Canadian Stroke Best Practices

CANADIAN STROKE BEST PRACTICE RECOMMENDATIONS

Acute Stroke Management Evidence Tables

Seventh Edition, Update 2022

Section 3: Emergency Medical Services Management of Acute Stroke

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on Behalf of the Canadian Stroke Best Practice Recommendations
Acute Stroke Management Writing Group and in collaboration with the
Canadian Stroke Consortium

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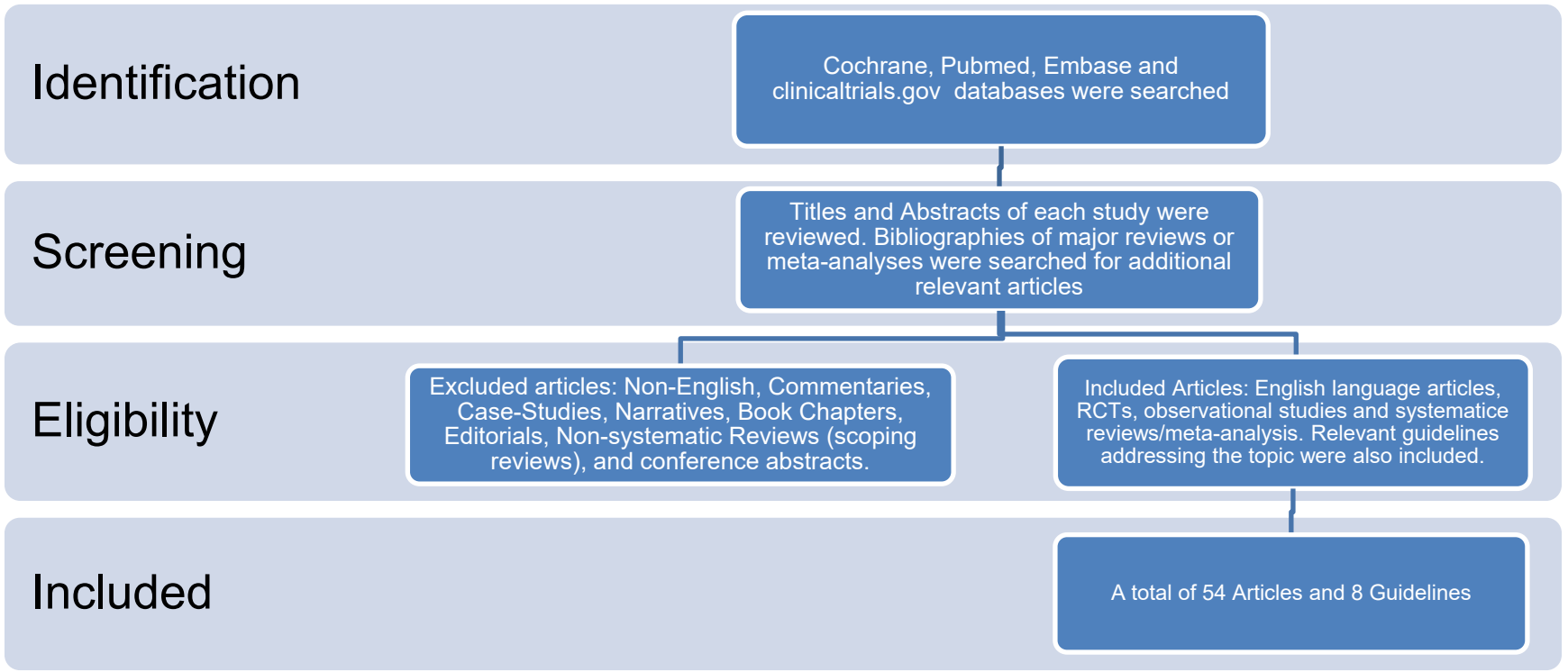
Search Strategy



Pubmed, EMBASE, Clinicaltrials.gov and the Cochrane Central Register of Controlled Trials databases were search using the terms “stroke”, “cerebrovascular disorders”, “emergency medical service” “emergency service”, “emergency mobile units”, “thrombolysis”, “pre-hospital stroke scale”, “stroke code”, and “telemedicine” to identify potentially relevant articles. Articles were excluded if they were: non-English, commentaries, case-studies, narrative, book chapters, editorials, non-systematic review, or conference abstracts. Additional searches for relevant best practice guidelines were completed and included in a separate section of the review. A total of 54 articles and 8 guidelines were included and were separated into separate categories designed to answer specific questions.

