AHA/ASA Policy Statement

Implementation Strategies for Emergency Medical Services Within Stroke Systems of Care

A Policy Statement From the American Heart Association/ American Stroke Association Expert Panel on Emergency Medical Services Systems and the Stroke Council

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Stroke remains the third leading cause of death and a leading cause of long-term disability among Americans, despite advances in stroke prevention, diagnosis, treatment, and rehabilitation. Approximately 700 000 individuals suffer a new or recurrent stroke each year.[1] Advances over the past decade in acute stroke care, including the introduction of fibrinolytic and other short-term therapies, have highlighted the critical roles of emergency medical services (EMS) agencies and emergency medical services systems (EMSS) in optimizing stroke care.[2–7]

In this context, the term "EMS" refers to the full scope of prehospital services necessary for the acute care of patients with stroke, including 9-1-1 activation and dispatch, emergency medical response, triage and stabilization in the field, and transport by ground or air ambulance to a hospital or between facilities.

The term "EMSS" refers to the delivery systems for EMS that may be organized on a local, regional, statewide, or nationwide basis.[8] EMSS involves the organization of public and private resources for the delivery of emergency medical care. These systems include the community, emergency medical and healthcare personnel, public safety agencies, emergency facilities, and critical care units. The dissemination of public information and education, provision of professional training, and development of disaster planning and standardized record keeping also are key elements of EMSS. Additionally, EMSS must address issues related to communication, transportation, access to care, patient transfer, mutual aid (the sharing of resources across EMSS), and system review and evaluation.[9] The successful integration of one (and often multiple) EMSS is critical to ensuring the effectiveness of a stroke system of care.

The American Stroke Association (ASA), a division of the American Heart Association (AHA), is dedicated to improving stroke prevention, treatment, and rehabilitation through research, education, advocacy, and the development of scientifically based standards and guidelines. In 2004, the ASA convened a multidisciplinary task force on the development of stroke systems (2004 Task Force). The 2004 Task Force found that the fragmented approach to care that exists in many regions of the United States is a significant obstacle to reducing the morbidity and mortality attributable to stroke. To address this fragmentation in care, the 2004 Task Force recommended the establishment of stroke systems of care and identified the activation and response of EMS as one of the 7 critical components of effective stroke systems of care.[10]

In 2006, the ASA convened a multidisciplinary group, the ASA's Expert Panel on Emergency Medical Services, to examine in greater detail the 2004 Task Force's recommendations involving EMSS. In this article, the Expert Panel examines the challenges associated with integrating EMS activation and response within stroke systems of care and identifies both performance measures and resources to ad-

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dress these challenges. Additional expert panels will address the remaining components of effective stroke systems.

The ASA's Expert Panel comprises nationally recognized experts in the areas of stroke care, EMS, emergency medicine, and healthcare policy development. Under the direction of the Expert Panel, ASA/AHA staff and HealthPolicy R&D (a policy research firm in Washington, DC, affiliated with the law firm of Powell Goldstein LLP) conducted a review of the clinical and health policy literature relevant to the activation and response of EMSS for stroke. The authors were subject to full disclosure, and any conflicts of interest were reviewed by the Manuscript Oversight Committee of the AHA. The literature review included the use of Medline and other electronic databases to identify articles, government studies, and reports published by the EMS community between January 1994 and April 2006.

The Expert Panel also reviewed preliminary survey information compiled by the ASA regarding the strategies used and challenges faced by various states and communities in establishing stroke systems of care.[11] (See also AHA Survey of State Stroke Plans; unpublished data, 2005.) Members of the Expert Panel identified additional resources and participated in a series of teleconferences and other communications to draft the content of these recommendations.

Challenges and Strategies for Integrating EMSS Within Stroke Systems of Care

The effective integration of EMS for stroke involves complex interactions among the public, 9-1-1 call center personnel, EMS providers, emergency department (ED) providers, and stroke care specialists. The most important goals for prehospital care for stroke patients include the identification of the stroke patient in the field, the provision of appropriate prehospital care to the patient, and the transport of the patient to the most appropriate hospital. All of these goals should be achieved in the shortest amount of time possible.

When integrated effectively within a stroke system, rapid EMS activation, response, and transport to an appropriate facility can translate into significant reductions in time for the treatment of a stroke patient. Effective stroke systems of care may include 2 types of stroke centers: primary stroke centers and comprehensive stroke centers.[7,10]

Primary stroke centers include facilities recognized as providing stroke patients with high-quality stroke care designed to improve patient outcomes.[7] Comprehensive stroke centers provide the stroke services available through primary stroke centers, as well as the higher-intensity services needed by patients with complex types of stroke or with conditions requiring services that typically are not available at primary stroke centers.[6] Primary stroke centers are certified by the Joint Commission on Accreditation of Healthcare Organizations and in several cases by state-administered programs. Some states are just beginning to explore the definition of a comprehensive stroke center and its role within the stroke system, but comprehensive stroke center certification by a national organization is not currently available.

The 2004 Stroke Systems Task Force's original recommendations involving EMSS in the context of stroke systems of care fall within the following 4 categories:

- For activating and dispatching the EMS response for stroke patients, stroke systems should require appropriate processes that ensure rapid access to EMS for acute stroke patients.
- For EMS responders, EMSS should use protocols, tools, and training that meet current ASA/AHA guidelines for stroke care.
- Prehospital providers, emergency physicians, and stroke experts should collaborate in the development of EMS training, assessment, treatment, and transportation protocols for stroke.
- Patients should be transported to the nearest stroke center for evaluation and care if a stroke center is located within a reasonable transport distance and transport time. The determination needs to take into account regional issues such as the availability of stroke centers and geography and whether transportation to a stroke center is possible within the appropriate time for acute therapeutic interventions.

The 2004 Task Force also highlighted the critical role of continuous quality improvement (CQI) strategies in the successful ongoing operation of stroke systems of care. CQI strategies involve ongoing assessments of the functions performed by all participants in the stroke system that affect the health outcomes of stroke patients. The development of performance measures and CQI strategies should address the activation and response of EMS and involve the exchange of information among EMSS and hospitals. Performance measures should reflect both process and outcomes measures that are identified through evidence-based methods or national expert consensus.[10]

The current EMSS Task Force therefore proposes the following recommendations and metrics for implementation.

For Activating and Dispatching the EMS Response for Stroke Patients, Stroke Systems Should Require Appropriate Processes That Ensure Rapid Access to EMS for Acute Stroke Patients

Stroke systems should address the following 3 issues to help ensure that stroke patients have rapid access to EMS:

- Locate acute stroke patients rapidly by ensuring that the public has access to enhanced landline and wireless 9-1-1.
- Identify acute stroke patients rapidly and accurately by ensuring that EMS communicators recognize stroke signs and symptoms as reported by callers.
- Dispatch the highest level of care available to suspected stroke patients in the shortest time possible by ensuring that EMS communicators use emergency medical dispatch guidelines reflecting the current ASA/AHA guidelines.

