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To cite this article: T. J. Crocco, J. C. Grotta, E. C. Jauch, S. E. Kasner, R. U. Kothari, B. R. Larmon, J. L. Saver, M. R. Sayre & S. M. Davis (2007) EMS Management of Acute Stroke—Prehospital Triage (Resource Document to NAEMSP Position Statement), *Prehospital Emergency Care*, 11:3, 313-317, DOI: [10.1080/10903120701347844](https://doi.org/10.1080/10903120701347844)

To link to this article: <https://doi.org/10.1080/10903120701347844>



Published online: 02 Jul 2009.



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# EMS MANAGEMENT OF ACUTE STROKE— PREHOSPITAL TRIAGE (RESOURCE DOCUMENT TO NAEMSP POSITION STATEMENT)

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## ABSTRACT

PREHOSPITAL EMERGENCY CARE 2007;11:313–317

## INTRODUCTION

Stroke is the third leading cause of death and the leading cause of adult disability in the United States.<sup>1</sup> Roughly one American suffers a stroke every minute, and one American dies of stroke every 3.5 minutes.<sup>2</sup> In 1995, the National Institute of Neurological Disorders and Stroke (NINDS) study showed that intravenous administration of tissue plasminogen activator (tPA) had clinical benefit for a select group of patients with acute ischemic stroke. Most importantly, patients maximally benefit from intravenous administration of tPA if treatment is started as soon as possible within 3 hours of symptom onset.<sup>3–6</sup>

In addition to intravenous fibrinolysis, emerging endovascular therapies have shown promise or have received FDA approval as treatments for stroke in early time windows. Intra-arterial fibrinolysis within 6 hours of onset of middle cerebral artery infarction improved outcome in a randomized phase 3 trial.<sup>7</sup> Endovascular mechanical embolectomy with the MERCI Clot Retriever within 8 hours of onset showed technical success in achieving recanalization and was approved by FDA in 2004 for the restoration of blood flow in the neurovasculature in patients experiencing acute ischemic stroke.<sup>8,9</sup> Other therapies are also likely to be time dependent because the viability of ischemic brain tissue diminishes rapidly with time. This would be the

case for not only specific pharmacological or interventional therapy targeting reperfusion, neuroprotection, and limitation of bleeding but also for blood pressure control, correction of hyper- or hypoglycemia, and reversal of hypoxemia.

The narrow therapeutic window of stroke therapy has important implications for emergency medical services (EMS) system operation. EMS professionals must be proficient in their ability to recognize, assess, manage, treat, triage, and transport stroke patients. On the basis of a review of the literature, we make the following recommendations for the prehospital triage of stroke patients.

## DISCUSSION

### Expeditious EMS Dispatch and Response

An EMS response begins with the dispatch priority level. Because approved treatment for acute stroke must be initiated rapidly, dispatches for suspected stroke patients should be expedited.<sup>10–14</sup> Consequently, the prehospital response to a suspected acute stroke patient should always assume that a therapeutic window for treating an ischemic stroke is closing.

EMS transport to and arrival at the emergency department increases the odds that a patient will present within the 3-hour time window, compared to private physician referral and self-transport,<sup>15</sup> and significantly reduces the time from symptom onset to CT evaluation.<sup>16–20</sup> These findings imply that patients and their family members who suspect development of acute stroke should be encouraged to use EMS to expedite care. Unfortunately, the general public has limited understanding of the signs and symptoms of stroke.<sup>21–25</sup> Therefore, the burden of suspecting stroke is often transferred to EMS dispatchers. By providing additional guidance to EMS dispatchers to encourage appropriate questioning of callers to public safety answering points, the possibility of acute stroke may be recognized and aid sent quickly.

Patients with ischemic stroke and hemorrhagic stroke often have similar signs and symptoms, yet they require very different treatment. Only computerized tomography (CT) or magnetic resonance imaging (MRI) of the brain interpreted by an appropriately trained physician can determine whether the stroke is ischemic or hemorrhagic in etiology and guide appropriate selection of therapies.

