

# Mode of Arrival to the Emergency Department of Stroke Patients in the United States

## Abstract

**Background:** The modality of transport to the emergency department has implications for triage, evaluation, and treatment of patients with stroke. We performed this study to determine the national trends in modes of arrival in patients with stroke and its association with emergency department evaluation in a nationally representative sample of United States.

**Methods:** We used the data from the National Hospital Ambulatory Medical Care Survey (NHAMCS). The NHAMC is one of the largest studies designed to provide utilization and provision of services in hospital emergency departments (ED). Patients were categorized into three modes of arrival: 1) ambulance, either air or ground; 2) walk-in, this include car, taxi, bus, or foot; and 3) public services such as police car or social service vehicle/Unknown.

**Results:** Of the 630,402 patients evaluated with stroke in the ED, the mode of arrival was by ambulance [331,760 (53%)], walk-in [271,268 (43%)], and public services/unknown [27374 (4%)]. The mean time for evaluation by a physician was 30±37 minutes, 34±44 minutes, and 55±105 minutes for ambulance, walk-in (P=0.535), and public services/unknown (P=0.664) mode of arrival, respectively. There was a trend for more frequent utilization of brain imaging in the patients presenting by ambulance (73%) compared to walk-in (63%, P=0.64) and public services/unknown (59%, P=0.5). Patients transferred by ambulance were more often admitted to the intensive care unit (11%) compared to walk-in (0.2%, P=0.02) and public services/unknown (6%, P=0.47).

**Conclusion:** Although arrival by ambulance was associated with a higher level of care, a prominent proportion of patients with suspected stroke are not arriving by ambulance to the ED.

**Keywords:** Emergency department; national survey; ambulance; stroke; arrival

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Ischemic stroke is the leading cause of disability among adults with 750,000 new cases yearly in the United States.<sup>1</sup> Fifteen to thirty percent of stroke victims are left disabled.<sup>2</sup> Intravenous rt-PA administered within three hours of symptom onset improves functional outcome.<sup>3</sup> The earlier treatment is administered, the more likely is the likelihood that a patient will benefit.<sup>4</sup> However, only 2 % of stroke patients receive intravenous thrombolysis in the United States<sup>5,6</sup> and the rate is much lower in other nations. Most patients are ineligible for treatment because of delayed arrival at the ED.<sup>7</sup> Currently, less than 48% of the patients arrive within two hours from onset of symptoms.<sup>8</sup> The modality of transport to the ED has implications for triage, evaluation, and treatment of patients with stroke. Moreover, patients transported by ambulance reach the ED earlier.<sup>8</sup> We performed this study to determine the trends in modes of arrival in patients with stroke and their association with ED evaluation in a nationally representative patient sample.

**Abbreviations:** rt-PA, recombinant tissue plasminogen activator; ED, Emergency department; ICD-9-CM, International Classification of Diseases-9th Revision-clinical modification; CDC, Center for Disease Control and Prevention.

## Methods

We used the data from the National Hospital Ambulatory Medical Care Survey-2003 (NHAMCS). The NHAMCS<sup>9</sup> is one of the largest studies designed to provide utilization and provision of services in hospital EDs. Findings are based on a national sample of visits to the ED of non-institutional general and short stay hospitals in the United States. The sample excludes federal, military and Veterans' Affairs hospitals. The NHAMCS is conducted annually by the National Center for Health Statistics (NCHS) and covers geographic primary sampling units, hospitals within primary sampling units, EDs within hospitals, and patients within EDs. The number of EDs sampled is around 400 each year. Trained staff from NCHS collects data from patient medical records using standard-

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**Table 1.** Demographic and clinical characteristics of patients according to mode of arrival to the emergency department.

