

# Emergency Department Companions of Stroke Patients

## *Implications on Quality of Care*

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**Abstract:** Acute care of stroke victims largely relies on the rapid identification and timely clinical and radiological assessment. We evaluated the effect of the number of patient companions on the efficiency of the diagnostic process in the emergency department (ED).

Consecutive stroke patients admitted to the ED between August 2011 and October 2012 were evaluated. Clinical, epidemiological, and timeline data (symptoms onset, ED arrival, computed tomography [CT] scanning, and recombinant tissue plasminogen activator infusion), as well as the number of accompanying persons in the ED were prospectively recorded. We used multivariate Poisson log linear models to analyze the association of number of companions adjusted and door-to-CT times and logistic regression for the analysis of the successful identification of stroke patient by ED triage nurse.

Out of a total of 724 stroke patients admitted, data regarding number of ED companions were available for 610 (84.3%) patients. Number of companions was associated with higher National Institute of Health Stroke Scale and speech disturbances. It was found to be independently associated with shorter time to CT scanning adjusted for the stroke severity, sex, and speech disturbances (no companions as a reference group, relative risks 0.82, 0.73, and 0.70 for 1, 2, and  $\geq 3$  companions, respectively, all  $P < 0.001$ ). Similarly, number of companions was associated with higher rates of stroke recognition by the triage nurse adjusted for covariates (odds ratios 2.11, 2.62, and 4.11, respectively, all  $P < 0.05$ ).

Our findings suggest that the family members and other companions could serve as facilitators of faster and more effective ED management of stroke patients, possibly improving their outcome.

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**Abbreviations:** CI = confidence interval, CT = computed tomography, ED = emergency department, EMS = Emergency Medical Services, ICH = intracerebral hemorrhage, IS = ischemic stroke, NIHSS = National Institute of Health Stroke Scale, ORs = odds ratios, rTPA = recombinant tissue plasminogen activator,

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SUMC = Soroka University Medical Center, TIA = transient ischemic attack.

## INTRODUCTION

The quality of the acute care of stroke victims largely relies on the rapid identification, clinical and radiological assessment, coordination of emergency physicians, neurologists, and radiologists, and management of the patient. The guidelines for the early management of patients with acute ischemic stroke (IS) state that emergency department (ED) patients with suspected acute stroke should be triaged with the same priority as patients with acute myocardial infarction or serious trauma regardless of the severity of neurological deficits. Even patients with mild or rapidly improving stroke symptoms<sup>1</sup> may have a poor final stroke outcome, and are currently considered candidates for thrombolytic therapy. Therefore, efforts are directed toward accelerating the triage process and identifying factors associated with the delay.

Family presence may influence the conduct of the diagnostic and treatment processes. For example, the effect of family presence during cardiopulmonary resuscitations and invasive procedures was extensively investigated during the last decade. Many patients and family members wish to be given the option, and health care providers generally support it.<sup>2</sup> Nevertheless, the policy of the ED often limits the presence of family members to avoid crowding.

The number of persons wishing to accompany a patient in the ED in general, and a stroke patient in particular, may be affected by multiple factors—disease-related (severity, symptoms, and time of onset) and nondisease-related (cultural, familial, and personal). In this prospective study, we attempted to evaluate the effect of the number of companions on the efficiency of the diagnostic process in ED, that is, likelihood of recognition by the triage nurse and time from door to computed tomography (CT).

## METHODS

### Setting

Soroka University Medical Center (SUMC) is a tertiary referral center (~1000 beds), singly serving the metropolitan area with over 700,000 residents of the region of Southern Israel. The Soroka 60-bed ED treats >500 adult patients a day<sup>3</sup> on average. Hospital policy is to admit all stroke patients (transient ischemic attack [TIA], IS, and spontaneous intracerebral hemorrhage [ICH]) presenting to the ED, to the 30-bed Department of Neurology. Patients with suspected IS or TIA are evaluated by a triage nurse, who initiates a “stroke protocol”: blood tests are drawn, electrocardiography is performed, a neurologist is paged, and an urgent CT scan is ordered. Thrombolytic therapy is initiated according to the decision of the

neurologist and the patient is admitted to the stroke service in the Department of Neurology. Although the official ED policy is to allow only 1 companion per patient, this policy is not enforced and many patients are accompanied by multiple family members. This study was approved by the SUMC Ethics Committee.