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doi: 10.1080/10903120701347844

## Prehospital Stroke Screening and Patient Assessment

Early identification of stroke symptoms by emergency medical personnel is a valuable part of optimal care for victims of stroke. To optimize stroke identification in the field, prehospital professionals should be competent in the use of a prehospital stroke screening instrument that has been prospectively evaluated for sensitivity, specificity, reproducibility, and validity.<sup>27–30</sup>

The sensitivity of paramedic identification of stroke patients unaided by a formal screening algorithm has varied between 61% and 72%.<sup>27,31</sup> However, the use of a prehospital stroke assessment instrument has been shown to markedly increase paramedic sensitivity to stroke identification in the field. Two common prehospital stroke instruments, the Los Angeles Prehospital Stroke Screen (LAPSS) and the Cincinnati Prehospital Stroke Scale (CPSS), have both demonstrated sensitivities of greater than 90%.<sup>29,32,33</sup> In addition, the more recent Melbourne Ambulance Stroke Screen (MASS), which is an amalgamation of the CPSS and LAPSS, has also shown a sensitivity of 90%.<sup>33,34</sup>

Some studies have shown that EMS dispatchers may be trained to a modified stroke identification instrument, which can be effective in optimizing stroke care.<sup>35–38</sup> EMS personnel should be familiar with a technique of prehospital stroke assessment and use it routinely on patients suspected of having a stroke. Prehospital care providers should be capable of incorporating their prehospital stroke findings with the patient's signs, symptoms, and risk factors to make a final stratification of stroke likelihood.<sup>39</sup>

EMS professionals should attempt to determine the time of onset of the patient's neurological symptoms and the time the patient was last known to be symptom free. EMS professionals frequently have access to historical and medical information from family members, caregivers, or bystanders that may not be immediately available when the patient arrives in the emergency department. Time of onset is an essential component of prehospital stroke screening instruments and may be a factor in determining triage and transport modality decisions (see air medical transport of stroke patients). The onset time is based on when the patient was last seen at his or her normal or baseline level of function. Without a clear time of symptom onset, most recanalization (intravenous tPA) strategies may be precluded.<sup>28,29,40</sup>

Furthermore, EMS providers should have specific basic knowledge of, and document the proper use of, important principles of stroke management as embodied in acute stroke guidelines,<sup>5,11–13</sup> such as treatment of glucose and hypoxia.

Despite the importance of identifying stroke in the field, stroke-related subject matter has been given scant attention in the Department of Transportation's (DOT) National Standard Curriculum for all Emergency Med-

ical Service personnel. However, didactic material pertaining to stroke has been included in the majority of the most popular textbooks and reference materials for EMS providers. Furthermore, many of the handbooks and training manuals used in first responder training programs include a detailed coverage of stroke.

## Communication with Receiving Facilities

Previous studies on the prehospital management of acute myocardial infarction have shown that prehospital notification of impending patient arrival can reduce the time to reperfusion treatment.<sup>41–43</sup> Similarly, early EMS notification of an in-bound stroke patient can provide significant preparation time to hospital personnel.<sup>44</sup> Physicians, nurses, CT/MR technologists, pharmacists, and others are able to use early notification to mobilize necessary resources for the patient.<sup>5,45,46</sup> Prehospital notification of in-bound stroke has been demonstrated to shorten delays from ED arrival until initial neurological assessment and initial brain imaging, and to increase the proportion of patients treated with reperfusion therapy, both as an individual intervention,<sup>18,19</sup> and as one element in the implementation of a comprehensively organized prehospital stroke care system.<sup>25,47–50</sup>

