

Activation of Emergency Medical Services for Acute Stroke in a Nonurban Population

The T.L.L. Temple Foundation Stroke Project

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Background and Purpose—Activating emergency medical services (EMS) is the most important factor in reducing delay times to hospital arrival for stroke patients. Determining who calls 911 for stroke would allow more efficient targeting of public health initiatives.

Methods—The T.L.L. Temple Foundation Stroke Project is an acute stroke surveillance and intervention project in nonurban East Texas. Prospective case ascertainment allowed chart abstraction and structured interviews for all hospitalized stroke patients to determine if EMS was activated, and if so, by whom.

Results—Of 429 validated strokes, 38.0% activated EMS by calling 911. Logistic regression analysis comparing those who called 911 with those who did not activate EMS found that individuals who were employed were 81% less likely to have EMS activated (OR 0.19, 95% CI 0.04 to 0.63). Of the 163 cases in which 911 was called, the person activating EMS was: self (patient), 4.3%; family member of significant other, 60.1%; paid caregiver, 18.4%; and coworker or other, 12.9%. Significant associations between the variables age group ($P=0.02$), insurance status ($P=0.007$), and living alone ($P=0.05$) with who called 911 was found on χ^2 analysis.

Conclusions—Educational efforts directed at patients themselves at risk for stroke may be of low yield. To increase the use of time dependent acute stroke therapy, interventions may wish to concentrate on family, caregivers, and coworkers of high-risk patients. Large employers may be good targets to increase utilization of EMS services for acute stroke. (*Stroke*. 2000;31:1925-1928.)

Key Words: ambulance ■ education ■ emergency medical services ■ stroke, acute

Intravenous recombinant tissue plasminogen activator (r-TPA) remains the only FDA-approved therapy for reducing disability in acute ischemic stroke.¹ Despite this advancement in acute stroke therapy, relatively few patients are treated with thrombolytic therapy in the United States. In large part, this is due to the short 3-hour window for r-TPA use. Patients' failure to recognize stroke symptoms and subsequent delay in presentation to the emergency department plays a critical role in the exclusion of potential r-TPA candidates.²

Previous studies have documented that activation of Emergency Medical Services (EMS) is the single most important factor in the rapid triage and treatment of acute stroke patients. Individuals who activate EMS by calling 911 arrive to the emergency department earlier and are more rapidly evaluated.³⁻⁸ Currently, the American Heart Association (AHA), the National Stroke Association (NSA), and the

National Institute of Neurological Disorders and Stroke (NINDS) have initiated educational efforts targeting the whole population at risk.⁹⁻¹¹ Specific educational targets identified by population-based research may help to efficiently direct precious resources to where they are most needed.

As part of a prospective stroke surveillance project, we first sought to establish if EMS was contacted when acute stroke occurred. We explored if any sociodemographic variables would be predictive of EMS activation. In the cases in which EMS was activated, we then sought to identify which individuals actually initiated contact by calling 911. We hypothesized that it is not the stroke victim themselves who call 911. Given the limited resources available for stroke education, a more effective strategy might be to target family members, caregivers, or coworkers of those at high risk for stroke.

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TABLE 1. Description of Intervention and Control Communities

Variable	Intervention	Control
Population	151 973	319 031
Race/ethnicity	73% NHW 17% AA 9% HA 1% Other	64% NHW 27% AA 6% HA 3% Other
911 EMS	Yes	Yes
Hospitals	5	5
Hospital beds	777	1069
24-h ER and CT	5 of 5	5 of 5
Neurologist on staff	4 of 5	5 of 5

From Reference 12.

NHW indicates non-Hispanic white; AA, African American; HA, Hispanic American; ER, emergency room.

Subjects and Methods

The T.L.L Temple Foundation Stroke Project is a prospective acute stroke surveillance and intervention project in nonurban East Texas. The primary objective is to identify the target population in the community and do better stroke education. The purposes of the current report were (1) to determine the proportion of stroke patients transported by EMS and compare features between those transported by EMS and those not using 911 services and (2) among those transported by EMS, to determine who initiated the call to 911 services.