## Study Population

All consecutive patients presenting to the ED of the SUMC with acute stroke (TIA, IS, and ICH) and admitted between August 2011 and October 2012 were prospectively enrolled into the study. Patients transferred from other hospitals or having in-hospital strokes were excluded. All patients underwent a CT scan, and based on the imaging studies and clinical course were diagnosed with either ICH, IS, or TIA.

We ascertained the demographic and clinical data, including symptoms, stroke severity (measured by the National Institute of Health Stroke Scale [NIHSS]), mode of ED arrival, Emergency Medical Services (EMS) prenotification, identification of the stroke by a triage nurse, and management timeline. The following times were recorded: symptoms onset time, ED arrival time (morning 7:00–15:00, evening 15:00–23:00, and night 23:00–7:00), time of the CT scanning, and time of recombinant tissue plasminogen activator (rTPA) infusion.

Risk factors for cerebrovascular event were documented based on the diagnoses by the primary care physician, prior to the stroke. Obesity was defined as body mass index  $>30$ . We obtained death dates from the national registry, where the patients are identified by the unique national identification number also used for the hospital admissions. The number of persons accompanying the patient during ED stay (ED companions) was recorded by the study personnel during ED evaluation.

## Statistical Analysis

The exposure (number of ED companions) was divided into 4 groups (no companions, single, 2, or  $\geq 3$  companions). We used a convenience sample of all stroke patients admitted to the hospital during 15 months period. Primary outcome of the analysis was door-to-CT time. Secondary outcomes were CT-to-thrombolysis time and successful identification of stroke by the triage nurse at ED admission. We compared patient characteristics and outcomes using  $\chi^2$  or Fisher exact tests for categorical variables, and the *t*-test or Mann–Whitney U test for the continuous variables.

We used multivariate Poisson log linear models to analyze the association of the number of companions adjusted for covariates and door-to-CT and CT-to-thrombolysis times. We used logistic regression for the analysis of the successful identification of stroke patient by ED triage nurse. Covariates were selected based on the clinical significance and results of univariate analyses ( $P < 0.10$  for inclusion).

Results are presented as odds ratios (ORs), with confidence intervals (CIs), and means (standard deviation). A *P* value of  $<0.05$  represents a statistically significant finding. Statistical analyses were performed using IBM SPSS Statistics 20 (IBM Corp., Armonk, NY).

## RESULTS

A total of 724 patients with acute stroke were admitted during the study period, 585 (80.8%) of which have suffered from IS, 75 (10.4%) from TIA, and 64 (8.8%) from ICH. Data

on the number of ED companions were available for 610 (84.3%) patients, comprising the study analysis cohort.

## Patient Population and Stroke Characteristics

Most of the patients were accompanied by 1 (291, 40.2%) or 2 persons (147, 20.3%). Multiple companions (3–6) accompanied 99 patients (13.7%) whereas 73 patients (10.1%) came alone. A total of 318 patients arrived to the ED using the EMS (52.1%) of which 148 (46.5%) had  $>1$  companion compared with 98 (33.6%) who did not use EMS ( $P < 0.001$ ). Stroke patients were more likely to be accompanied by  $>1$  person during the evening (47.1%) than the night (43.1%) or the morning (35.7%) ( $P = 0.027$ ), and were not more likely to arrive alone during nighttime (16.9%) compared with the morning or evening (10.8 and 11.3%, respectively) ( $P = 0.36$ ).