Published Guidelines

Guideline	Recommendations
Walter S, Audebert H, Katsanos AH, Larsen K, Sacco S, Steiner T, Turc G, Tsivgoulis G. **EXPRESS: European Stroke Organisation (ESO) Guidelines on Mobile Stroke Units for Prehospital Stroke Management.** ***European Stroke Journal*. 2022 Mar;7(1):XXVII-LIX.**	We suggest the use of Mobile Stroke Units over conventional care for the prehospital management of patients with suspected stroke, for the following reasons: - In patients with acute ischaemic stroke, prehospital management with a MSU improves functional outcomes, increases the rates of treatment with intravenous thrombolysis, including the rates of thrombolysis within the golden hour and shortens onset to treatment time without any safety concerns. Quality of evidence: Moderate ⊕⊕⊕ - In patients with intracranial haemorrhage, prehospital management with a MSU increases the proportion of primary transport to tertiary care stroke centres, without concerns on short-term mortality. Quality of evidence: Low ⊕⊕ - In other patients (e.g. stroke mimics), no signal of safety concerns was identified. Quality of evidence: Very low ⊕ Overall strength of recommendation: Weak ↑
Lou M, Ding J, Hu B, et al. **Chinese Stroke Association guidelines for clinical management of cerebrovascular disorders: executive summary and 2019 update on organizational stroke management** **S*troke Vasc Neurol*. 2020 Sep;5(3):260-269.** **(selected)**	*Organisational management of prehospital emergency system:Rapid identification of stroke before hospital* ► Emergency personnel use standardised tools such as stroke 120, Cincinnati Prehospital Stroke Scale, Los Angeles Prehospital Stroke Scale or face arm speech test (FAST) scale to screen patients with stroke before hospital, so that patients with stroke can be quickly identified. (Class I, level of evidence B) ► Emergency personnel used Rapid Arterial Occlusion Evaluation, Los Angeles Motor Scale, Field Assessment Stroke Triage for Emergency Destination (FAST-ED) or Prehospital Acute Stroke Severity Scale to screen patients with stroke for large vessel occlusion before hospital. (Class II, level of evidence B) *Dispatch of emergency medical service personnel and onsite diagnosis and treatment* ► Emergency medical service (EMS) dispatchers should use prehospital identification and screening tools to quickly identify suspected patients with stroke, and priority should be given to ambulances and EMS personnel. (Class I, level of evidence B) ► EMS personnel should make brief assessment and necessary emergency treatment as soon as possible for suspected patients with stroke, including determining the onset time, dealing with respiratory and circulatory problems, conducting ECG examination and vital signs monitoring, establishing intravenous channels and avoiding delays in transportation due to prehospital intervention. (Class I, level of evidence B) *Rapid transportation to hospitals with stroke treatment capacity* ► For suspected patients with AIS who may need intravenous thrombolysis within the onset time window, EMS personnel should transfer them to the nearest qualified primary stroke centres (PSC)/comprehensive stroke centres (CSC) in the shortest time. (Class I, level of evidence A) ► Patients suspected of large vessel occlusion (LVO)- induced AIS may need emergency thrombolysis and/ or endovascular therapy within the time window (up to 24hours of onset) and should be transported to CSC in time for endovascular therapy. (Class I, level of evidence A) ► Hub, drip-and-ship and trip-and-treat mode have their own advantages and disadvantages. When EMS personnel choose the transport mode for suspected LVO-induced patients with AIS, they should make a reasonable transport plan based on the patient's condition, onset time, local PSC/CSC distribution, traffic condition, transport distance and patient's willingness. (Class I, level of