This study is being conducted in 5 nonacademic community hospitals in the intervention communities of Angelina, Nacogdoches, and Shelby counties and in 5 matched, nonacademic community hospitals in the control communities of Orange and Jefferson counties (Table 1¹²). These counties are geographically isolated from tertiary care centers, making referral very unlikely. Complete case capture for first medical contact in the setting of acute stroke is highly probable, given the significant distance to other healthcare centers.

Data in this study are drawn from the preintervention period of the project and were collected during the baseline study period, from February 1998 through October 1998. The project was approved by the Committee for the Protection of Human Subjects at the University of Texas–Houston and at each of the participating hospitals. Subject interviews were carried out only after informed consent was obtained.

Patient data were acquired through a combination of active and passive surveillance. To identify potential stroke patients, emergency room and admission logs from all 10 hospitals were reviewed daily by abstractors rigorously trained in stroke identification. A list of 29 previously validated screening terms was used to identify potential stroke patients.¹³ A “Hot Pursuit” method similar to that used by the World Health Organization Monitoring Trends and Determinants of Cardiovascular disease (MONICA) study was then used with each identified stroke case.¹⁴ In addition, a passive surveillance technique using discharge International Classification of Disease, 9th Revision (ICD-9) codes 430 to 438 was used to ensure complete case capture. Subjects were eligible for the study if they had symptoms suggestive of stroke and met the following inclusion criteria: ≥ 21 years of age at time of stroke; diagnosis of stroke confirmed by a fellowship-trained stroke neurologist; resident of one of the counties comprising the study area.

Once a subject’s eligibility was confirmed, data collectors trained in stroke identification reviewed the chart and completed the case report forms. After obtaining informed consent, data collectors conducted interviews by using a standardized, precoded questionnaire to obtain information regarding subject demographics, socioeconomic status, healthcare information, and specific questions

TABLE 2. Entity Contacted When Acute Stroke Symptoms Occurred

EMS	163 (38.0%)
No call made	129 (30.0%)
Personal physician	66 (15.4%)
Family member	28 (6.5%)
Friend	3 (0.7%)
Insurance company	1 (0.2%)
Other	3 (0.7%)
Does not remember/no response	36 (8.4%)

regarding the stroke event. If the subject could not be interviewed because of physical limitations or death, a consenting surrogate (eg, family member, caregiver) was interviewed. It should be emphasized that all data collected pertained only to the acute stroke patient; no demographic information about the individual who actually called 911 was obtained unless that person happened to be the stroke patient. Abstractors were required to photocopy emergency room face sheets; EMS records; admission laboratories; admission and discharge summaries; MRI, CT scan reports, or both; nursing notes; and death certificates (when applicable) for case validation from source documentation. After completion of each case file, records were transferred to the study center in Houston. Cases were reviewed by fellowship-trained stroke neurologists and then validated as either “stroke” or “not stroke,” based on criteria established by the Greater Cincinnati Stroke Study and the MONICA study.^{15,16} Data from the case report form and interview were then entered into the T.L.L. Temple Foundation Stroke Project Database.

Validated stroke cases were dichotomized to those that called 911 and those that did not. In cases in which EMS was not contacted, the first contact was identified. The entire analysis was prespecified. With the use of the statistical package SAS (SAS for Windows 6.12, SAS Institute Inc), the data analysis comprised 2 parts: (1) Determine the number of patients for whom EMS was activated compared with those whom 911 was not called. We determined demographic and medical characteristics that distinguished these 2 groups through the use of logistic regression analysis. (2) In the subgroup of patients in which EMS was activated, we determined the relation of the caller to the patient and examined predictors of who called 911, based on the patient’s demographic and medical characteristics. χ^2 analysis was used to assess whether there were any significant associations between who called 911 and the following sociodemographic variables: sex, race, age group, education, income, employment status, living alone, having healthcare insurance, having a primary care physician, history of a previous stroke, and stroke subtype. A 1-tailed z test for a proportion of $>50\%$ was performed to test if being called by a family member was most likely within each particular subgroup.