The baseline characteristics of the study population are presented in Table 1. The average age of the patients was 69.0 years, 259 (55%) were males, and 319 (84.4%) were married. Age, sex, marital status, and cardiovascular risk factors were not associated with the number of companions.

Table 2 presents the stroke characteristics of the study population. Patients suffering from TIA did not differ in the number of companions neither from the patients suffering from IS nor from the patients subsequently diagnosed with ICH. Larger number of companions was associated with higher NIHSS scores. It was also associated with speech disturbances but not with motor or sensory symptoms.

## Procedural Outcomes

Table 3 presents the acute management of stroke patients and its association with the number of companions. Patients that arrived to the ED with larger number of companions were more likely to be identified as having a stroke by the triage nurse (Spearman correlation  $\rho$  0.185,  $P < 0.001$ ) and a CT scan was performed earlier (Spearman correlation  $\rho$   $-0.17$ ,  $P < 0.001$ ). Figure 1 depicts the effect of the number of companions on time to CT. The presence of the first companion was associated with a decrease of 18% of the time to CT scan (95% CI 81–85, *P* value  $<0.001$ ) as compared with a lone patient. The presence of the second companion reduced this time by 27% (95% CI 0.71–0.75, *P* value  $<0.001$ ). The number of companions was associated with neither the likelihood of thrombolysis (Spearman correlation  $\rho$  0.018,  $P = 0.655$ ) nor the time from ED arrival and beginning of rTPA infusion (Spearman correlation  $\rho$   $-0.108$ ,  $P = 0.51$ ).

Table 4 presents the multivariate analysis (Poisson log linear regression). The number of companions was found to be independently associated with shorter time to CT scanning adjusted to the stroke severity, sex, and speech disturbances (no companions as a reference group, relative risks 0.82, 0.73, and 0.70 for 1, 2, and  $\geq 3$  companions, respectively, all  $P < 0.001$ ). Similarly, adjusted for the stroke severity, sex, and speech disturbances, a larger number of companions was associated with higher rates of stroke recognition by the triage nurse (no companions as a reference group, ORs 2.11, 2.62, and 4.11 for 1, 2, and  $\geq 3$  companions, respectively, all  $P < 0.05$ , Table 5).

Finally, we performed an analysis of stroke recognition by the triage nurse stratified by sex and age (Figure 2). It appears that women and patients  $>65$  years had higher OR for stroke recognition when coming to ED with companions as compared with coming alone. The effect of companions was lower in males and younger patients.

**TABLE 1.** Characteristics of ED-Diagnosed Stroke Patients According to Number of ED Companions

Variable	Number of ED Companions				P Value
	None N = 73	1 N = 291	2 N = 147	3 N = 99	
Male, N (%)	32 (56.1)	132 (55.9)	58 (50.9)	37 (57.8)	0.77
Age (mean ± SD)	66.0 ± 13.5	68.2 ± 14.09	71.1 ± 13.3	72.5 ± 10.0	0.11
Marital status—single, N (%)	6 (14.3)	35 (17.9)	12 (14.1)	6 (10.7)	0.56
Cerebrovascular risk factors					
Smoking, N (%)	15 (20.5)	52 (17.9)	22 (15.1)	15 (15.3)	0.71
Obesity, N (%)	14 (19.2)	101 (34.7)	52 (35.6)	43 (43.9)	0.009
IHD, N (%)	23 (31.5)	65 (22.3)	32 (21.8)	27 (27.3)	0.3
Prior stroke, N (%)	21 (28.8)	52 (17.9)	31 (21.2)	18 (18.2)	0.19
PVD, N (%)	31 (42.5)	64 (22)	38 (25.9)	19 (19.2)	0.002
CAF/PAF, N (%)	10 (13.7)	45 (15.5)	24 (16.3)	18 (18.2)	0.87

CAF = chronic atrial fibrillation, ED = emergency department, IHD = ischemic heart disease, PAF = paroxysmal atrial fibrillation, PVD = peripheral vascular disease, SD = standard deviation.