Guideline	Recommendations
	evidence B)
Ahmed N, Audebert H, Turc G, Cordonnier C, Christensen H, Sacco S, Sandset EC, Ntaios G, Charidimou A, Toni D, Pristipino C. **Consensus statements and recommendations from the ESO-Karolinska stroke update conference, Stockholm 11–13 November 2018.** ***European Stroke Journal*. 2019; 4(4): 307–317.** **(selected)**	*Prehospital management, patient selection* Recommendation: Mobile stroke units can be used to effectively reduce time to intravenous thrombolysis that is related to better outcome. However, there is currently not sufficient evidence whether and to what extent mobile stroke units improve outcome of AIS patients. Further evaluation is needed with regard to adaptation of the MSU concept to different health care settings. Because of costs and resource use of mobile stroke units, their routine use can currently not be recommended (Grade C). *Prehospital identification of candidates for mechanical thrombectomy* Recommendation: Prehospital scales provide only a gross estimate of the presence or absence of an LAO. They are inadequate to exclude LAO with certainty and many triage positive patients may have no LAO (Grade C). Because none of the currently published scales has both high sensitivity and specificity and there is no evidence for the superiority of any prediction instrument, we cannot recommend the prioritization of one particular scale over the others. Further efforts are needed to prospectively test and validate the different scores in unselected patients with suspected stroke in the prehospital setting by paramedics (Grade C). *Drip-and-ship versus mothership for thrombectomy* Recommendation: As there is lack of randomized evidence for superiority of one organizational model, the choice of model should depend on local and regional service organization and patient characteristics (Grade C). For patients without identified contraindication to Intravenous thrombolysis (IVT), if estimated transportation time to a comprehensive stroke centre is considerably longer than transportation to the nearest primary stroke centre (approximately more than 30– 45 min), the drip-and-ship model should be considered (Grade C). Conversely, if the difference in travel time between the nearest primary stroke centre and the nearest comprehensive stroke centre is below 30–45 min, or if contraindications to IVT are suspected in the field (i.e. recent surgery, oral anticoagulation...), direct transportation to the comprehensive stroke centre should be considered if LAO is deemed clinically plausible (Grade C). We recommend that patients in late time windows (beyond 6h) or with unknown time of symptom onset (wake-up stroke, unwitnessed stroke) have rapid access to advanced imaging (Grade A). The first picture-to-puncture time and the door-indoor-out time in drip-and-ship patients should be as low as possible, ideally less than 90 min and 60 min respectively (Grade C).
Powers WJ, Rabinstein AA, Ackerson T, Adeoye OM, Bambakidis NC, Becker K, Biller J, Brown M, Demaerschalk BM, Hoh B, Jauch EC, Kidwell CS, Leslie-Mazwi TM, Ovbiagele B, Scott PA, Sheth KN, Southerland AM, Summers DV, Tirschwell DL; on behalf of the American Heart Association Stroke Council.	**1. Prehospital Stroke Management and Systems of Care** **1.1 Prehospital Systems** 1. Public health leaders, along with medical professionals and others, should design and implement public education programs focused on stroke systems and the need to seek emergency care (by calling 9-1-1) in a rapid manner. These programs should be sustained over time and designed to reach racially/ethnically, age, and sex diverse populations. Class I; LOE B-R). 2. Activation of the 9-1-1 system by patients or other members of the public is strongly recommended. 9-1-1 dispatchers should make stroke a priority dispatch, and transport times should be minimized. (Class I; LOE B-NR). 3. To increase both the number of patients who are treated and the quality of care, educational stroke programs for physicians, hospital personnel, and EMS personnel are recommended. Class I; LOE B-NR). **1.2. EMS Assessment and Management**