		Mode of Arrival		
		Ambulance	Walk-in	Public services /Unknown
N		331760	271268	27374
Mean age in years ± SD		69.9 ± 15.3	61.3 ± 20.3 P=0.024	72.6 ± 12.5
Gender	Male	103965 (31%)	120486 (44%)	14461 (53%) OR 2.5 (95% CI 0.58 –10.32)
	Female	227795 (69%)	150782 (56%)	12913 (47%)
Race	Caucasian	275283 (83%)	237463 (88%)	22800 (83%)
	African American	45396 (14%)	22490 (8%) OR 0.57 (95% CI 0.21-1.61)	3496 (13%) OR 0.93 (95% CI 0.10 –8.76)
	Other	11081 (3%)	11315 (4%) OR 1.17 (95% CI 0.10 – 14.11)	1078 (4%) OR 1.18 (95% CI 0.22 –6.42)
Mean time to physician evaluation in minutes ± SD		30.3 ± 36.8	34.2 ± 43.8 P=0.535	55.0 ± 104.9 P=0.664
Mean length of visit in hours ± SD		6 ± 5.3	3.9 ± 3.2 P=0.002	9.8 ± 9.7 P=0.818
Mean SBP in mm Hg ± SD		152.4 ± 31.6	152.4 ± 29.9 P=0.992	165.6 ± 22.4 P=0.139
Mean DBP in mm Hg ± SD		80.6 ± 21.5	80.8 ± 14.8 P=0.937	95.1 ± 13.8 P=0.005
Thrombolytic therapy administered		0 (0.0%)	1283 (0.5%)	0 (0.0%)
MRI/CT Scan		242134 (73%)	171895 (63%) OR 0.64 (95% CI 0.28 –1.44)	16246 (59%) OR 0.5 (95% CI 0.13 –2.32)
Admitted to hospital		271850 (82%)	157051 (58%) OR 0.30 (95% CI 0.14 –0.68)	12615 (46%) OR 0.19 (95% CI 0.04 – 0.82)
Admitted to ICU/CCU		37099 (11%)	554 (0.2%) OR 0.02 (95% CI 0.002 – 0.15)	1544 (6%) OR 0.47 (95% CI 0.05 – 4.76)
Evaluated by staff physician		323219 (97%)	241703 (89%) OR 0.22 (95% CI 0.03 – 1.39)	22334 (82%) OR 0.12 (95% CI 0.01 – 1.29)
Disposition	DOA/Died in ED	3662 (1%)	0 (0%)	0 (0%)
	Referred to other physician/clinic for follow-up	17001 (5%)	69865 (26%) OR 6.4 (95% CI 2.1 – 18.79)	13318 (49%) OR 17.54 (95% CI 3.61 –85.07)
	Admitted for 23 hour observation	11052 (3%)	1893 (1%) OR 0.20 (95% CI 0.012 – 3.42)	0 (0%)
	Transferred to other hospital	12352 (4%)	17119 (6%) OR 1.74 (95% CI 0.35 –8.65)	0 (0%)

Abbreviations used: SD, Standard Deviation; SBP, systolic blood pressure; DBP, diastolic blood pressure; MRI, Magnetic Resonance Imaging; CT, Computed Tomography; ICU, Intensive Care Unit; CCU, Cardiac Care Unit; DOA, dead on arrival; OR, odds ratio; CI, confidence interval

ized collection forms during a randomly assigned 4-week data period for each of the sampled hospitals. Completed forms are reviewed at NCHS, where all information contained in this database has been completely de-identified and the data are publicly available.

#### Data Variables

Specific patient record forms were completed by hospital staff containing pertinent demographic, clinical, and treatment data. Data sets included in NHAMCS are: demographic variables, vital signs on arrival, waiting time, primary and secondary diagnoses ICD-9-CM codes, procedure performed, disposal from ED and diagnostic/screening services.

#### Definitions

We used ICD-9-CM primary diagnosis codes (430 to 434, 436 & 437) to identify the stroke patients in NHAMCS data set. Patients were categorized into three modes of arrival:

- Ambulance, either air or ground
- Walk-in, this include car, taxi, bus, or foot
- Public services such as police car or social service vehicle/ Unknown

#### Statistical Analysis

NHAMCS has a complex sample design. To estimate national ED visits, we used the weights provided the dataset. All analysis was done in SUDAAN statistical software, Release 9.0.1, Research Triangle Institute, Research Triangle Park, NC. We used the Cochran-Mental-Haenszel test and analysis of variance for categorical and continuous data, respectively to identify significant difference between values for mode of arrival.