### DISCUSSION

In this prospective observational study, we found an independent beneficial effect of companions joining the acute stroke patient during ED visit, on the quality of care such as earlier recognition by the ED triage nurse and shorter door-to-CT time.

Patients with IS benefit from systemic thrombolytic therapy when treated up to 4.5 hours from the symptom onset. This degree of the potential benefit is tightly associated with time from stroke onset to the beginning of rTPA infusion (“time equals brain”).<sup>4</sup> Multiple efforts are directed to reduce the ED delays in identification, evaluation, and management of acute stroke patients. Several procedural approaches<sup>7</sup> were evaluated

and used with various degrees of success: improving EMS involvement, hospital prenotification, use of point-of-care International Normalized Ratio measurements, direct delivery of the patient to the CT scanner, bypassing ED triage mechanisms, and premixing of TPA. The use of these measures decreased the “door-to-needle time” to 20 minutes in selected centers, but is not used routinely in most centers.

Our findings suggest that the family members and other companions could serve as facilitators of faster and more effective ED management of stroke patients, possibly improving their outcome. Many hospitals limit the number of companions to 1, to prevent crowdedness. Our data showed that the presence of 2 companions may potentially decrease time to CT by 15 minutes compared with 1 and >30 minutes compared

**TABLE 2.** Stroke Types, Symptoms, and Severity According to Number of ED Companions

Variable	Number of ED Companions				P Value
	None N = 73	1 N = 291	2 N = 147	3–6 N = 99	
Stroke type					
TIA, N (%)	11 (15.1)	38 (13.1)	11 (7.5)	5 (5.1)	0.06
Ischemic stroke, N (%)	55 (75.3)	233 (80.1)	123 (83.7)	80 (80.8)	
ICH, N (%)	7 (9.6)	20 (6.9)	13 (8.8)	14 (14.1)	
Stroke symptoms					
Speech disturbances, N (%)	36 (50)	177 (61.5)	99 (67.8)	69 (70.4)	0.026
Motor symptoms, N (%)	52 (71.2)	215 (74.1)	121 (82.3)	79 (80.6)	0.125
Sensory symptoms, N (%)	31 (42.5)	123 (42.4)	74 (50.3)	45 (45.9)	0.44
Headache, N (%)	5 (6.8)	41 (14.2)	26 (17.7)	16 (16.3)	0.17
Dizziness, N (%)	13 (17.8)	30 (10.4)	18 (12.2)	17 (17.3)	0.17
Visual disturbances, N (%)	9 (12.3)	21 (7.3)	12 (8.2)	13 (13.3)	0.22
Severity					
NIHSS median (IQ range)	3 (1–6)	4 (1.75–8)	5 (2–12)	5 (2.75–12.25)	<0.001

ED = emergency department, ICH = intracerebral hemorrhage, IQ = interquartile, NIHSS = National Institute of Health Stroke Scale, TIA = transient ischemic attack.

**TABLE 3.** Arrival Time, Use of EMS, and ED Management According to Number of ED Companions

Variable	Number of ED Companions				P Value
	None N = 73	1 N = 291	2 N = 147	3–6 N = 99	
Symptoms onset to ED arrival time <3 h, N (%)	21 (28.8)	97 (33.3)	53 (36.1)	36 (36.4)	0.68
Arrival with EMS, N (%)	24 (33.3)	146 (50.5)	79 (54.1)	69 (69.7)	<0.001
EMS prenotification, N (%)	6 (8.3)	62 (21.3)	41 (27.9)	33 (33.3)	0.001
ED triage recognition, N (%)	16 (22.2)	110 (37.8)	70 (47.6)	54 (54.5)	<0.001
ED arrival to CT time median (IQ range)	137 (89–251)	122 (75–212)	102 (56.5–164)	101.5 (55.25–152.25)	0.001
Thrombolysis, N (% of IS)	5 (9.1)	18 (7.7)	11 (8.9)	7 (8.8)	0.96
CT to thrombolysis time median (IQ range)	131 (48–131)	45 (24.5–71)	51 (27–69)	51 (42–60)	0.25
ED arrival to thrombolysis time median (IQ range)	270 (145–270)	90 (73–153.25)	100 (77–117)	92 (83–177)	0.10
In-hospital mortality, N (%)	6 (8.3)	12 (4.1)	15 (10.3)	14 (14.1)	0.006