Guideline	Recommendations
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:e344–e418.** **(selected)**	1. The use of a stroke assessment system by first aid providers, including EMS dispatch personnel, is recommended. (Class I; LOE B-NR). 2. EMS personnel should provide prehospital notification to the receiving hospital that a suspected stroke patient is en route so that the appropriate hospital resources may be mobilized before patient arrival. COE I; LOE B-NR. 1.3. EMS Systems 1. Regional systems of stroke care should be developed. These should consist of the following: (a) healthcare facilities that provide initial emergency care, including administration of IV alteplase, and (b) centers capable of performing endovascular stroke treatment with comprehensive periprocedural care to which rapid transport can be arranged when appropriate. COE I; LOE A 2. EMS leaders, in coordination with local, regional, and state agencies and in consultation with medical authorities and local experts, should develop triage paradigms and protocols to ensure that patients with a known or suspected stroke are rapidly identified and assessed by use of a validated and standardized tool for stroke screening. COE I: LOE B-NR. 3. Patients with a positive stroke screen or who are strongly suspected to have a stroke should be transported rapidly to the closest healthcare facilities that are able to administer IV alteplase. COE I: B-NR 4. When several IV alteplase–capable hospital options exist within a defined geographic region, the benefit of bypassing the closest to bring the patient to one that offers a higher level of stroke care, including mechanical thrombectomy, is uncertain. Further research is needed. (Class IIb; LOE B-NR). 5. Effective prehospital procedures to identify patients who are ineligible for IV thrombolysis and have a strong probability of large vessel occlusion (LVO) stroke should be developed to facilitate rapid transport of patients potentially eligible for thrombectomy to the closest healthcare facilities that are able to perform mechanical thrombectomy. COE IIb: LOE C-EO **1.5. Hospital Stroke Teams** 1. An organized protocol for the emergency evaluation of patients with suspected stroke is recommended. Class I; LOE B-NR.
Kobayashi A, Czlonkowska A, Ford GA, Fonseca AC, Luijckx GJ, Korv J, et al. **European Academy of Neurology - European Stroke Organisation consensus statement and practical guidance for pre-hospital management of stroke.** ***Eur J Neurol* 2018 Mar;25(3):425-433.**	We recommend that all EMS technicians and paramedics are familiar with a simple pre -hospital stroke scale to identify potential stroke patients. No specific scale can be recommended. (SOR strong; low quality of evidence). There is insufficient evidence to recommend a pre -hospital stroke scale to predict large vessel occlusion. In patients with SaO 2 levels < 95% we suggest the administration of O 2 titrated to maintain normoxia. Routine use of O2 is not recommended. (SOR weak; very low quality of evidence) We do not recommend pre -hospital treatment of high blood pressure in people suspected with acute stroke. (SOR weak; very low quality of evidence). Because of safety concerns we do not recommend pre -hospital administration of insulin in persons with suspected stroke and hyperglycemia. (SOR weak; very low quality of evidence). In the absence of clinical studies, no recommendations can be made on pre - hospital interventions for lowering elevated body temperature. We recommend that all EMS implement a ‘code stroke’ protocol, including highest priority dispatch, pre -hospital notification, and rapid transfer to the closest ‘stroke - ready’ center. (SOR strong; moderate quality of evidence).

Guideline	Recommendations
	No recommendation on the additional value of pre -hospital telemedicine can be made. We do not recommend the routine use of mobile emergency stroke units because there is insufficient evidence that they lead to better functional outcome. (SOR weak; low quality of evidence) No recommendation on the use of pre -hospital POC laboratory analysis of blood count and INR can be made. No recommendation can be made on the use of currently available biomarkers in persons with a suspected stroke. We do not suggest air medical transport outside of settings where a pragmatic decision has been taken that geographical conditions favor air transport. (SOR weak; very low quality of evidence). We do not recommend the use of any neuroprotective intervention in persons with suspected acute stroke in the pre -hospital setting. (SOR strong; high quality of evidence).
Clinical Guidelines for Stroke Management 2017. Melbourne (Australia): National Stroke Foundation.	Strong recommendation Updated All stroke patients should be managed as a time critical emergency. The dispatch of ambulances to suspected stroke patients who may be eligible for reperfusion therapies requires the highest level of priority. Strong recommendation Updated • Ambulance services should preferentially transfer suspected stroke patients to a hospital capable of delivering reperfusion therapies as well as stroke unit care. • Ambulance services should pre-notify the hospital of a suspected stroke case where the patient may be eligible for reperfusion therapies. Practice point **New** General practitioners are encouraged to educate reception staff in the FAST stroke recognition message and to redirect any calls about suspected acute stroke to 000
Intercollegiate Stroke Working Party. Royal College of Physicians. National Clinical guidelines for stroke. 5th Edition 2016, Edinburgh, Scotland	A-People seen by ambulance clinicians outside hospital with the sudden onset of focal neurological symptoms should be screened for hypoglycaemia with a capillary blood glucose, and for stroke or TIA using a validated tool. Those people with persisting neurological symptoms who screen positive using a validated tool should be transferred to a hyperacute stroke unit as soon as possible. B- People who are negative when screened with a validated tool but in whom stroke is still suspected should be treated as if they have stroke until the diagnosis has been excluded by a specialist stroke clinician. C- The pre-hospital care of people with suspected stroke should minimise time from call to arrival at hospital and should include a hospital pre-alert to expedite specialist assessment and treatment. D- Patients with suspected stroke whose airway is considered at risk should be managed appropriately with suction, positioning and airway adjuncts. E- Patients with residual neurological symptoms or signs should remain nil by mouth until screened for dysphagia by a specifically