Results

Between February 1, 1998, and October 13, 1998, 429 subjects with validated strokes or transient ischemic attacks presented to one of the emergency departments or were directly admitted to a hospital. Of the 429 validated cases, EMS was activated in 163 (38.0%) cases, no phone call was made in 129 (30.0%), and in $\approx 25\%$ of cases a family member, friend, personal physician, or insurance provider was contacted. (Table 2).

Table 3 is a logistic regression analysis exploring potential covariates predictive of EMS activation when comparing patients for whom 911 was activated with those who did not use 911 (62%). Individuals who were employed were 81% less likely to have EMS activated ($P=0.01$). Sex, race/ethnicity, age, education, insurance, living alone, prior stroke,

TABLE 3. Logistic Regression Analysis of Predictors of Calling EMS Versus Not Calling EMS for Acute Stroke

Variable	P	OR	95% CI
Race/ethnicity	0.83	1.07	0.57–2.03
Sex	0.37	1.29	0.74–2.23
Age group	0.12	1.02	1.0–1.04
Education	0.16	0.69	0.41–1.16
Health insurance	0.21	0.53	0.19–1.43
Living alone	0.84	0.94	0.52–1.69
Prior stroke	0.30	1.32	0.78–2.23
Ischemic stroke	0.054	0.44	0.19–1.01
Employment	0.013	0.19	0.04–0.63
Primary care physician	0.98	1.02	0.27–4.23

stroke type, and having a primary care physician did not independently distinguish cases in which 911 was called from those in which EMS was not activated.

Table 4 summarizes information regarding the 163 cases in which EMS were activated. Family members were most likely to initiate 911 calls for acute stroke followed by paid caregivers and coworkers. Stroke victims were the least likely to activate EMS services. This table also shows the 3 variables found on χ^2 analysis to have a significant association with variations in who called 911; living alone ($P=0.05$), insurance status ($P=0.007$), and age group ($P=0.02$). Across all subgroups, a family member was most likely to activate 911. Further χ^2 testing revealed a significant positive association between subjects not living alone and a family member ($P=0.008$) and a negative association between not living alone and a coworker ($P=0.01$) activating EMS. A significant association between uninsured subjects and a coworker activating EMS was also found ($P=0.024$). A 1-tailed z test for a proportion $>50\%$ found that individuals not living alone, subjects with insurance, and individuals 60 to 74 years of age were most likely to have a family member activate EMS.

No significant association by χ^2 analysis was found when looking at sex ($P=0.076$), race ($P=0.84$), or education ($P=0.38$) and who activated EMS. A 1-tailed z test for a proportion $>50\%$ found that men and whites were most likely to have a family member activate EMS. No significant

association by χ^2 analysis with the person activating EMS was found when looking at employment status ($P=0.68$), having a primary care physician ($P=0.49$), a previous history of stroke ($P=0.36$), or stroke subtype ($P=0.19$). Across all subgroups, the 1-tailed z test for proportion of $>50\%$ found family members most likely to call 911. Further χ^2 analysis did find an association between stroke type (ischemic versus intracerebral hemorrhage) and a family member calling 911 ($P=0.04$).

Discussion

Calling 911 is critical to increasing the chance that an acute stroke patient will present to the emergency department early enough to be eligible for acute treatment.^{3–8} Although a myriad of factors contributing to delay to emergency room presentation have been identified, the most important has been thought to be lack of patient knowledge regarding stroke symptoms and how to most appropriately respond to them by activating EMS.^{3,17} Studies have documented that 39% to 75% of stroke patients or the general population is unable to name a single warning sign or symptom of stroke.^{4,18,19} Increasing the use of EMS likely involves more than just improving stroke symptom knowledge but also that effective therapy exists and the possibility of good outcome is directly improved by calling 911.