CT = computed tomography, ED = emergency department, EMS = Emergency Medical Services, IQ = interquartile, IS = ischemic stroke.

with unaccompanied patient. We suggest that 2 companions are optimal, and may assist the medical emergency system in achieving better quality of care, in the case of a stroke patient. However, having 2 companions in overcrowded ED might pose an additional logistic challenge to the medical teams.

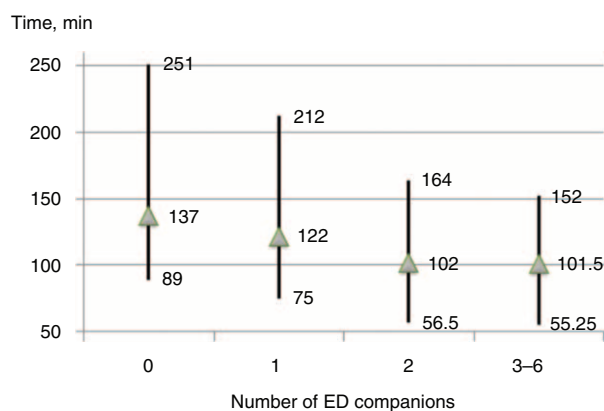
The way companions shorten ED delays was never studied. We believe that family members or other companions increase the attention of the medical staff and, on the other hand, assist in technical care of the patient—for example, assisting in the transfer of the patient from the EMS stretcher to the ED bed, pushing the ED bed to the CT scanner, or transferring the patient from the bed to the scanner. Possibly, this dual effect makes the optimal number of companions 2.

Stroke victims arriving unaccompanied to the ED may receive suboptimal care. They are less likely to be immediately identified as stroke patients, and imaging studies are frequently performed with significant delays. Although not surprising in an

overcrowded ED, emergency systems should try to eliminate this barrier to care. We suggest that patients should be encouraged to come to the ED escorted by a family member and medical staff should be especially alert to the lonely patient, especially when unable to express himself clearly. Moreover, assigning a “stroke liaison” to a lone patient with the suggestive findings may improve the diagnostic and treatment processes.

To the best of our knowledge, the role of companions of stroke patients in the ED was rarely discussed in the stroke literature. It has been shown that patients’ families are perceived as a burden by ED nurses. Outside the acute neurological events management, the magnitude and effect of the presence of patient family in EDs was investigated, but its effect on the quality of care was only scarcely reported. The delays in door-to-balloon time in coronary patients were found to be associated with “explaining the procedure to the family,” requiring a median time of 68 minutes. Significant delays in the initiation of cardiopulmonary resuscitation and medication administration were found in 30 simulation cases in which family members were present.<sup>6</sup> On the contrary, the quality of care was not affected by family presence in other situations, such as pediatric trauma,<sup>7,8</sup> lumbar punctures,<sup>9</sup> and other invasive procedures,<sup>10,11</sup> and adult cardiopulmonary resuscitation. Our findings not only support the concept that family presence is not detrimental but also suggest that in the case of acute stroke it can be beneficial.