Guideline	Recommendations
	trained healthcare professional. F- Patients with suspected TIA should be given 300mg of aspirin immediately and assessed urgently within 24 hours by a specialist physician in a neurovascular clinic or an acute stroke unit. G- Patients with suspected stroke or TIA should be monitored for atrial fibrillation and other arrhythmias.
Harris D, Hall C, Lobay K, McRae A, Monroe T, Perry JJ et al. **Canadian Association of Emergency Physicians Position Statement on Acute Ischemic Stroke.** ***CJEM* 2015; 17(02):217-226**	Prehospital triage and transportation protocols should identify facilities locally or regionally designated to receive acute stroke patients and bypass more proximal facilities in favor of transporting to these sites, assuming the absence of other immediately life-threatening conditions (STRONG RECOMMENDATION, MODERATE QUALITY EVIDENCE). Emergency departments that treat acute stroke patients should have “Code Stroke” protocols or stroke teams to rapidly assess, image and treat patients with the highest priority (STRONG RECOMMENDATION, MODERATE QUALITY EVIDENCE). Designated stroke centers should be identified within regions to receive acute stroke patients; these centers should have organized inpatient (stroke unit) services (STRONG RECOMMENDATION, STRONG QUALITY EVIDENCE). Emergency medical dispatchers should triage calls identified as suspected acute stroke with the highest transport priority level possible (STRONG RECOMMENDATION, HIGH QUALITY EVIDENCE). Initial priorities for prehospital providers assessing suspected acute stroke patients include standard treatment of emergent airway, breathing, and circulatory compromise, followed by establishing a firm time of onset of symptoms (to be set at the time last seen to be normal by bystanders if symptoms occurred on waking from sleep or precise time cannot otherwise be accurately ascertained) and obtaining a point-of-care blood glucose level to rule out hypoglycemia as a stroke mimic (STRONG RECOMMENDATION, MODERATE QUALITY EVIDENCE). Prehospital assessment of suspected acute stroke patients should employ a validated and standardized clinical tool such as the Los Angeles Prehospital Stroke Scale which can be rapidly completed in the field (STRONG RECOMMENDATION, MODERATE QUALITY EVIDENCE). Prehospital triage and transportation protocols should identify facilities locally or regionally designated to receive acute stroke patients and bypass more proximal facilities in favour of transporting to these sites, assuming the absence of other immediately life-threatening conditions (STRONG RECOMMENDATION, MODERATE QUALITY EVIDENCE). Identification of suspected acute stroke by prehospital providers should prompt immediate prenotification of the destination facility (STRONG RECOMMENDATION, MODERATE QUALITY EVIDENCE)