Locate Acute Stroke Patients Rapidly by Ensuring That the Public Has Access to Enhanced Landline and Wireless 9-1-1

Although all persons requiring emergency care may benefit from systems that assist EMS personnel in locating patients rapidly, acute stroke patients are at heightened risk of being unable to describe their location to EMS communicators. This challenge highlights the need for widespread access to en-

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hanced 9-1-1 capabilities for landline telephones (E911) and for wireless telephones (W-E911) that automatically provide the appropriate 9-1-1 call center with the caller's number and address.[10,12]

Currently, approximately 93% of the counties in the United States have E911 coverage for landline telephones.[13] In contrast, despite the growing reliance on wireless telephones, W-E911 is at least partially implemented in only approximately 51% of counties.[13]

The effort to expand access to E-911 and W-E911 is complicated by the patchwork of private and public organizations involved with the oversight of 9-1-1 call centers and telephone service providers. For example, implementing W-E911 capabilities requires that wireless carriers, local telephone companies, and 9-1-1 call centers coordinate and install equipment that allows EMS communicators to identify caller number and location information.[14]

To facilitate the implementation of W-E911, the Federal Communications Commission (FCC) adopted rules requiring wireless carriers to develop the capability to provide caller number and location information to 9-1-1 call centers on request.[15] Despite these efforts, wireless carriers in a number of areas have secured waivers under these rules, and in many other areas, 9-1-1 call centers have not yet requested this information from wireless carriers. In many instances, 9-1-1 call centers have inadequate funding to purchase equipment or sustain operations for E911 or W-E911 service. Unfortunately, the funds collected by states from wireless carriers through customer taxes are not always used to update 9-1-1 call center capabilities.[14]

Rural communities face additional challenges. Many rural areas are serviced by smaller wireless carriers that may have difficulty devoting resources to the necessary equipment upgrades. States that allocate resources on the basis of population may leave 9-1-1 call centers in rural areas without sufficient funds to upgrade their equipment. As a result, even individuals who typically have W-E911 capabilities in urban areas may find that local wireless carriers in rural areas are unable to decode the information describing their location when traveling.

In areas where E911 and W-E911 capabilities direct EMS personnel to the correct address, significant challenges remain in locating callers within office buildings, hotels, and other large establishments that use multiline telephone systems (MLTS). In most circumstances, calls received through MLTS do not offer reliable location information, which may slow the EMS response to these calls as EMS providers search for the patient.

Another emerging challenge involves locating individuals who call using Voice over Internet Protocol (VoIP) services, which permit individuals to call from any computer over the Internet through landline or wireless connections. The FCC has established rules mandating that VoIP providers transmit 9-1-1 calls and forward the caller's number and registered location to EMS communicators.[16,17] However, these rules generally do not address the portable use of VoIP services. VoIP providers often do not have the capability to determine the location of the caller and must rely on consumers to update their registered location information if they change locations.[18]

New technologies and services are becoming available to assist EMS in locating callers. For example, vehicle safety and security systems provide around-the-clock access to operators who can connect callers to EMS communicators and identify each caller's location. Additionally, newly developed advanced automatic crash notification systems used in conjunction with National Highway Traffic Safety Administration (NHTSA) software allow in-vehicle services' operators to forward data on the severity of the crash directly to 9-1-1 call centers that are capable of receiving these data.[8]

Taken in combination, efforts to automatically identify callers' locations help enhance the treatment of acute stroke, as well as myocardial infarction and other acute emergencies.

Potential Solutions and Resources for Additional Information

- Advocate for funding and legislation at the federal, state, and local levels to provide universal availability of W-E911 capabilities. For example, Wisconsin has enacted legislation to promote and help fund the implementation of W-E911 capabilities in portions of the state.[19–21]
- Support public policy initiatives and other activities that promote increased quality and appropriate use of 9-1-1 systems. For example, Indiana and Virginia have established state-level boards to disburse funds and oversee the statewide implementation of enhanced 9-1-1 services.[22–26]
- Identify political leaders or champions for rural areas in the state and advocate for funding on behalf of 9-1-1 call centers and wireless carriers that serve rural areas.
- Advocate for the adoption of legislation that will require MLTS to provide 9-1-1 call centers with sufficient information to locate callers. This legislation could permit entities with MLTS a range of options for meeting these requirements on the basis of the particular technical limitations of the MLTS and the local 9-1-1 call center.[27]
- Advocate for the FCC to disallow or limit waivers of the rules that require wireless carriers to develop and implement the capabilities necessary to provide caller number and location information to EMS communicators. In addition, advocate for the FCC to enforce compliance with the existing federal requirements for VoIP providers and to develop requirements for portable VoIP services.
- Consider collaborating with in-vehicle services, which locate the caller as well as provide an operator intercept for emergency calls. For example, Birmingham Regional Emergency Medical Services System has established a partnership with an in-vehicle service.[28] The in-vehicle service provides immediate notification to Birmingham Regional EMSS concerning medical emergencies for vehicle occupants, allowing the in-vehicle system to transmit data directly to the EMSS.[29] The in-vehicle communications system can help EMS personnel locate drivers or passengers experiencing a stroke (and other medical emergencies) and offer emergency medical dispatch instructions.

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Recommended Measurement Parameters

- Ensure 100% coverage for E911 and W-E911 services for all callers in all geographic areas covered by the stroke system of care.

Identify Acute Stroke Patients Rapidly and Accurately by Ensuring That EMS Communicators Recognize Stroke Signs and Symptoms as Reported by Callers

Educating EMS communicators about the signs and symptoms of stroke can have important positive benefits. Bystanders and relatives calling 9-1-1 for stroke patients often spontaneously identify key signs of stroke. EMS communicators need to improve the frequency with which they identify suspected stroke patients when provided with these key signs and symptoms.[30–34]

By identifying suspected acute stroke patients, EMS communicators can dispatch the most appropriate EMS response (see discussion below). In addition, EMS communicators serve a vital role by providing prearrival information to stroke patients and their families to assist in mitigating the potential negative consequences of stroke.

When patients with suspected acute stroke are identified, EMS communicators also can begin the process of collecting vital prehospital information that is necessary for determining the most appropriate transport destinations and ultimately the most appropriate treatment. For example, EMS communicators can collect important information about the last time the patient was seen without signs or symptoms of a stroke, the patient's medical history, and the patient's current medications.

The rapid identification of a patient with suspected acute stroke also enables EMS communicators to notify EMS responders en route that the patient may be experiencing a stroke. Some EMS responders have limited experience in assessing and screening for stroke. The typical EMS responder encounters approximately 4 to 10 stroke patients each year.[33,35,36] As a result, advance notice by EMS communicators of a suspected stroke can provide first responders, emergency medical technicians (EMTs), and paramedics with the opportunity to review stroke protocols, screening tools, and assessment tools while traveling to the patient.[31]

Potential Solutions and Resources for Additional Information

- Use stroke educational materials and 1 or more stroke experts (physicians, nurses, EMTs, and paramedics) to provide education to EMS communicators about the signs and symptoms of stroke.[10] These educational materials should reflect current published ASA/AHA recommended guidelines for emergency cardiovascular care.[37]
- Ensure EMSS emergency medical dispatch (EMD) guide cards and educational resources are stroke-specific. Such guide cards and educational resources are available within the EMSS community.[38–41]

Recommended Measurement Parameters

- Ensure that all EMS communicators within a stroke system of care receive written and in-person education on recognizing stroke signs and symptoms as reported by callers. These educational efforts should be conducted periodically, although the frequency should be based on local training requirements and resource availability.

