Table 2. Signs and Symptoms Associated With Missed Stroke Diagnosis**

	Academic Hospital			Community Hospital			Combined Data			
	Missed Strokes (n=55)	Not Missed (n=225)	P Value	Missed Strokes (n=48)	Not Missed (n=137)	P Value	Total (n=465)	Missed Strokes (n=103)	Not Missed (n=362)	P Value
Lethargy, n (%)	12 (22)	46 (20)	0.822	7 (15)	15 (11)	0.503	80 (17)	19 (18)	61 (17)	0.705
Disorientation, n (%)	20 (36)	62 (27)	0.198	14 (29)	37 (27)	0.773	133 (29)	34 (33)	99 (27)	0.262
Gaze preference, n (%)	1 (2)	60 (27)	<0.001	0 (0)	21 (15)	0.004	82 (18)	1 (1)	81 (22)	<0.001
Focal weakness, n (%)	26 (47)	178 (79)	<0.001	10 (21)	88 (64)	<0.001	302 (65)	36 (35)	266 (73)	<0.001
Focal numbness, n (%)	10 (18)	61 (27)	0.172	2 (4)	40 (29)	<0.001	113 (24)	12 (12)	101 (28)	0.001
Aphasia, n (%)	11 (20)	68 (30)	0.131	5 (10)	40 (29)	0.009	124 (27)	16 (16)	108 (30)	0.004
Dysarthria, n (%)	11 (20)	93 (41)	0.003	10 (21)	62 (45)	0.003	176 (38)	21 (20)	155 (43)	<0.001
Dysmetria, n (%)	6 (11)	10 (4)	0.064	8 (17)	18 (13)	0.545	42 (9)	14 (14)	28 (8)	0.067
Neglect, n (%)	1 (2)	28 (12)	0.020	1 (2)	11 (8)	0.150	41 (9)	2 (2)	39 (11)	0.005
HA, n (%)	6 (11)	10 (4)	0.064	15 (21)	24 (18)	0.045	55 (12)	21 (20)	34 (9)	0.002
N/V, n (%)	12 (22)	10 (4)	<0.001	8 (17)	6 (4)	0.006	36 (8)	20 (20)	16 (4)	<0.001
Dizziness, n (%)	15 (27)	14 (6)	<0.001	19 (40)	22 (16)	0.001	70 (15)	34 (33)	36 (10)	<0.001
Seizure, n (%)	2 (4)	3 (1)	0.248	4 (8)	0 (0)	0.001	9 (2)	6 (6)	3 (1)	0.001
Syncope, n (%)	2 (4)	2 (1)	0.124	4 (8)	2 (1)	0.021	10 (2)	6 (6)	4 (1)	0.004
Vision change, n (%)	7 (13)	62 (28)	0.022	6 (13)	19 (14)	0.811	94 (20)	13 (13)	81 (22)	0.030

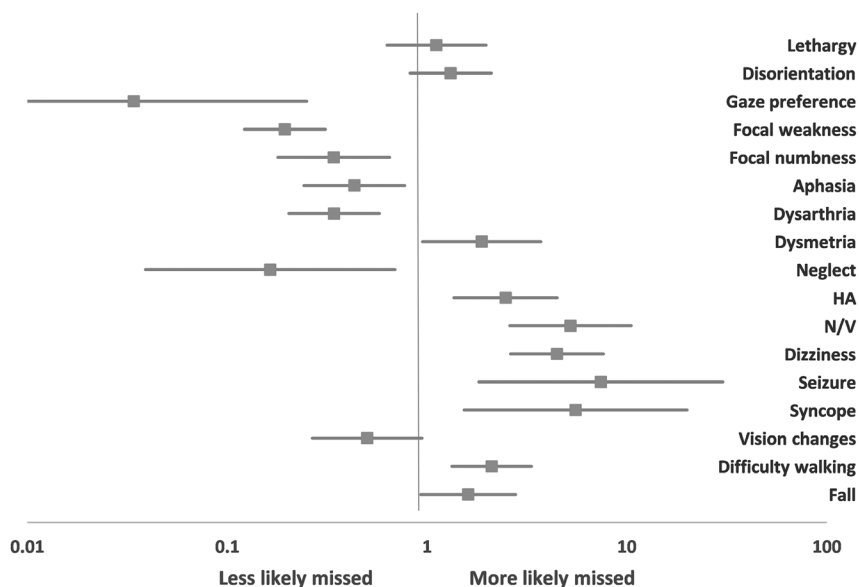
HA indicates headache; and N/V, nausea or vomiting.

symptoms, such as headache, gastrointestinal symptoms, and dizziness. Discharge disposition did not significantly differ between misdiagnosed and accurately diagnosed patients. The strokes that were missed were clinically relevant strokes that caused disability.