Evidence Tables

Mobilization of Emergency Services

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Berglund et al. 2012 **Sweden** **RCT** ***Hyper Acute STroke Alarm (HASTA) Study***	CA: ☑ Blinding: Patient ☒ Assessor ☒ ITT: ☒	943 patients aged 18-85 years, previously independent in ADLs, with a suspected stroke within 6 hours of symptom onset. Mean age was 71 years.	Patients were randomized to an intervention group (n=332) and received an upgraded priority level (Level "1") by the Emergency Medical Communications Centre (EMCC) or to a control group (n=335) and received the standard priority level (Level "2"). In cases when a stroke was not initially suspected by the EMCC, EMS personnel randomized patients on scene to receive either priority 1 or 2 level notification. Level 1 notification required an immediate ambulance dispatch with prenotification to the ED. Priority 2 notification required ambulance arrival on scene within 30 minutes, unless the ambulance was required by another call.	**Primary outcome:** Time between all stages of the process between call to EMS and call to hospital stroke unit. **Secondary outcome:** Rate of thrombolysis.	**Time delays:** Patients classified as Priority Level 1 by EMCC (intervention group) experienced fewer delays in the median time between the call to EMS and dispatch of EMS (5 vs. 8 minutes, p<0.001), between ambulance dispatch to arrival on scene (9 vs. 15 minutes, p<0.001), and between pre-hospital call to hospital arrival (42 vs. 55 minutes, p<0.001) compared to patients classified as Priority Level 2 (control group). **Rate of thrombolysis:** Patients classified as Priority Level 1 by EMCC received thrombolysis more often than those classified as priority level 2 (24% vs. 10%, p<0.001) and a greater number arrived to the stroke unit within 3 hours of symptom onset (61% vs. 46%, p=0.008).

Ambulance Use by Sex and Age Group in Canada

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Kapoor et al. 2020 **Canada** **Retrospective study**	NA	463,310 adult patients admitted to 547 hospitals between 2003/2004 and 2015/2016 with a primary discharge diagnosis of ischemic stroke, subarachnoid hemorrhage, intracerebral hemorrhage, TIA, and cerebral venous sinus thrombosis. 3.9% were <45 years, 50% were men.	Ambulance use was compared between men vs, women, younger (18-44 years) men vs. younger women, older men vs. older women, and among stroke types.	**Primary outcome:** Percentage of persons using ambulance	66% of patients arrived by ambulance. A significantly higher percentage of older persons arrived by ambulance compared with younger patients (66.1% vs. 62%, p< 0.001). Older women were more likely to arrive by ambulance compared with older men (68.4% vs. 63.9%; p < 0.001). There were no sex differences between younger men vs. women. Persons with TIA were significantly less likely to arrive by ambulance compared with other stroke types (51.8% vs. 68.7%, p < 0.001). Persons with ischemic stroke were significantly less likely to arrive by ambulance compared with patients with hemorrhages (66.6% vs. 78.0%, p < 0.001). Older women with ischemic stroke were significantly more likely to arrive by ambulance. Overall, older patients arrived significantly faster than younger patients (6.8 vs. 8.3 hours, p < 0.0001). Older women arrived at hospital sooner than older men (6.6 vs. 6.9 hours, p < 0.0001), whereas younger women arrive significantly later than younger men (9.2 vs. 7.5 hours, p = 0.004).

Hospital Prenotification by EMS

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Nielsen et al. 2020	NA	9,230 adult patients with a primary discharge diagnosis of ischemic	Independent predictors of the primary outcome were examined in 2	**Primary outcome:** Proportion of patients treated with intravenous t-PA	16.7% of patients arriving by EMS received t-PA compared with 5.0% who arrived by other means.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
USA **Retrospective study**		stroke, admitted to 50 regional hospitals. 70% of patients were ≥ 65 years, 49.3% were women.	groups of patients i) those presenting to hospital by EMS (56.4%) and those presenting to hospital with EMS prenotification (44.6% of those arriving to hospital by EMS)		Arrival by EMS was an independent predictor of receiving t-PA (OR=1.52, 95% CI 1.28-1.80). Among patients arriving to the hospital by EMS, hospital prenotification was an independent predictor of receiving t-PA (OR=1.75, 95% CI 1.36-2.24)
Abboud et al. 2016 **USA** **Retrospective study**	NA	399 patients with a final diagnosis of stroke or TIA who arrived by EMS to the ED between 2009-2012. Median age was 63 years, 45.9% were male. Median NIHSS score was 6.	Process indicators were compared among 3 groups: EMS providers who did not recognize a stroke, EMS providers who did recognize a stroke but did not prenotify, and EMS providers who recognized a stroke and prenotified the receiving hospital.	**Primary outcomes:** Pre-hospital and in-hospital time intervals	The final diagnoses at discharge were ischemic stroke (67.2%), hemorrhagic stroke (18.3%), and TIA (14.5%). EMS dispatches correctly identified 58.2% of all stroke cases (including TIAs) compared with 57.6% for EMS providers. The median door-to-physician and door-to-CT scan times for patients where stroke was recognized but without prenotification were significantly shorter compared with those patients where EMS did not recognize stroke (7 vs. 11 minutes, p<0.0014 and 28 vs. 48 minutes, p<0.001, respectively). EMS prenotification occurred in 40.4% of the stroke cases identified by EMS. The median door-to-physician and door-to-CT scan times for patients where stroke was recognized and with prenotification were significantly shorter compared with those patients with stroke without prenotification (2 vs. 7 minutes, p<0.001 and 19 vs. 28 minutes, p<0.001, respectively). In multivariable analysis, stroke recognition was associated with an increased likelihood of treatment with thrombolysis (OR=6.43, 95% CI 1.74-23.7, p=0.005), as was stroke recognition with prenotification (OR=4.44, 95% CI 1.23-16.01, p=0.023).
Hsieh et al. 2016	NA	928 patients ≥20 years, treated by EMS	Process indicators were compared between	**Primary outcome:** Door to CT scan	A greater proportion of patients arriving with prenotification were male (64.5% vs. 51.75,