Our study has several limitations. The study was conducted in a single center, making its generalizability limited; however, our hospital provides acute neurologic care to over 700,000 residents from different religious and cultural backgrounds assuring that these results are relevant to a wide variety of the patients. The sample size was relatively small and stroke severity was somewhat low. We have not collected the information regarding medical personnel such as triage nurses experience. Although we believe that no selection bias should have been introduced (i.e., there is no association between number of companions and personnel characteristics), we cannot exclude the possibility that the efficiency of stroke



**FIGURE 1.** Time (minutes) from ED arrival to beginning of CT scanning according to number of ED companions (median, IQ range). CT = computed tomography, ED = emergency department, IQ = interquartile.

**TABLE 4.** Door-to-CT Time—Poisson Log Linear Regression

Variable		P Value	Relative Risk	95% CI	
				Lower	Upper
Number of escorts in emergency department	3–6 escorts	<0.001	0.7	0.68	0.72
	2 escorts	<0.001	0.73	0.71	0.75
	1 escort	<0.001	0.82	0.81	0.85
	No escorts		1		
Speech disturbances		<0.001	0.87	0.85	0.89
Female vs male		<0.001	1.08	1.06	1.1
NIHSS, per point		<0.001	0.98	0.97	0.98

CI = confidence interval, NIHSS = National Institute of Health Stroke Scale.

**TABLE 5.** Emergency Department Triage Nurse Recognition of Stroke Patients—Multivariate Logistic Regression

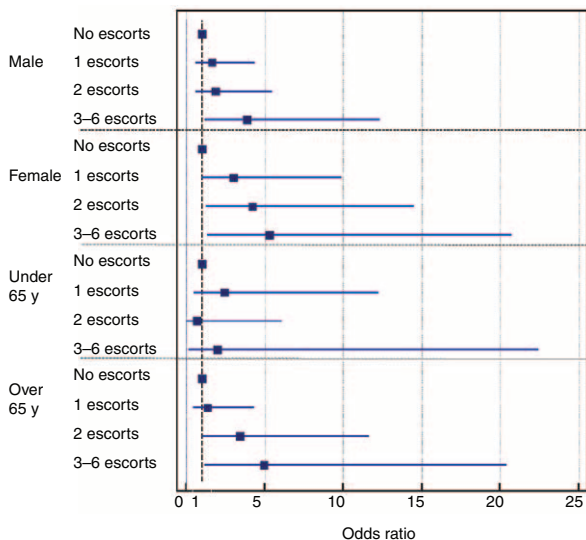
Variable		P Value	OR	95% CI	
				Lower	Upper
Number of escorts in emergency department	No escorts		1		
	1 escort	0.04	2.11	1.01	4.41
	2 escorts	0.01	2.62	1.19	5.77
	≥3 escorts	0.001	4.11	1.73	9.76
Speech disturbances		0.006	1.93	1.20	3.09
NIHSS, per point		<0.001	1.07	1.04	1.11

CI = confidence interval, NIHSS = National Institute of Health Stroke Scale, OR = odds ratio.

diagnostic process is affected by the staff experience. We have not assessed the cognitive status of the patients during the ED stay, and therefore, we cannot exclude this characteristic as being a potential confounder.

The exact causes for the time reduction observed in our study were not clear and require further investigation. However, we have shown that women and elderly—particularly vulnerable healthcare groups—are gaining the largest benefit from the presence of companions. We can hypothesize that for these cases companions can continuously alert the ED medical staff to allow an expedite care.

Despite the limitations, our results suggest that more attention should be focused on the study of the role of the family members both in the decision to seek medical attention and as facilitators of care in the ED for stroke victims. These findings merit further research, targeting the role of caregivers, the experience of medical staff, the importance of psychiatric/cognitive state, family members, and close contacts of stroke patients on the acute management. ED protocols should welcome companions of stroke patients as possible.



**FIGURE 2.** Logistic regression for the recognition of stroke patient by triage nurse (odds ratio and 95% confidence intervals). Model adjusted for escorts, NIHSS, and speech disturbances. NIHSS = National Institute of Health Stroke Scale.

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