The implications of initially misdiagnosing strokes are great. Intravenous r-tPA has been shown to improve clinical outcomes when given within 3 hours of symptom onset or within 4.5 hours in a clinical subset of patients.<sup>12,13</sup> More recent data have supported the use of mechanical thrombectomy in addition to intravenous r-tPA, but again within a set time frame from symptom onset.<sup>2-4</sup> When the combination of intravenous and intra-arterial interventions are used, patients with ischemic stroke have improved immediate and 90-day

clinical outcomes. Morbidity is reduced when ischemic stroke is treated rapidly. A patient with stroke who presents within the narrow time frame for therapy, and then is subsequently misdiagnosed, is a potential missed opportunity for improved outcome.

Nearly half of all missed strokes presented within a time window for consideration of either lytics or endovascular therapy, which has been shown to reduce disability. In addition, for all missed strokes a delayed diagnosis may increase the likelihood that interventions are not rapidly initiated, such as an antiplatelet agent within 48 hours, which has been shown to reduce morbidity and mortality.<sup>14</sup> A delayed diagnosis may also increase overall length of stay. In this study, missed stroke patients stayed in the hospital for 1 day longer, although



**Figure.** Symptoms associated with missed stroke diagnosis.



**Table 3. Multivariable Analysis of Independent Predictors of a Missed Stroke Diagnoses**

	aOR	95% CI
Higher odds of missed diagnosis		
Nausea/vomiting	4.02	1.60–10.1
History of former stroke	2.40	1.30–4.42
Dizziness	1.99	1.03–3.84
Lower odds of missed diagnosis		
Focal weakness	0.396	0.228–0.688
Vision changes	0.377	0.176–0.809
Gaze preference	0.058	0.007–0.452
Dysarthria	0.048	0.288–0.994

aOR indicates adjusted odds ratio; and CI, confidence interval.

the difference was not statistically significant. Importantly, missed strokes were shown to have higher readmission rates at 60 days. This finding suggests socioeconomic consequences to hospitals and insurers. We are currently performing further studies to determine the variables that may lead to readmission.

The diagnosis of stroke remains elusive for multiple reasons. First, the patient has to be able to accurately relay his symptoms to medical providers. Second, to identify a stroke, a cerebrovascular event has to be part of the initial diagnostic consideration and differential in the ED. Our results show that far fewer strokes were missed when a neurologist was involved in the ED. Previous studies support neurologist involvement in the ED as a way to improve acute stroke diagnosis, although this may not be feasible at all institutions.<sup>15,16</sup> In order for a neurologist to be consulted though, the ED has to first consider stroke. An atypical stroke symptom such as nausea/vomiting may not trigger a neurology consult or even an initial neurological examination.

Ideally, the neurology consult should mitigate ED miss rates but that is not always the case. In our data, 35% of missed strokes had neurology involvement. A consulting physician can anchor on the ED's initial impression of a patient's diagnosis, thereby formulating a differential before seeing the patient. For an acute neurological syndrome, stroke should remain on the differential until after a complete history and examination are performed by the consulting neurologist. This may require seeing the patient urgently until the diagnosis of stroke has been fully explored.

Cerebrovascular events have variable presentations and can be cryptic in the early diagnostic phase. Many stroke symptoms overlap with those in other disorders and patterned heuristics are often used to make an efficient diagnosis. This is particularly true in posterior circulation strokes, where a symptom such as nausea and vomiting can be the chief presenting complaint. In our data, there was no documented NIHSS score or neurology examination in a significant proportion of missed strokes. If a primary neurological event is not considered, then a thorough neurological examination may not be performed. A proportion of the missed strokes may have been identified if a neurological examination was done. Completing a systematic review of systems and examination is a fast, cost-effective way to ensure that neurological findings are not being missed.

## Limitations

There are several limitations to this study. This was a retrospective analysis that used data from the electronic medical record from the ED, thus depending on the completeness and accuracy of written record. If a sign or symptom was not mentioned in the hospital record, it was considered as not present. This could have affected the cases where NIHSS was abstracted from the chart, leading to unintentional bias, although estimating the NIHSS from medical records has been validated in previous studies.<sup>17,18</sup>

Our study used charts from 2 distinct hospital systems, both of which have different computerized databases and methods of recording. The study population included only patients who had strokes identified at some point during their hospitalization. Patients who had strokes that were never identified on imaging would not have been included in the study. Also, patients who had an incorrect discharge diagnosis, or were not processed by the billing department, would not have been included in the study. Therefore, the stroke misses in our data are likely an under-representation of true missed strokes.