## Local/Regional Strategies for Stroke Patient Destination

Several factors are important in determining a hospital's capability in providing emergent stroke care. Some of these important factors include (1) the presence of physicians with expertise in the diagnosis and management of stroke and head CT and/or MRI interpretations, (2) the availability of essential brain imaging capacity (CT or MRI) and adequate emergent ancillary care, and (3) the availability of knowledgeable personnel to carry out approved stroke therapies including the use of IV-rtPA, and (4) the presence of an institutional plan to handle, or at least provide initial evaluation of, primary hemorrhages and hemorrhagic transformation of cerebral infarcts.<sup>51</sup> It is unreasonable to expect all hospitals (urban, suburban, and rural) to provide this level of care for patients with stroke on a 24-hour basis. However, any limitations in the availability of these important factors should be incorporated into the regional protocol for triaging acute stroke patients in the prehospital setting and agreed upon by the stakeholders. The stakeholders for developing such protocols should include (but are not limited to) EMS personnel, EMS medical directors, emergency physicians, neurologists, radiologists, neurosurgeons, and stroke patients. Many state health departments and EMS agencies in collaboration with the American Heart Association/American Stroke Association are working with these stakeholders to facilitate the development of these protocols.

Previous research has documented the improved outcome of patients who receive in-hospital care at facilities specializing in stroke care.<sup>52–54</sup> In addition, transporting patients to a center with immediate access to stroke expertise and willingness to treat has been shown to increase tPA use.<sup>25,47</sup> Lattimore also found that becoming a stroke center increased tPA use.<sup>55</sup> These findings suggest that bypass of facilities unable to reliably provide basic stroke care in favor of primary stroke center facilities capable of providing this care may increase the number of patients treated with thrombolytic therapy and thus promote better patient outcomes, when resultant additional travel times and system burden are not too great.

The Joint Commission on Accreditation of Healthcare, nationally, and several state Departments of Health, regionally, now provide credentialing for hospitals that meet minimum criteria for carrying out acute stroke care. These are being adopted by some state legislatures to foster statewide stroke triage plans (New York, Massachusetts, Michigan, Florida, Texas, New Jersey, New Mexico, and others). Prehospital stroke triage policies should address time variables (interval between symptom onset and EMS evaluation), distance variables (transport distance to available health care facilities), and available stroke care capabilities in the region.

Because almost half of all acute stroke patients will not use EMS to access health care, it is important that all emergency departments develop plans to quickly assess and treat victims of stroke. It may be useful to secondarily transfer stroke patients to a regional stroke unit regardless of the age, size, or severity of the stroke as well as the administration (or lack thereof) of fibrinolytic therapy. Any protocols with respect to secondary transfers to regional stroke units should be developed with EMS operational and medical direction involvement to ensure timely transport by appropriate EMS personnel.

### Emerging Alternative: Air Medical Transport

In remote geographical areas without nearby hospital facilities, the use of air medical transport from the field to a stroke center or other facility capable of managing acute stroke patients should be considered.<sup>57</sup> Air medical transport may reduce transit times, may increase the availability of thrombolytic therapy to residents of rural communities,<sup>58</sup> and may be cost-effective.<sup>59,60</sup> The air medical evacuation of a stroke patient in the prehospital setting could be considered if both of the following conditions are present:<sup>51</sup>

1. The closest facility capable of providing treatment to the patient with an acute stroke is more than an hour

away by ground ambulance. Given the current 3-hour window for fibrinolytic therapy, ground transportation for more than 1 hour is likely to preclude intravenous tPA administration. Transport times exceeding 60 minutes could potentially be used more effectively for in-hospital evaluation and supportive care than in transit.

2. The patient can reach a facility providing definitive stroke diagnosis and treatment within the 3-hour therapeutic time window for intravenous thrombolysis, or longer if medically appropriate for other interventions, using air medical transport.

If these conditions cannot be achieved, then prehospital triage should be determined by the guidelines set forth above, and the patient should be transported to the nearest hospital for initial assessment and stabilization. Secondary interfacility transport to a stroke center, either by ground or air, may follow when feasible if medically appropriate.<sup>60–62</sup>

In any situation where air medical evacuation is necessary, we strongly support prehospital discussion with medical oversight because air transportation may be influenced by weather, availability of personnel and air ambulances, maintenance issues, and other factors that may negate its potential advantage of speed.

In summary, EMS systems should consider developing a policy of transporting acute stroke patients by air if the closest facility capable of treating acute stroke is more than 1 hour away by ground transport, and the patient can reach the facility within the treatment time windows for selected therapies. Because of the many factors that influence the success of air medical transport, future research should examine the factors that are most strongly associated with the optimal use of air medical transport for stroke patients.

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