



BACKGROUND

The field of acute ischemic stroke (AIS) care has undergone a revolution with the ability to provide critical reperfusion therapies, including intravenous (IV) alteplase and endovascular thrombectomy (EVT) in patients with AIS, potentially out to 24 hours from last known well.

In 2018, the American Heart Association and American Stroke Association (AHA/ASA) Mission: Lifeline Stroke Committee crafted an updated consensus algorithm incorporating assessment for patients with potential large vessel occlusions (LVO).¹ The updated 2020 algorithm seeks to balance the impact of triage recommendations, including the benefits of rapid, early access to EVT for patients with suspected LVO with the potential harm of delayed initiation IV alteplase. Since the majority of stroke patients will not be candidates for EVT, a robust Primary Stroke Center (PSC) and Acute Stroke Ready Hospital (ASRH) network is a vital part of an effective stroke system of care (SSOC), the algorithm will require tailoring to reflect the regional stroke centers certification levels, geographic distribution of resources, and the overall needs of the community. Comprehensive Stroke Centers (CSC) serve as the anchor for a regional SSOC and serve patients requiring EVT, neurocritical care, and hemorrhagic stroke care. Thrombectomy-capable Stroke Center (TSC) certification is intended for regions of the country that do not have ready access to CSCs; CSC are the preferred destination for patients with suspected LVO when they are within acceptable transport times. If no CSC is available, a TSC should be the preferred destination for these patients from among all nearby PSCs.

No randomized trial data exist to support a definitive recommendation on the acceptable additional time when considering triaging a patient with suspected LVO to a CSC. Therefore, the committee felt it was best to err on the side of caution and initially set the total transport time from scene to CSC at 30 minutes. This relatively short period of time will support the implementation of the algorithm with minimal disruption to the current flow of patients, while giving time for EMS systems to become proficient in the collection and reporting of stroke screens and severity scores, the capture of relevant time intervals, and the assessment of triaged patients to permit quality assurance activities and case review. In rural communities or those where large distances separate stroke centers, additional transport time, including air medical transport, of up to 30 additional minutes may be reasonable.

ON SCENE EMS TASKS

- Interview patient, family members and other witnesses to determine Last Known Well (LKW) Time and Time of Symptom Discovery. This is especially important in stroke of unwitnessed onset.
- Identify stroke mimics (e.g. seizure, migraine, intoxication) and determine if patient has pre-existing substantial disability (e.g., need for nursing home care or unable to walk independently).
- Identify current medications, especially anticoagulants, and obtain patient history including co-morbid conditions (e.g. recent surgery, procedures or stroke) that may impact treatment decisions.



- Perform a validated stroke screen and stroke severity score to assess for possible LVO.
- IV thrombolysis eligible patients should be routed to the nearest ASRH or PSC if transport to the nearest CSC or TSC would make them ineligible on arrival due to additional transport time.
- For patients with suspected LVO, a CSC is the preferred destination over TSC if the CSC is accessible within acceptable transport times per local protocol.
- Minimize on-scene times to < 15 min, provide prehospital notification and encourage family to go directly to ED if not transported with patient. Obtain mobile number of next of kin and witnesses.

STROKE CENTER LEVELS OF CARE

This algorithm reflects considerations outlined in the current 2019 AHA/ASA AIS guidelines update.² Where clear scientific guidance was not available, consensus expert opinion and current practice were used. As with any algorithm, it should augment but not replace clinician judgment. The Joint Commission (JC) and other certification programs offer four advanced levels of stroke certification for accredited hospitals. All levels of certification utilize a standardized method of delivering care centered on evidence-based guidelines for stroke care. Each level builds on the capabilities of the previous certification

Acute Stroke Ready Hospital (ASRH) - Provides stabilization and acute care while transferring most patients to higher level of care. ASRH may provide IV thrombolysis often utilizing tele-stroke expertise.

Primary Stroke Center (PSC) – Advanced stroke care with onsite stroke unit or designated beds for acute care of stroke patients. PSC readily provide IV thrombolysis and may transfer for EVT

Thrombectomy-Capable Stroke Center (TSC) - TSC build upon the capabilities of PSC and are able to perform EVT and provide post-procedure care, including in dedicated neurocritical care beds for complex stroke patients. These centers are held to the same standards as CSC for ischemic stroke care but hemorrhagic stroke care for ICH and aneurysmal SAH is typically beyond the scope of TSC practice.

Comprehensive Stroke Center (CSC) - CSC provide advanced knowledge of stroke care with onsite stroke unit or designated beds for acute care of emergent needs of multiple complex stroke patients. CSC perform EVT and post-procedure care in dedicated neurocritical care beds for the most complex stroke patients. Minimum volume requirements for treatment of SAH caused by aneurysms and mechanical thrombectomy ensure optimal provider competency. CSC provide regional leadership, expertise, research, and education for stroke care.



DEFINITIONS

Last Known Well refers to the time that the patient or a witness can confirm the patient was at their baseline state prior to the current stroke

Time of Symptom Discovery refers to the time at which the symptoms were first noticed by a reliable witness. These terms are often mistakenly used interchangeably, and so explicit capture of both ensures accuracy. Among patients with a witnessed stroke onset, these two times will be the same.