Dispatch the Highest Level of Care Available to Suspected Stroke Patients in the Shortest Time Possible by Ensuring That EMS Communicators Use Emergency Medical Dispatch Guidelines Reflecting the Current ASA/AHA Guidelines

Dispatch prioritization is a critical stroke system function, requiring EMS communicators to identify correctly the most appropriate response level in terms of types of personnel (eg, advanced life support or basic life support), types of responding vehicles, and timeframe (eg, use of red lights and siren for life-threatening emergencies).[42] Historically, emergency calls from patients suffering a stroke often have not received the highest available care level.[10,31]

Nonetheless, EMS response units should be dispatched at the highest priority and highest available care level for suspected acute stroke patients (prioritized above conditions with less time-dependent treatment regimens).[43] Fibrinolytic and other acute therapies for acute stroke must be administered within a narrow timeframe after the onset of stroke signs and symptoms. These therapies require EMS communicators to treat stroke in the same manner as they would a significant trauma or heart attack.[44]

EMS communicators should strive to dispatch the nearest available advanced life support (ALS) response unit to calls involving signs and symptoms of stroke. Optimally, this response unit should be fully equipped with ventilation and oxygenation capabilities, including the ability to provide advanced airway maintenance, endotracheal tube checks, end-tidal CO_2 monitoring, and ECG monitoring.[45] Ideally, there should be a minimum of 2 paramedics who are certified in AHA advanced cardiovascular life support (ACLS)[46] and are prepared to administer all ACLS Class I and Class II interventions on each stroke response.

The lack of sufficient resources can interfere with the immediate dispatch of appropriate EMS response units for a patient experiencing a stroke. Financial support for EMSS generally relies on public funding (eg, local taxes, state funds, government levies, user fees, Medicare). Sparsely populated areas may be unable to sustain the operation of a 24-hour EMSS, and individuals in these communities may rely on services from neighboring communities through mutual aid agreements. This dynamic may greatly increase the time required for EMS responders to reach patients. EMSS in urban areas also may face financing problems, such as increasing demands for services (without corresponding increases in funding) or decreased funding secondary to other financial pressures on local or state budgets.[47]

EMSS in rural areas face additional challenges. They often rely on volunteer EMS responders who have full-time jobs that may prevent participation in responses to daytime emergencies. Rural areas also experience greater attrition of EMS personnel and difficulty maintaining continuous education and access to continuing medical education activities.[47] This kind of training is imperative for optimal stroke systems to

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ensure that EMS responders have the most current competency in stroke.

In addition, language barriers may occur when callers do not speak English as their primary language, creating delays in the immediate dispatch of response units. Additional educational opportunities or language resources may be required to address language barriers that exist in certain cities and areas of the country, especially where large portions of the population have limited English-speaking skills.

Potential Solutions and Resources for Additional Information

- Review dispatch guidelines used by all 9-1-1 call centers within the stroke system to ensure that the highest-priority response is given to callers with signs and symptoms of stroke. Revise guidelines that are incompatible with this priority response principle.
- Promote the use of nationally recognized emergency medical dispatch guidelines reflecting current ASA/AHA recommendations for stroke care among the 9-1-1 dispatch agencies within the stroke system of care. Work with the appropriate federal standard-setting organization for emergency medical dispatch protocols—NHTSA and the American Society of Testing and Materials—to ensure that their standards include the appropriate guidelines for identification of and assistance with stroke patients.[48,49]
- Advocate for funding for local 9-1-1 call centers to receive training and to acquire an EMD caller interrogation tool to help EMS communicators more effectively identify suspected stroke patients in the field. For example, the Massachusetts Department of Public Health Heart Disease and Stroke Prevention and Control Program is partnering with the Massachusetts Statewide Emergency Telecommunications Board to support 9-1-1 call centers with EMD software. This EMD software is designed to ensure that the EMS responses to stroke, myocardial infarction, and other medical emergencies are appropriate and consistent. Upon funding, 9-1-1 call centers agree to conduct regular quality assurance on 9-1-1 medical emergency calls and to submit electronic data to the Heart Disease and Stroke Prevention and Control Program for surveillance.
- Work with the leading commercial providers of EMD protocol interrogation tools to ensure that their products meet ASA/AHA standards and guidelines for identifying and assisting stroke patients.
- Advocate for state legislation that establishes EMD guidelines consistent with federal guidelines as the standard of care. For example, in 2003, the AHA affiliate in Florida helped pass HB 0195, legislation that established federal guidelines for EMD protocols as the legal standard of care in Florida.
- Establish targets for reducing the time-to-dispatch interval. These targets could be included as a component of certification and proficiency programs for EMS communicators.
- Advocate for local, state, federal, and third-party payer funding to ensure the availability of ALS ambulances and paramedics across the stroke system's catchment area.
- Advocate for state and federal rules or standards to require that ALS units be equipped with ECG monitoring devices and other resources necessary to properly care for stroke patients.
- Collaborate with organizations that provide services and assistance to non–English-speaking patients and callers to improve the ability of EMS communicators to communicate effectively with contacts who do not speak English as their primary language. For example, the AHA affiliate in Massachusetts is working with the Statewide Emergency Telecommunications Board to provide a statewide solution for linguistic services for EMS communicators.[50] In cities or areas of the country where a large portion of the population speak the same non-English language as their primary language, educational opportunities may need to be made available for existing staff, or bilingual EMS communicators or responders may be required. Alternatively, especially in areas with diverse communities where many different languages are spoken, EMSS may consider implementing over-the-phone interpreter services to provide assistance to EMS communicators and responders and ED staff.
- Advocate for state and federal policymakers to support EMS personnel in rural areas to ensure the availability and quality of the emergency response system.

Recommended Measurement Parameters

- Ensure that 100% of 9-1-1 call centers use dispatch guidelines that prioritize patients experiencing stroke as requiring a high-priority EMS response at the highest care level available.
- Ensure that the time period between the receipt of the call and the dispatch of the response team is less than 90 seconds for 90% of calls involving stroke. Incoming calls should be answered immediately, and there should be rapid determination of the nature of the emergency and event time for onset of the stroke.
- Ensure that EMS communicators correctly identify a maximum percentage of callers experiencing stroke and dispatch EMS responders at the highest priority for these calls.

For EMS Responders, EMSS Should Use Protocols, Tools, and Training That Meet Current ASA/AHA Guidelines for Stroke Care

Stroke systems should address the following 2 issues to ensure the effective response of EMS within a stroke system of care.

- Identify acute stroke patients rapidly and accurately by ensuring that EMS responders use validated screening algorithms effectively.
- Establish goals for the EMSS response time for suspected stroke patients.

Identify Acute Stroke Patients Rapidly and Accurately by Ensuring That EMS Responders Use Validated Screening Algorithms Effectively

EMS communicators play an important role in identifying suspected stroke patients quickly, but it is equally important for EMS responders to confirm and otherwise identify acute

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stroke patients rapidly and accurately in the field.[10] The identification of stroke patients by EMS responders in the field allows for initiation of appropriate treatment in the field, rapid transport of acute stroke patients, determination of the most appropriate hospital, and prearrival notification to the receiving hospital that a stroke patient is en route.[51]

EMS responders can identify stroke patients with a high degree of accuracy when validated stroke screening algorithms for the prehospital setting are used. For example, the Cincinnati Prehospital Stroke Scale (adapted from the hospital-based National Institutes of Health Stroke Scale for the identification of stroke in the prehospital setting) and the Los Angeles Prehospital Stroke Screen (developed by a prehospital and stroke expert panel) enable EMS responders to identify stroke patients with a high degree of reliability.[52–57]

Despite the literature demonstrating the effectiveness of validated stroke screening forms, there remains a need to increase the use of these forms by EMS responders. Although other medical conditions may produce similar symptoms, all patients with symptoms consistent with stroke should be treated as suspected stroke patients until proven otherwise.[58,59]

After identifying a stroke patient using a validated screening form, EMS responders can use validated stroke scales to rate the severity of the stroke in the field.[60–62] Validated stroke severity scales developed specifically for prehospital use include the Los Angeles Motor Scale[62] and the Shortened National Institutes of Health Stroke Scale.[61] Stroke severity scales have been used in prehospital treatment trials[63] and were shown to discriminate with high accuracy ischemic stroke patients likely to have a large-vessel vascular occlusion from patients without large-vessel occlusion.[64] Further research is warranted regarding the potential use of these scales or other triage factors for routing selected patients directly to stroke centers that provide acute large-vessel endovascular recanalization therapy.