In addition, the intensity of the interview and examination by the ED physician could depend not on the patient presentation itself, but rather on factors, such as the business of the ED, the time of day, or their own fatigue. The study is also prone to reporting bias. These factors were not analyzed or controlled for in this study and could lead to bias.

The study population consisted of predominantly white older adults who presented to an ED at a primary stroke center. The results may not be generalizable to other types of populations.

## Conclusions

Despite stroke center certification, a significant proportion of ischemic strokes are initially misdiagnosed, and this leads to

**Table 4. Symptoms by Stroke Location**

Stroke Symptom	Anterior Circulation Strokes (n=325)	Posterior Circulation Strokes (n=140)	P Value
Lethargy, n (%)	64 (20)	16 (11)	0.030
Disorientation, n (%)	111 (34)	22 (16)	<0.001
Gaze preference, n (%)	76 (23)	6 (4)	<0.001
Focal weakness, n (%)	248 (76)	54 (39)	<0.001
Focal numbness, n (%)	78 (24)	35 (25)	0.818
Aphasia, n (%)	112 (34)	12 (9)	<0.001
Dysarthria, n (%)	136 (42)	40 (29)	0.007
Dysmetria, n (%)	22 (7)	40 (29)	0.009
Neglect, n (%)	35 (11)	6 (4)	0.024
HA, n (%)	25 (8)	30 (21)	<0.001
N/V, n (%)	14 (4)	22 (16)	<0.001
Dizziness, n (%)	22 (7)	48 (34)	<0.001
Seizure, n (%)	8 (2)	1 (1)	0.210
Syncope, n (%)	8 (2)	2 (1)	0.481
Vision changes, n (%)	51 (16)	43 (31)	<0.001
Difficulty walking, n (%)	77 (24)	58 (41)	<0.001
Fall, n (%)	61 (19)	17 (12)	0.079

HA indicates headache; and N/V, nausea or vomiting.

**Table 5. Outcome Measures at the Academic Hospital**

	Missed Strokes (n=55)	Not Missed (n=225)	PValue
Length of stay, days	6.9	5.9	0.266
Discharged home (%)	62	56	0.456
Readmissions at 60 days (%)	33	17	0.012

missed opportunities for intervention and improved outcomes. Atypical symptoms associated with brain stem and cerebellar posterior circulation strokes lead to misdiagnoses. This was true at both an academic center and a large community hospital. Symptoms such as acute nausea/vomiting, dizziness, and difficulty walking should be triggers to consider ischemic stroke in the ED, particularly when paired with a history of hypertension or a currently elevated blood pressure. Performing a systematic neurological examination on all patients with these complaints is the first step to ensuring that a stroke diagnosis is not missed in the ED. In our study, a patient who was accurately diagnosed was 6× more likely to be triaged as an acute stroke code. It may be useful to develop an algorithm for when to call an acute stroke code, or when to consult neurology for a potential stroke diagnosis. Future studies need to focus on the evaluation of these types of identification systems and tools in the ED to improve the accuracy of stroke diagnosis.

### Disclosures

None.

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# Stroke

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## Missed Ischemic Stroke Diagnosis in the Emergency Department by Emergency Medicine and Neurology Services

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# Correction

In the article by Arch et al (Arch AE, Weisman DC, Coca S, Nystrom KV, Wira CR III, Schindler JL. Missed ischemic stroke diagnosis in the emergency department by emergency medicine and neurology services. *Stroke*. 2016;47:668–673. DOI: 10.1161/STROKEAHA.115.010613.), which published online on February 4, 2016, and appeared in the March 2016 issue of the journal, a correction was needed.

On page 668, in the Abstract section Results, “Fifty-five of these were missed at the academic hospital (22%) and 48 were at the community hospital (26%,  $P=0.11$ ),” has been changed to read “Fifty-five of these were missed at the academic hospital (20%) and 48 were at the community hospital (26%,  $P=0.11$ ).”

On page 669, in the Results section Missed Strokes, “Fifty-five of these were missed at the academic hospital (22%),” has been changed to read “Fifty-five of these were missed at the academic hospital (20%).”

This correction has been made to the online and print version of the article, which is available at <http://stroke.ahajournals.org/content/47/3/668>.