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Taiwan **Retrospective study**		technicians who were transported and treated at 9 hospitals from 2012-2014, with a final discharge diagnosis of +/- stroke or TIA, who arrived at hospital within 3 hours of the event	patients who arrived at hospital with prenotification (n=727) and without prenotification (n=201). Prenotification occurred when a patient met criteria including: a positive Cincinnati Prehospital Stroke Scale, symptom onset within 3 hours and blood glucose of ≥60 mg/dL plus evidence of facial palsy, arm weakness or slurred speech.	**Secondary outcome:** Door to needle time	p=0.001) and more likely to have suffered a hemorrhagic stroke (34.4% vs. 32.8%, p<0.001). The stroke severity was non-significantly higher in the pre-notification group (median NIHSS 16 vs. 12.5, p=0.081). The median door to CT time was significantly shorter for prenotification patients (13 vs. 19 minutes, p<0.001). The proportion of prenotification patients who received a CT scan within 25 minutes of hospital arrival was also significantly higher (90.8% vs. 62.2%, p<0.001). Although a higher proportion of prenotification patients received thrombolytic therapy (19.8% vs. 12.4%, p=0.017), the median door to needle time was not significantly different between the prenotification and no prenotification groups (63 vs. 68 minutes, p=0.138). Patients who did not received thrombolytic therapy (in either group) were more likely to have a hemorrhagic stroke, >80 years of age or rapidly improved.
Kim et al. 2016 **Korea** **Retrospective study**	NA	274 patients admitted to a single stroke centre with a standardized stroke code with ischemic stroke or TIA, treated with t-PA from 2012-2015. Mean age was 67.5 years, 36.1% were female. Median NIHSS score was 9.	Process indicators of patients who arrived to hospital by EMS +/- prenotification (n=215) were compared with those arriving by private means without hospital prenotification (n=59).	**Primary outcomes:** Times associated with onset to admission, door-to-imaging, door-to-needle	**EMS vs. private transport** The median onset to hospital arrival time was significantly shorter in the EMS group (62 vs. 116 minutes. P<0.001). The proportion of EMS patients arriving within 60 minutes of symptom onset was significantly greater (49.3 vs. 18.6%, p<0.001). The median door-to-imaging time was not significantly different between groups (12 vs. 12 minutes, p=0.46). The median door-to-needle time was not significantly different between groups (28 vs. 28 minutes, p=0.99). The proportion of patients who received t-PA ≤30 minutes after arrival did not differ between groups (57.7% vs. 62.7%, p=0.49).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					The median symptom onset-to-needle time was significantly shorter for EMS patients (93 vs. 153 minutes, p<0.001). **EMS with prenotification** Of the 215 patients who arrived by EMS, prenotification was used in 28 (13%) cases. There was no significant difference in the median onset- to-door time between patients who arrived with and without prenotification (60 vs. 62 minutes, p=0.24). The median door-to-imaging time was significantly shorter for patients who arrived with prenotification (9 vs. 12 minutes, p=0.045) The median door-to-needle time was significantly shorter for patients who arrived with prenotification (20 vs. 29 minutes, p=0.011).