Potential Solutions and Resources for Additional Information

- Ensure that EMS responders use validated stroke screening tools to aid in the identification of stroke patients.
- Advocate for consistent use of a single stroke screening tool at the community, state, or regional level, as appropriate, to improve the identification of stroke patients by EMS responders.
- Request that the medical directors of EMSS include a stroke screening tool in the protocols for prehospital stroke assessment and provide education on the use of the screening tool for all EMS personnel.[65]
- Include stroke screening tools within the 10 core ACLS cases when teaching both prehospital and hospital personnel.[65,66]
- Request that all ED personnel who receive EMS prearrival patient reports obtain copies of the stroke screening tools for all suspected stroke patients.
- Implement CQI programs and iteratively improve the accuracy of stroke identifications made by prehospital personnel by comparing completed prehospital stroke screening forms with final hospital discharge diagnoses for stroke patients. EMSS need support and participation from hospitals in the quality assessment/quality initiatives process. Hospitals should report pertinent data back to EMSS, including mortality/morbidity and discharge diagnosis.
- Include research on the use of prehospital stroke severity scales or other triage factors as part of prehospital treatment trials that seek to evaluate the direct routing of certain stroke patients by ground or air ambulance to comprehensive stroke centers, or as part of other EMSS activities where the assessment and recognition of the severity of the stroke could be an important component of care.

Recommended Measurement Parameters

- Ensure that 100% of EMSS use validated prehospital stroke screening tools to identify stroke patients.
- Ensure that when EMS responders screen patients for stroke, they err on the side of over-identification ("over-triage") rather than under-identification ("under-triage") of stroke patients. Initially, EMSS should establish a goal of over-triage of 30% for the prehospital assessment of acute stroke. Trauma triage criteria experience has shown that if over-triage is not present, then under-triage will result.[67] In the case of stroke, under-triage could delay the patient's receipt of time-sensitive care.
- As part of the CQI process, EMS responders' stroke screening assessments should be compared against final patient diagnoses to identify instances where the initial prehospital screening failed to identify patients who were experiencing a stroke (under-triage). These data should be used to develop and adjust EMS responder training and protocols for the use of stroke screening forms. Additional educational assistance also should be provided to EMS personnel who routinely under-triage patients.

Establish Goals for the EMSS Response Time for Suspected Stroke Patients

Each EMSS should develop response time goals for stroke that are tailored to the region's resources and infrastructure. Dispatch decisions should balance the availability of different levels of EMS responders and the need for rapid transport to an appropriate hospital.[10]

The following definitions for response times are based on nationally accepted standards that facilitate the collection of response time data that benefit all patients in an EMSS, including stroke patients.[68–72]

- The EMSS response time comprises the dispatch time, the turnout time, and the travel time, as described below.
- The dispatch time is the interval between the time a call is received at the EMS answering point and the time the EMS unit is selected and notified of the need to respond. The provision of prearrival instructions occurs during this time interval.
- The turnout time (also referred to as the "out-of-chute" time) is the interval between the time the EMS unit is notified of the need to respond and the time the EMS unit starts moving (wheels turning).

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- The travel time is the interval between the time the EMS unit starts moving and the time the EMS unit arrives at the scene and stops moving.
- The "on-scene" time is the amount of time spent with the patient before start of transport.

Although standardized definitions should be used to measure response time intervals, each EMSS should consider factors such as available system resources, geography, population density, community expectations, and ultimately, the type of response that constitutes the best care for the patient when determining acceptable time intervals for each component of the response time.

Within each stroke system, there should be a multitiered EMS response system with dispatch triage protocols to provide ALS units on all responses triaged as suspected stroke whenever possible. Well-established criteria should be created within stroke systems for the dispatch of air transport in areas where ground transport to the appropriate facility would exceed 1 hour or result in a stroke patient who is potentially eligible for thrombolytic or other acute therapies becoming ineligible for treatment.[35]

Potential Solutions and Resources for Additional Information

- Measure and report the overall EMSS response time and on-scene time for all stroke patients. Although the EMSS response time is 1 overall measurement parameter, the times for each component of the response time should be captured and reported to provide the EMSS with the data necessary to measure and improve overall response time performance. Often, precious time is lost during delays in the dispatch time and the turnout time.
- Measure and report additional response times for every element of the EMSS whenever possible. These response times include, but are not limited to, 9-1-1 call center processing time, the response times of first responders, basic life support response times, and the time spent to reach the patient.
- Work with the National EMS Information System (NEMSIS) project to recommend that states collect and submit all necessary data elements for stroke for inclusion in the national EMS dataset. NEMSIS, a public–private collaboration to promote implementation of the NHTSA Uniform Pre-Hospital EMS Dataset, defines more than 400 data elements that EMSS may collect for planning, evaluation, and quality-improvement activities. At this time, states are asked to collect and submit only 68 of these data elements for inclusion in a national database.[73] For example, states are asked to submit data to the national database on the complaint reported by the dispatcher to the responding unit (which could include "stroke/cerebrovascular accident"). However, although data elements already exist to capture the length of time a patient has been experiencing stroke symptoms and the use and results of stroke prehospital stroke screening forms and thrombolytic screenings, states are not asked to submit these data for inclusion in the national dataset.[72]
- For data elements absent from the NHTSA's national dataset, work with state EMS offices to ensure that the appropriate stroke elements are nonetheless captured in state datasets.
- Encourage EMSS to collect NHTSA-defined stroke data elements and use these data for CQI activities.

Recommended Measurement Parameters

- Ensure that EMSS response time is less than 9 minutes at least 90% of the time for suspected acute stroke patients. The EMSS response time reflects the amount of time elapsed from the receipt of the call by the dispatch entity to the arrival on the scene of a properly equipped and staffed ambulance.
- Ensure that dispatch time is less than 1 minute, turnout time is less than 1 minute, and travel time is equivalent to trauma or acute myocardial infarction (AMI) calls.
- Ensure that on-scene time is less than 15 minutes (unless there are extenuating circumstances or extrication difficulties).
- Report all times using the fractile method (eg, 90th percentile). For accurate data collection, all clocks capturing these times in the EMSS should be synchronized.

Prehospital Providers, Emergency Physicians, and Stroke Experts Should Collaborate in the Development of EMS Training, Assessment, Treatment, and Transportation Protocols for Stroke

Frequent and meaningful dialogue should occur among prehospital providers, EMS medical directors, ED medical and nursing directors, stroke center directors, and stroke neurologists about operational and CQI issues.[10] Stroke systems should address the following 4 issues to help ensure that prehospital providers, emergency medicine physicians and nurses, and stroke experts collaborate in the care of stroke patients and the development of EMS training and protocols.

- Promote ongoing collaboration among prehospital and hospital providers in the acute treatment of stroke patients.
- Develop and implement stroke education activities collaboratively with prehospital and hospital providers.
- Develop stroke system transport protocols collaboratively with prehospital and hospital providers, as well as with other stakeholders.
- Engage collaboratively with prehospital and hospital providers in CQI processes for stroke patient care while complying with protections for the privacy of personal health information.