This prospective study found that EMS was activated in $<40\%$ of acute stroke cases. Logistic regression analysis found employment to be the only predictive variable of differentiating those who called 911 from the 62% that did not. When the stroke victim was employed, EMS was 81% less likely to be activated compared with those patients who were not employed at the time of their stroke. This may reflect the fact that coworkers are more likely to transport patients in their private car. Alternatively, those who are employed spend more time away from family members, who are more likely to call 911 for stroke symptoms. This finding may emphasize that large employers may be good targets to improve the use of 911 services for stroke victims.

This study showed that only 4.3% of acute stroke patients called 911 themselves in a representative nonurban United States community. The study also found that a family member was most likely to contact 911 (60.1%), followed by a paid caregiver (18.4%), and then by a coworker or other

TABLE 4. Activators of EMS: Comparison of Patients' Sociodemographic Variables (Living Alone, Insurance Status, and Age Group)

χ^2, P	All	Lives Alone 0.05		Insured 0.007		Age Group 0.002		
	n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	<59 n (%)	60–74 n (%)	75+ n (%)
Who called 911								
Self	7 (4.3)	4 (11.8)	3 (2.5)	5 (3.5)	2 (18.2)	2 (10.5)	0 (0)	5 (5.7)
Family member	98 (60.1)	15 (44.1)	82 (68.9)	92 (64.8)	5 (45.5)	11 (57.9)	39 (78)	48 (55.2)
Paid caregiver	30 (18.4)	6 (17.6)	22 (18.5)	28 (19.7)	0 (0)	0 (0)	8 (16)	22 (25.3)
Coworker/other	28 (17.3)	9 (26.4)	12 (10.1)	17 (12.0)	4 (36.3)	6 (31.6)	3 (6.0)	12 (13.8)
P^*	0.0007	0.75	0.00002	0.0002	0.62	0.25	0.00004	0.17

*One-tailed z test for family member significantly $>50\%$ proportion.

χ^2 test of the association of these variables with significant variation in who called 911.

(12.9%). These data suggest that stroke patients are the least likely to call 911. On the basis of these findings, we suggest that educational programs should target those who are more likely to call 911, namely family members, paid caregivers, or coworkers of persons at risk for stroke. The alternative argument is that those at risk of stroke are appropriate targets, particularly since no call is made to any source in 30% of cases (Table 1). We believe this is less likely because physical limitations such as hemiparesis, aphasia, and agnosia may be the explanations for the low 911 activation by stroke patients. This will need confirmation in another study.

Interestingly, individuals with prior strokes were not more likely to activate the 911 system. These results are not surprising, given the previous work by Samsa et al,²⁰ in which <50% of patients with prior stroke were aware of their increased risk of stroke. In a previous study in Houston, Texas, acute stroke victims with a history of stroke were slower to arrive to the emergency room.³ These findings argue that knowledge of stroke symptoms alone is insufficient to change patient behavior. The population needs to know that getting to the hospital early will yield benefit. Patients with a previous stroke may think they have no incentive to get to the hospital quickly because no specific therapy was available when they had their first stroke.

Previous studies have identified sex and insurance status as critical factors in determining access to acute stroke care.³⁻⁵ In the current study, we found no significant association between these variables and activation of EMS. However, in those cases in which EMS was activated, men and whites were most likely to have a family member activate EMS. The sex differences may reflect the fact that women are more likely to be care providers rather than care recipients or may reflect the fact that women live longer and may be more likely to reside alone.

Since the study community is nonurban, caution must be used to extrapolate this data to urban populations. This data may be more relevant to the 25% of US residents that reside in nonurban areas.²¹ The majority of acute stroke research occurs in populations residing around large tertiary-care urban centers. Additional research is needed to determine the barriers to stroke therapy implementation for the more than 60 million nonurban residents in the United States in addition to those in other countries.

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