## Results

A total of 630,402 estimated stroke patients were seen at EDs in 2003. Mean age was  $66 \pm 18$  years and 238912 (38%) were men. Those transferred by ambulance were older (69.9 years) when compared to those who were transferred by walk-in (61.3 years,  $P=0.024$ ). However, there was no significant difference in the gender and race associated with the mode of arrival (see Table 1). Of the 630,402 patients, the mode of arrival was by ambulance (331,760, 53%), walk-in (271268, 43%), and public services / unknown (27374, 4%). The mean time for evaluation by a physician was  $30 \pm 37$  minutes,  $34 \pm 44$  minutes, and  $55 \pm 105$  minutes for ambulance, walk-in ( $P=0.535$ ), and public services/unknown ( $P=0.664$ ) mode of arrival, respectively. In regard to the evaluation with computed tomography / magnetic resonance imaging, there was a trend in favor of the patients transferred by ambulance (73%) compared to walk-in (63%,  $P=0.64$ ) and public services / unknown (59%,  $P=0.5$ ). Also, more patients were admitted to the intensive care unit if arrived by ambulance (11%) compared with walk-in (0.2%,  $P=0.02$ ), and public services / unknown (6%,  $P=0.47$ ) (see Figure 2). Moreover a higher proportion of patients arriving by ambulance were evaluated by a staff physician [97% as opposed to 89% ( $p=0.22$ ) and 82% ( $p=0.12$ ) for the other modes of arrival].

## Discussion

Our study demonstrated a trend towards a higher level of care in the patients who arrived to the ED via ambulance. They were evaluated earlier, had more emergent investigations, and were more frequently admitted to the hospital. Unfortunately, a prominent proportion of patients with suspected stroke did not arrive by ambulance to the ED. Moreover, there is some evidence to suggest better functional outcome in the acute stroke patients who are cared for in the ICU.<sup>10</sup> Regrettably, per the findings of our study more patients were admitted to ICU when arrived to the ED by ambulance. The results of our study are consistent with a study conducted by the CDC. Furthermore, the previous study demonstrated the interval between ED arrival and brain imaging was significantly reduced for those arriving by ambulance.<sup>8</sup>

The efficacy of acute stroke treatment is very time dependant. This includes both pharmacological and mechanical thrombolysis. Hence, the proportion of stroke patients eligible to this effective therapy will be significantly enhanced if more patients arrive earlier to the ED. This in turn will be reflected by reduced disability and improved functional outcome after a stroke. Prior studies showed earlier arrival to the ED when acute stroke patients are transferred via ambulance.<sup>8</sup> In conclusion, arrival to the ED by ambulance predicts better functional outcome. Hence, efforts must be intensified to increase the proportion of stroke patients transferred by this modality. These efforts should be directed at three levels: Patients, Paramedics, and ED physicians.

A significant proportion of the population is not aware of the stroke symptoms or the existing effective therapy.<sup>11</sup> Awareness among the general population of the stroke symptoms is essential and poor awareness of stroke symptoms contributes to a delay in the arrival of patients in hospital ED for immediate effective treatment. Therefore, extensive public education regarding early stroke symptoms recognition and to call 911 to receive ambulance transport is vital.

Paramedic stroke recognition and hospital pre-notification are associated with shorter pre-hospital time from the ambulance to hospital arrival and in hospital time from hospital arrival to first medical assessment.<sup>12</sup> Hence, constant paramedic education on recognition of stroke signs and symptoms and the exiting effective stroke treatment is essential.

The need for the ED physicians to perform prompt evaluation on the acute stroke patients has been well documented. Actually warning the ED physicians against procrastination appears to be important in regard to shortening the delays (Arrival through CT scan and door to needle time).<sup>13</sup> Thus ED physicians must be continuously urged to proceed promptly when managing acute stroke patients.

The findings of the study highlight the importance of mode of arrival on subsequent ED evaluation and management.

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