Promote Ongoing Collaboration Among Prehospital and Hospital Providers in the Acute Treatment of Stroke Patients

Collaboration between EMS responders and hospital providers can help minimize the time required for stroke patients to receive evaluation, care, and urgent therapy. Currently, 1 important benefit for patients of the close collaboration between EMS responders and ED providers is the ability of EMS responders to facilitate rapid treatment at the hospital through prearrival notification.[35,74]

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Prearrival hospital notification by EMS responders who are known to accurately recognize stroke patients can increase the likelihood that hospitals quickly receive and treat stroke patients.[36] Physicians, nurses, computed tomography/magnetic resonance technologists, pharmacists, and others are able to use early notification to mobilize necessary resources for the patient.[75–77] Prehospital notification of an in-bound stroke patient has been demonstrated to shorten delays from ED arrival until initial neurological assessment and initial brain imaging. In addition, prehospital notification increases the proportion of patients treated appropriately with reperfusion therapy, both as an individual intervention[78,79] and as 1 element in the implementation of a comprehensively organized prehospital stroke care system.[80–84]

Challenges exist to the implementation of effective collaborations among stakeholders within stroke systems of care. Difficulties have been reported in achieving open communication among all parties involved in stroke patient care, highlighting the need for better integration of prehospital and hospital services. Lack of support from key leaders, including EMS medical directors and 9-1-1 call center managers, often is an obstacle to improved collaboration and successful implementation of the EMS component of stroke systems of care (American Heart Association, Survey of State Stroke Plans, unpublished data, 2005).

Even established collaborations among stakeholders can experience difficulties over time. Existing collaborations involving stroke have reported on the need to frequently reenergize collaborative efforts, to become more proactive over time in setting the agenda for these partnerships, and to better expand upon existing infrastructure and relationships (American Heart Association, Survey of State Stroke Plans, unpublished data, 2005).

Potential Solutions and Resources for Additional Information

- Integrate EMS within ED stroke care and ongoing CQI activities for stroke. For example, the Harborview Medical Center in Seattle, Wash, communicates closely with the EMSS and has integrated EMS personnel into the hospital's stroke code process. In addition, the Greater Cincinnati/Northern Kentucky Stroke Team system collaborates with EMS personnel on an ongoing basis. In this system, EMS personnel are invited to weekly stroke meetings, and EMS responders often remain in the ED as suspected stroke patients are evaluated to observe the examination and to learn the final diagnosis. Additional information about these initiatives is available.[85,86]
- Provide ongoing feedback to EMS providers who care for and transport stroke patients. For example, the Birmingham Regional EMSS mails a report on each stroke patient to the EMS agency that initially entered the patient into the stroke system. Additional information about the Birmingham Regional EMSS is available.[28]
- Incorporate into EMSS protocol algorithms and checklists for the prearrival notification of the destination hospital for suspected stroke patients, and include prearrival notification as a component of EMS training and continuing education courses for stroke. In addition, review the use of prearrival notification for suspected stroke patients as a part of CQI activities within stroke systems of care.
- Incorporate mechanisms to garner participants' enthusiasm in collaborative activities (eg, create newsletters to capitalize on successes or survey participants for ways to improve participation and attendance at collaborative meetings).
- Create a broad-based coalition of healthcare providers, experts, and regulators to develop improved EMSS processes and protocol enhancements. For example, Alabama has developed statewide protocols for prehospital care for suspected stroke patients.[87]
- Urge stroke centers and EMS personnel to collaborate in stroke system research projects as appropriate.[88–90]

Recommended Measurement Parameters

- Ensure that prearrival notification of hospitals is provided for all suspected stroke patients.

Develop and Implement Stroke Education Activities Collaboratively With Prehospital and Hospital Providers, Including Initial as Well as Continuing Education

The delivery of acute stroke therapies can be enhanced through multilevel educational interventions that include the collaborative development of EMS and ED protocols, skill training, and mock stroke codes for EMSS and hospital ED providers. Educational activities combining community education and aggressive professional education among multidisciplinary hospital and EMS providers can significantly increase the proportion of patients treated with thrombolytic therapies.[80] Furthermore, the increased use of thrombolytic therapy is sustained after this type of educational intervention.[81]

In particular, EMS communicators and responders in both urban and rural areas receive varying amounts of training and education. This inconsistency is due in part to the lack of a single regulating entity and the lack of standardized training tools. A recent Institute of Medicine report notes that EMS personnel are not equally prepared across the nation because of the wide variation in educational requirements that exist from state to state.[8]

In general, EMS communicators and responders receive limited information about stroke in initial and continuing education and training curriculums.[36,91,92] In fact, the majority of emergency calls are answered by basic life support responders, who often receive less education and training about stroke than ALS responders.[92] To facilitate better continuing education and optimal training, editors of EMS textbooks should incorporate the most current stroke knowledge.

Potential Solutions and Resources for Additional Information

- Encourage prehospital providers, emergency physicians, and stroke experts to collaborate in evaluating the evidence for quality stroke care, writing stroke guidelines, and developing stroke training materials and programs. For example, the AHA facilitated such collaboration in the review, development, and dissemination of stroke guide-

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lines and training materials as part of its publication of the "2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care."[37]

- Encourage stroke system leaders to determine and facilitate the education needed by EMS personnel to provide optimal care for patients with stroke. EMS medical directors should proactively define the frequency of stroke reeducation on the basis of factors such as the prevalence of stroke care within the EMSS so that skill sets are maintained over time.
- Work with agencies that oversee EMS to ensure that the regulations include adequate requirements for evidence-based stroke training.
- Advocate for funding of professional education training for prehospital providers.
- Advocate for a stroke training requirement for the renewal of EMS responders' licensure. Stroke-specific training modules, such as the University of Miami's advanced stroke life support training program or programs offered through the ASA, could be offered to meet licensure renewal requirements. Additional information on these programs is available.[93–95]
- Collaborate with professional organizations, such as nursing associations, to provide stroke training and educational opportunities at conferences.
- Ensure that stroke experts are available to help teach the 10 core ACLS cases and to promote the use among providers of computer- and video-based self-directed learning and other training resources.[66,96]

Recommended Measurement Parameters

- Ensure that 100% of EMS providers complete a minimum of 2 hours of stroke assessment and care as a part of their required continuing medical education for certification and re-licensure.

Develop Stroke System Transport Protocols Collaboratively With Prehospital and Hospital Providers, as Well as With Other Stakeholders

Collaboration among EMS personnel, emergency physicians and nurses, and stroke experts is necessary. These collaborations are needed to identify hospital capabilities and to develop written plans that enable EMS responders to triage and transport stroke patients to the appropriate hospital for care using the most appropriate and timely transport means possible.[35,97]

The ability to develop and implement stroke transport protocols that direct EMS responders to transport stroke patients to the appropriate hospital often is contingent on the availability of information about the capabilities of hospitals in the state or service area. Such information includes whether hospitals meet the Joint Commission on Accreditation of Healthcare Organizations' criteria for primary stroke centers (established in collaboration with the ASA) or the Brain Attack Coalition's criteria for comprehensive stroke centers.[6,7,98,99]

In addition, the availability of a hospital identification system also can help encourage more hospitals to become recognized stroke centers. Triaging of patients by EMSS that includes the routing of patients past closer hospitals in favor of direct transport to recognized stroke centers may have financial or competitive impacts on hospitals. These financial or competitive impacts may drive improvements in the standards of care by stimulating interest from other hospitals in becoming recognized stroke centers.

Once consensus is reached among local physicians, EMSS, hospitals, and other stakeholders on appropriate transport protocols, the lack of adequate funding can be another barrier to new or existing transport protocols. The local and regional structure of EMSS also can create challenges for the dissemination and adoption of up-to-date transport protocols.