Stroke Screening Tool refers to a simple screening method that generates a binary result of positive (stroke suspected) or negative (stroke unlikely). Many patients with another cause for neurologic disability (e.g., seizure) may have a positive screen. Many EMS agencies mandate a point-of-care blood glucose test as part of stroke screening and this data should be included if available. Some examples are Cincinnati Prehospital Stroke Scale (CPSS), Los Angeles Prehospital Stroke Screen (LAPSS), Melbourne Ambulance Stroke Screen (MASS), and Recognition of Stroke in the Emergency Room (ROSIER) Scale.

Stroke Severity Score refers to a numerical scale used to quantify neurologic deficits in order to identify patients with severe symptoms likely due to LVO. Each EMS region should choose a single screening tool and severity tool and monitor adherence to usage as well as accuracy. Some examples are Cincinnati Stroke Triage Assessment Tool (C-STAT), Facial palsy, Arm weakness, Speech changes, Time, Eye deviation, Denial / neglect (FAST-ED) scale, Rapid Arterial Occlusion Evaluation Scale (RACE), Los Angeles Motor Scale (LAMS) and Vision, Aphasia, Neglect (VAN).

Door-In Door-Out (Dido) Time refers to the time interval between initial ED arrival to ED departure acute stroke patients transferred to a higher-level stroke center for emergent therapy. This performance is now tracked in the JC measure STK-OP-1

EMS Prehospital Triage Time refers to the total EMS transport time required to transport suspected stroke patient from scene arrival to hospital arrival at the initial stroke facility recommended by the stroke protocol. Current maximal acceptable bypass times for stroke are unknown but are dependent on regional EMS resources and regulations. Other time-critical conditions such as trauma, STEMI and cardiac arrest may have defined bypass time windows.

Endovascular Treatment Window refers to the maximum safe time window for initiating EVT treatment. Data support EVT treatment as a function of LKW, stroke severity, and presence of penumbra on advanced imaging. For patients <6 hr. from LKW no penumbral imaging is recommended; for those 6-24 hr. from LKW some form of image-guided selection is recommended to ensure safe and effective patient selection.^{3,4}



STROKE SYSTEMS OF CARE (SSOC) MODIFICATIONS FOR URBAN, SUBURBAN AND RURAL COMMUNITIES

The following regional modifications to transport time thresholds are suggested to help EMS agencies modify their regional stroke triage protocols according to local resources in collaboration with key stakeholders.

- We define an urban SSOC as appropriate for a metro region (RUCA code 1).⁵ These areas generally have high population density ($\geq 50,000$ residents) and abundant healthcare resources, with access to one or more TSC/CSC within 30 min transport time by EMS ground.
- We define a suburban SSOC modification as appropriate for large residential communities adjacent to an urban core (RUCA codes 2-3). These areas generally have a population density closer to the urban threshold and may have access to both nearby community hospitals as well as suburban or urban advanced stroke centers (e.g., TSC, or CSC) with a 30-60 min transport time by EMS air or ground. Patients with suspected LVO should be routed directly to a CSC if the additional transport time past the nearest TSC does not exceed 30 minutes, and the maximum total transport time from scene to CSC does not exceed 45 minutes. If no CSC is within 45 minutes, then EMS should go directly to a TSC if the additional transport time past the nearest PSC or ASRH does not exceed 30 minutes, and the maximum total transport time from scene to TSC does not exceed 45 minutes. If no TSC or CSC exists within 45 minutes total travel time, then EMS should go to the nearest ASRH or PSC.
- We define a rural SSOC modification as appropriate for a very small or non-metropolitan region (RUCA codes 4-10). These areas generally have low population density (<50,000 residents), limited local general healthcare resources, few nearby ASRH or PSC, and often no TSC/CSC within 60 min transport time by EMS ground, although they may be one within 60 min by air. Patients with suspected LVO should be routed directly to a CSC if the additional transport time past the nearest TSC does not exceed 30 minutes, and the maximum total transport time from scene to CSC does not exceed 60 minutes. If no CSC is within 60 minutes, then EMS should go directly to a TSC if the additional transport time past the nearest PSC or ASRH does not exceed 30 minutes, and the maximum total transport time from scene to TSC does not exceed 60 minutes.

References

1. American Heart Association. American Heart Association Mission Lifeline: Stroke Severity-based Stroke Triage Algorithm for EMS. 2018; https://www.heart.org/HEARTORG/Professional/MissionLifelineHomePage/MissionLifeline-Stroke_UCM_491623_SubHomePage.jsp. Accessed December 26, 2019.
2. Powers WJ, Rabinstein AA, Ackerson T, et al. Guidelines for the Early Management of Patients With Acute Ischemic Stroke: 2019 Update to the 2018 Guidelines for the Early Management of Acute Ischemic Stroke: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association. *Stroke*. 2019;50(12):e344-e418.
3. Albers GW, Marks MP, Kemp S, et al. Thrombectomy for Stroke at 6 to 16 Hours with Selection by Perfusion Imaging. *New England Journal of Medicine*. 2018;378(8):708-718.
4. Nogueira RG, Jadhav AP, Haussen DC, et al. Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct. *N Engl J Med*. 2018;378(1):11-21.
5. USDA 2010 Rural-Urban Commuting Area (RUCA) codes. <https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes/documentation/>. Accessed January 10, 2020.