Air transport can be used to shorten the time to treatment and may be especially appropriate for the transport of patients in rural areas who otherwise would be unable to access acute therapies for stroke.[10,100] Organized transport programs can enable ground EMS responders who identify a suspected stroke patient to simultaneously call for air transport and to prenotify the ED at the receiving stroke center, although stroke systems must balance the use of air transport to shorten transport time against the effects of field mis-assessment, overall patient outcome, and increased cost.[101] Communications with stroke center personnel may assist EMS responders in making decisions regarding air transport. Air transport also can be considered in areas with limited EMS resources, where the use of ground EMS to transport a patient to a distant hospital would leave the area without adequate EMS coverage.[102]

In situations in which it is impossible to transport stroke patients directly to a stroke center, air and ground critical care transport (CCT) and ALS interfacility transport resources can be used to transfer stroke patients rapidly and safely to a more appropriate hospital. For the transport of acute stroke patients, EMSS should consider treating interfacility transport of stroke patients as a higher level of care, similar to a 9-1-1 emergency response. The interfacility transfer of stroke patients for definitive care is a time-sensitive duty of EMSS.

Additionally, the Emergency Medical Treatment and Active Labor Act (EMTALA) may present perceived challenges in the collaborative development of transport protocols. EMTALA generally requires hospitals to provide patients with a medical screening examination and to stabilize the patients' emergency medical conditions (resolve the emergency condition) to the extent possible given the hospital's capabilities before transport.[103,104] These requirements extend beyond the hospital itself, applying also to ambulances owned and operated by a hospital.

Although there is the perception by some that EMTALA law is unclear on whether hospital-owned EMS providers may transport patients directly to the hospital most appropriate for the patient's condition, this concern can be addressed through the development of regional protocols.[105] For example, the Centers for Medicare and Medicaid Services, the agency that oversees EMTALA compliance, has stated that "the rule on hospital-owned ambulances and EMTALA does not apply if the ambulance is operating under a community-wide EMS protocol that requires it to transport the individual to a hospital other than the hospital that owns the ambulance." The Centers for Medicare and Medicaid Services also states

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that in such cases, "the individual is considered to have come to the emergency department of the hospital to which the individual is transported."[105] This serves to highlight the importance of promoting the development of community-wide transport protocols for stroke patients.

Potential Solutions and Resources for Additional Information

- Obtain support for updated stroke transport protocols from key EMSS, medical, and clinical leaders in the community. Leverage resources of stroke system members to update stroke protocols, such as ambulance electronic run sheets, professional education, CQI activities, and public education. Collaborate with state, regional, and community agencies to modify transport policies for stroke treatment and transport.
- Establish a hospital identification system that provides a transparent list of hospitals that meet standard criteria for primary stroke centers within the stroke system of care. Such a list should be readily available to EMS providers and the public. Comprehensive stroke centers are not yet certified by any national organization, and therefore it may be too early to add these to the list. Some states, such as Florida, have established statewide hospital identification programs for both primary and comprehensive stroke centers.[106] Further identification of comprehensive stroke centers may be necessary for more widespread implementation of these protocols.
- Create a broad-based coalition of healthcare providers, experts, and regulators to develop improved EMSS point-of-entry (transport destination) plans. For example, Massachusetts is currently working in this fashion to develop a statewide EMS point-of-entry plan for ST-segment–elevation myocardial infarctions.[107]
- Partner with professional organizations to more effectively communicate with prehospital and hospital providers the evidence supporting current treatment recommendations. Form alliances with professional organizations and advocate for the statewide adoption of transport protocols for stroke.
- Ensure that all available EMS transportation resources are considered for suspected stroke patients to minimize transport time to the appropriate hospital.
- Recognize air transport in the collaborative development of stroke transport protocols, such as those developed in Jacksonville, Fla.[101]
- Develop relationships with CCT and ALS interfacility transfer resources to provide for the rapid transfer of patients to more appropriate hospitals when indicated.
- Standardize equipment (including hospital and EMS equipment, such as infusion pumps) and/or cross-train transport personnel in CCT and ALS interfacility transfer procedures to increase available resources for the rapid transfer of patients to more appropriate hospitals when indicated.
- Educate providers to treat the transfer of stroke patients for stroke interventions as a true emergency and eliminate the mindset of characterizing CCT and ALS interfacility transfers as non-emergency transports.
- Develop and measure response time parameters for CCT and ALS interfacility transfers in a manner similar to the measurement of traditional emergency response times.
- Use helicopter transport in cases where resource constraints would adversely affect EMS ground availability.
- Work with state EMS medical director associations, the state chapter of the American College of Emergency Physicians, and the ASA to come to a consensus on common stroke training, triage, and transport protocols.[95,108,109]

Measurement Parameters

- Ensure the total EMSS contact time (from the receipt of the 9-1-1 call or presentation at a non-stroke center hospital to arrival at a stroke center) is measured for 100% of stroke patients. EMSS should strive to consistently decrease this time.
- Ensure the amount of time spent with the patient before the start of transport (eg, the on-scene time) is less than 15 minutes (unless extenuating circumstances or extrication difficulties are present). This on-scene time also should apply to emergent interfacility transportation of stroke patients. EMSS and hospitals should develop policies and procedures to streamline paperwork and equipment issues.
- Ensure that the EMS response time to reach a stroke patient for emergent interfacility transfer is the same as the time from dispatch to transport discussed above (eg, less than 9 minutes at least 90% of the time or as determined appropriate by the local EMSS). Similarly, the time spent with the patient before starting emergency interfacility transport should be the same as the on-scene time described above (less than 15 minutes 100% of the time). EMSS and hospitals must develop policies and procedures to streamline paperwork and equipment issues.

Engage Collaboratively With Prehospital and Hospital Providers in Continuous Quality Improvement Processes for Stroke Care While Complying With Protections for the Privacy of Personal Health Information

The success of a stroke system of care rests in large part on the ability of the various components of the stroke system to communicate effectively with one another, including the need for hospital and prehospital providers to communicate effectively.[10]

Sharing patient health information must be performed in full compliance with state and federal requirements designed to protect the confidentiality of health information, such as the protections arising from the Health Insurance Portability and Accountability Act of 1996 (HIPAA). HIPAA mandates the development of rules for protecting the privacy of patients' personal health information.[110–112]

In some instances, hospitals have cited concerns regarding compliance with HIPAA as a rationale for declining to share patient data with EMS providers in the context of CQI activities.[8] Regardless, HIPAA permits providers to use and disclose protected health information for certain "healthcare operations," and many CQI activities fall squarely within this "healthcare operations" exception.[8,113] Specifically, the federal HIPAA rules place both "quality assessment and im-

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provement activities, including outcomes evaluation" and "reviewing the competence or qualifications of healthcare professionals [and] evaluating practitioner and provider performance" within the healthcare operations exception.[113–115]

The application of this exception to CQI activities involving hospitals and EMS providers has been recognized by providers in numerous states. For example, the Missouri Hospital Association has advised its members that federal HIPAA law permits hospitals to disclose protected health information to EMS units for use in conducting quality review activities.[116]

Potential Solutions and Resources for Additional Information

- Ensure active participation by prehospital and hospital providers in the development and ongoing implementation of CQI activities. Include stroke experts in reviewing the prehospital care received by every stroke patient as part of CQI activities.
- Provide education about HIPAA to stroke system providers, including EMS providers and hospitals. Encourage meaningful CQI activities while complying in full with federal and state law involving privacy issues.
- Develop model CQI agreements that address HIPAA concerns for EMSS, hospitals, and other providers within stroke systems.

Recommended Measurement Parameters

- Ensure that 100% of stroke patients are included in CQI activities. Ensure that EMSS feedback is received from the hospital on 100% of stroke patients and that all suspected stroke patients are transported to that hospital for which EMS provided prearrival hospital notification of a suspected stroke.
- Implement the development and continuous monitoring of standard measures as part of the CQI process, including, but not limited to, the following: (1) stroke history obtained when indicated; (2) stroke assessment performed using validated screening tools when indicated; (3) stroke history checklist(s) that document eligibility for acute therapies properly completed; (4) on-scene time appropriate (did not unnecessarily delay transport); and (5) hospital transport destination decision appropriate (patient transported to the most appropriate hospital per protocol).
- Develop benchmarks for all such standard measures and create goals for successful completion of each benchmark at least 90% of the time at a minimum.
- Implement processes to report results of CQI activities to providers to heighten awareness and measure changes in performance.

Patients Should Be Transported to the Nearest Stroke Center for Evaluation and Care If a Stroke Center Is Located Within a Reasonable Transport Distance and Transport Time

Stroke systems should address the following 5 issues to help ensure that EMSS transport patients to the nearest stroke center or the closest hospital for evaluation as appropriate.

- Assess stroke patient eligibility for acute stroke therapies using a stroke history checklist or algorithm designed for prehospital personnel.
- Establish EMSS transport destination protocols that reflect optimal patient care with transport to a stroke center.
- Establish protocols for the transfer of stroke patients from nonstroke center hospitals to stroke centers.
- Transport stroke patients to stroke-ready hospitals regardless of the patients' geopolitical location.

Assess Stroke Patient Eligibility for Acute Stroke Therapies Using a Stroke History Checklist or Algorithm Designed for Prehospital Personnel

Once a patient is identified as a suspected stroke patient, stroke triage and transport protocols should be used to rapidly identify patients who may benefit from acute stroke therapies. All stroke patients should receive thrombolytic candidate screening by paper form or data entry completion. Forms used should document time of onset and contraindications to thrombolytic therapy or other acute therapies that may become available.[10,117]

EMS responders should document assessments and screening of patients for eligibility for acute stroke therapies. Prehospital patient assessments for stroke often are incomplete. A commonly reported omission is the lack of documentation about the onset time of symptoms, which is critical in determining the eligibility of patients for short-term therapies.[117] EMS personnel (especially EMS responders) often are the only medical providers to have access to all witnesses, which may provide the best opportunity to determine the time of onset of symptoms.[35,58]

Potential Solutions and Resources for Additional Information

- Develop and ensure the use of stroke triage and transport protocols that reflect current recommendations for assessing stroke patients for eligibility for acute stroke therapies, including thrombolytic therapy.
- Ensure that EMS responders have adequate education and training to screen patients accurately for acute therapies.

Recommended Measurement Parameters

- Ensure that stroke history checklists are completed for at least 90% of all suspected stroke patients.[87,92,118,119]
- Ensure that the amount of time EMS responders spend collecting the clinical history at the scene is no longer than 10 minutes; total on-scene time should not exceed 15 minutes (see discussion above).

Establish EMSS Transport Destination Protocols That Reflect Optimal Patient Care With Transport to Stroke Centers as Appropriate

Transport protocols should be designed both to provide patients with the highest possible quality of clinical care and to reduce transport times. The Brain Attack Coalition identified 11 key elements for primary stroke centers that are likely to improve patient care, and 7 of these elements are associated with increased access to acute interventions.[6,120,121]

Although further evaluation is ongoing, the initial evidence indicates that certain process measures improve when pa-

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tients are treated in designated stroke centers.[97,122–126] Direct routing by EMS of patients to designated stroke centers improves the speed of patient evaluation, the frequency and appropriateness of the administration of thrombolytic therapy, and the proportion of patients treated in stroke units.[82,83]

A hospital's decision to become a primary or comprehensive stroke center is voluntary, although all hospitals do not have the required capabilities or resources. Stroke center hospitals and nonstroke center hospitals alike must cooperate with EMSS within stroke systems of care to facilitate the rapid transport of stroke patients to the most appropriate destination.[43]

If transportation to a stroke center is not possible within the appropriate time for hyperacute therapeutic interventions, then patients should be transported to the closest hospital considered to be best prepared to treat stroke patients quickly.[127,128] These hospitals have computed tomography or magnetic resonance imaging and healthcare providers experienced in urgently treating stroke patients. Patients face significant delays in receiving care if they must be transferred from one hospital to another to receive neuroimaging or if there are delays in official computed tomography readings by board-certified radiologists.[127,129]

The challenges in transporting patients to primary or comprehensive stroke centers include an inadequate number of stroke centers in both urban and rural areas, insufficient specialty physicians in some geographic areas, and a backlog of applications for hospitals to become certified by the Joint Commission on Accreditation of Healthcare Organizations or other appropriate body.

Additionally, EMSS in some areas are unable to develop transport protocols because of resource constraints. Areas with limited ambulances or ALS responders may not be able to transport patients beyond the local or regional area without leaving EMSS areas uncovered. Stroke patient transports should be viewed similarly to trauma patient transports. If mutual aid can be obtained with neighboring EMSS for trauma patients, mutual aid should also be used for stroke patients.

State laws that create a statewide emergency stroke system can help ensure that EMS personnel adhere to stroke transport protocols designed to ensure that stroke patients receive emergency care at a recognized stroke center. In 2004, Florida enacted legislation that established criteria for hospitals that want to appear on the state's list of primary and comprehensive stroke centers.[106,130] The Florida Stroke Act has been a powerful catalyst in promoting awareness of the emergency needs of stroke patients among the public and providers. The legislation also has helped to drive collaboration on the development of stroke triage and transport protocols among EMS and emergency physicians and has generated a sense of urgency among hospitals to become recognized stroke centers.

The Florida legislation requires all licensed EMS providers to use a stroke triage assessment tool (stroke alert form) that is consistent with the triage tool provided by the Florida Department of Health.[119,130] In addition, all licensed EMS providers must develop and implement stroke transport protocols on the basis of the availability of stroke centers in their service area.

Rural and community hospitals lacking the staff or infrastructure recommended for the treatment of acute stroke can establish relationships with primary or comprehensive stroke centers to access needed neurological expertise and to safely administer acute therapies to patients.[124,131–133] The lack of stroke specialists in rural areas can be addressed, in part, through telemedicine technologies that enable hospital personnel in remote locations to obtain off-site assistance with stroke patients.[134]

Using telemedicine for stroke (telestroke), providers in rural and other areas can obtain access to specialists, including assistance in performing stroke assessments through interactive video technologies, review of computed tomography scans in real time, and telephone consultations for the administration of acute therapies. Rural hospitals using telestroke decision support technologies have been able to evaluate stroke patients and safely initiate acute therapies before transferring patients to stroke centers, although telemedicine programs for stroke have not been fully evaluated, and challenges remain in the areas of reimbursement, liability, malpractice insurance, and licensing.[131–133,135,136] Nonetheless, rural hospitals in some areas do not have the resources needed to implement telemedicine collaborations.

Potential Solutions and Resources for Additional Information

- Amend EMS transport destination protocols to place a greater priority on transporting patients to recognized stroke centers.
- Transport suspected stroke patients to the nearest stroke center that provides definitive treatment if such a hospital is within a reasonable transport time, taking into account regional issues such as availability of stroke centers and geography and whether transportation to a stroke center is possible within the appropriate time for acute therapeutic interventions. Alternatively, patients should be transported to the hospital considered to be best prepared to treat stroke patients on an emergency basis.
- Advocate for a statewide plan for EMS protocols to ensure stroke patients receive high-priority care at recognized stroke centers. Advocate for the development of a public statewide hospital identification system identifying hospitals that meet the criteria for primary or comprehensive stroke centers. For example, the Florida initiative requires that EMS providers develop protocols on the basis of the availability of stroke centers in their service area.[130]
- Involve all affected hospital systems and EMS providers in the development of prehospital transport and triage protocols.
- Include stroke survivors and family members of stroke survivors on committees that develop stroke transport protocols to help mitigate the likelihood that patient destination may be manipulated for economic reasons.
- Advocate for local, state, and federal legislation to facilitate and reimburse for the care and transportation of stroke patients to stroke centers.

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- Promote Joint Commission on Accreditation of Healthcare Organizations certification as well as other recognition programs that use similar quality-based outcome measurements.
- Encourage rural hospitals to enter into collaborative relationships with stroke centers to access expertise needed to initiate acute therapy before transporting patients to a stroke center, such as the "hub-spoke model" developed in Reno, Nev.[132,137,138]
- Advocate for funding for telestroke technologies, such as the Medical College of Georgia in Augusta's telemedicine system, and telestroke consultation services, such as the one provided by Massachusetts General Hospital neurologists for the remote evaluation of patients with possible acute strokes at emergency departments without on-site stroke expertise.[133]
- Extend mutual aid agreements with neighboring EMSS agencies for trauma patients to include stroke patients, or establish mutual aid agreements for stroke patients to obtain assistance from neighboring EMSS where transport out of the area to a stroke center would leave portions of the community without adequate EMS coverage.

Establish Protocols for the Transfer of Stroke Patients From Nonstroke Center Hospitals to Stroke Centers as Appropriate

Stroke patients who are treated outside of a stroke center (including patients who are evaluated initially at the "closest hospital" because they were not candidates for acute interventions) should be considered for transfer, if appropriate, to a stroke center or other facility through established referral processes.[10]

Every hospital with an ED should determine its capability for treating acute stroke patients. Regardless of capability, every hospital with an ED should have a detailed written plan describing the management of acute stroke patients. As appropriate, the plan should define which patients the hospital will treat with fibrinolytic therapy and when transfer to another hospital with a dedicated stroke unit will be considered.[45] EMSS should be informed of hospitals' capabilities and transfer protocols. EMSS should receive timely updates as changes in capabilities occur and should be prepared to transfer patients between facilities as appropriate.

Patients identified as candidates for short-term treatment in the community can safely be transported by ground or air transport to stroke centers for initiation of treatment or follow-up for treatment initiated in a community hospital.[124,131–133,139,140] Air transport may have a beneficial effect on patient care by reducing the patient's time to physician evaluation, imaging, and subsequent treatment modalities. The advanced training of an air transport crew may enable them to stabilize patients so that the patient can be taken immediately to imaging on arrival at the receiving hospital.[141]

The interfacility transfer of stroke patients is subject to federal rules arising from EMTALA, which generally requires hospitals to provide patients with a medical screening examination and to stabilize the patient's emergency medical condition (resolve the emergency condition) to the extent possible given the hospital's capabilities before transport.[142] Patients with conditions that are not stabilized may only be transferred in accordance with community-wide protocols when the physician provides written certification that the medical benefits expected from the transfer outweigh the risks or when the patient makes an informed, written request for transfer.[143] In all circumstances, patients must be informed of the benefits and risks of transfer.[144]

State and regional regulations vary in the extent and manner to which they address interfacility transport. This regional variation in interfacility regulation and standards may create uncertainty for hospitals when transferring patients to other hospitals.[145]

Potential Solutions and Resources for Additional Information

- Adopt goals for stroke patient arrival detailing initial evaluation and subsequent transfer with treatment at rural nonstroke center hospitals, such as those adopted in Reno, Nev.[137,138]
- Create community-wide guidelines for the interfacility transfer of stroke patients who are candidates for short-term therapies or who have conditions requiring more complex care.
- Provide stroke-specific education to assist providers in using system-wide interfacility transport protocols and in making medical decisions about when the benefits of transporting patients outweigh the risks in the context of stroke care and compliance with EMTALA requirements.
- Use the trauma system as a model for stroke system development of transport and interfacility transfers.
- Develop model preestablished referral processes and interfacility transport agreements that reflect EMTALA requirements and any other state or local requirements. Create easy-to-complete forms that address such requirements that physicians can complete before patient transport.[146]
- Advocate for the development of an interfacility transport component of EMS agencies.
- Advocate for the creation of model legislation to remove unnecessary legal and regulatory barriers to interfacility transfers.
- Develop for interfacility transfers a reverse transfer agreement, which returns the stroke patient after the receipt of acute care to the community hospital for subacute care and rehabilitation as appropriate.

Transport Stroke Patients to Stroke-Ready Hospitals Regardless of the Patients' Geopolitical Locations

Although EMSS vary greatly across the country, regulatory and technical assistance for EMS is available through state EMS offices and within the emergency medicine community. Regional and local EMSS should collaborate with these state-level organizations regarding the development of EMS transport protocols and related education initiatives when developing a stroke system of care. Cooperative discourse is essential to ensure the development and implementation of

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policies and regulations that address the transportation of stroke patients to a stroke-ready hospital, regardless of the patient's geopolitical location.

The development of collaborative partnerships with stakeholders, such as representatives of state EMS offices, regional and local EMS agencies, emergency department providers, hospitals and hospital associations, and the state legislature, can help ensure EMSS destination policies and regulations are adopted that direct patients to stroke-ready hospitals in accordance with the patient's needs and without regard to geopolitical location.

Potential Solutions and Resources for Additional Information

- Educate state EMS office personnel and regional and local EMS officials regarding EMSS efforts and goals for the development of stroke systems of care.
- Identify key stakeholders involved in the development of state and regional trauma systems and discuss their experiences and "lessons learned" that are applicable to the development of stroke systems of care.
- Form a coalition to address the development of polices and regulations that are specific to patient destination with regard to the stroke patient. This coalition should include representatives of key stakeholder organizations, such as state EMS offices, regional and local EMS offices, the state legislature, the state chapter of the American College of Emergency Physicians, the state chapter of the Emergency Nurses Association, hospitals, and hospital associations.

Recommended Measurement Parameters

- Establish a coalition with participation from representatives of the emergency medicine, political, and prehospital communities.
- Establish model polices and regulations for patient transportation protocols that can be adopted at the state, regional, and local levels.

Summary and Future Issues

This article is the first of a series focusing on individual key components of stroke systems of care. The authors hope this paper provides communities interested in developing and improving stroke systems of care with a better understanding of EMSS for stroke through the recommendations, examples, and resources discussed.

As improvements in the treatment of stroke emerge, EMSS within stroke systems of care will face new challenges. The adoption of new treatment modalities and emerging therapies for stroke in the prehospital setting will provide new opportunities for improving stroke care. The recommendations in this article are intended to provide assistance in implementing the EMS component of stroke systems within this evolving environment.

To facilitate improvements and advances in prehospital care for stroke, the issue of emergency consent should be considered, and further research into EMSS interventions for stroke patients should be encouraged. Additionally, review of EMSS for the treatment of hemorrhagic stroke and the relationship of stroke systems of care with traumatic brain injury in trauma systems warrants further attention.

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This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be "significant" if (a) the person receives $10 000 or more during any 12-month period, or 5% or more of the person's gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10 000 or more of the fair market value of the entity. A relationship is considered to be "modest" if it is less than "significant" under the preceding definition.

*Modest.

†Significant.

Reviewer Disclosures

Reviewer	Employment	Research Grant	Other Research Support	Speakers' Bureau/ Honoraria	Expert Witness	Ownership Interest	Consultant/ Advisory Board	Other
Larry B. Goldstein	Duke University	None	None	None	None	None	None	None
Philip B. Gorelick	University of Illinois	None	None	None	None	None	None	None
Ralph L. Sacco	University of Miami	None	None	None	None	None	None	None

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