Casolla et al. 2013 **France** **Prospective study**	NA	302 consecutive stroke patients admitted to an emergency department with acute ischemic stroke who received thrombolysis.	Patients were categorized based on type of pre-notification used: high-level (call to EMS and EMS neurologist), low-level (call to EMS but not EMS neurologist), and no pre-notification.	**Primary outcomes:** Time from stroke onset-to-hospital admission, admission-to-imaging time, imaging-to-needle time, door-to-needle time, and onset-to-needle time.	63% (n=191) of patients had a high-level of pre-notification, whereas 18% (n=55) had a low-level and 19% (n=56) had no pre-notification. Median time from admission-to-imaging was 27 min (IQR 14-35) for patients with high-level pre-notification, compared to 35 min (IQR 17-54) and 36 min (IQR 30-58) for those with low-level or no pre-notification, respectively (p<0.001). Pre-notification was associated with a significantly shorter door-to-needle time (high-level=49 min, low-level=57 min, no pre-notification=63 min; p<0.01) and onset-to-needle time (high-level=140 min, low-level=155 min, no pre-notification=182 min; p<0.001). Pre-notification was not associated with a significant reduction in stroke onset-to-admission time or imaging-to-needle time.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
McKinney et al. 2013 **US** **Retrospective study**	NA	229 patients included from a database of patients admitted to the emergency department with a possible acute stroke between January 2009 and June 2010. Mean age of patients was 65 years, 50% were male	The outcomes of 114 patients treated using hospital pre-notification were compared with 115 patients without hospital pre-notification. Hospital pre-notification involved informing emergency department physicians and other relevant personnel (blood and EKG technicians, radiologists and pharmacologists) of the arrival of a potential stroke patient with a time since symptom onset of less than 4.5 hours.	**Primary outcomes:** Times: from patient arrival to stroke team arrival, to CT completion and interpretation, to ECG, to availability of laboratory results, to making a treatment decision and receiving tPA. Analysis was adjusted for baseline variables and only included patients who arrived to hospital by EMS (i.e., excluded walk-ins)	Patients treated using pre-notification were significantly older (69.5 vs. 61.5 years, p=0.0002) and had higher mean NIHSS scores (11.1 vs. 6.9, p<0.0001) Mean time to stroke team arrival was significantly shorter for prenotification patients, (MD=16.4, 95% CI 12.8-20.0 minutes, p<0.001). Mean times to CT completion and interpretation were significantly shorter for prenotification patients (MD=11.7, 95% CI 6.9-16.4 minutes, p<0.0001 and MD=10.0, 95% CI 3.8-16.1 minutes, p=0.02, respectively). Mean decision time was non-significantly longer for pre-notification patients (-13.5, 95% CI -35.8 to -8.8, p=0.23). Although a higher proportion of prenotification patients were treated with t-PA (27% vs. 15%), after accounting for baseline covariates, prenotification was not an independent predictor of treatment with t-PA (p=0.13).
Lin et al. 2012 **US** **Retrospective study**	NA	371,988 acute ischemic stroke patients consecutively admitted to 1,585 hospitals and transported by ambulance.	As part of the Get with the Guidelines-Stroke initiative, data collected included onset time of stroke, mode of arrival, time of arrival, and use of EMS pre-notification, and time-to-administration of thrombolysis.	**Primary outcomes:** Door-to-imaging time, door-to-needle time, onset-to-needle time.	67% (n=249,197) of participants arrived at hospital following a pre-notification, while 72% of those arriving within 4.5 hours of symptom onset had a pre-notification. Patients with EMS pre-notification had significantly shorter door-to-imaging time (26 vs 31 mins, p<0.001), door-to-needle time (78 vs 81 mins, p<0.001), and stroke onset-to-needle time (141 vs 145 mins, p<0.001). Of those who arrived at hospital within 2 hours of stroke onset, patients with a pre-notification were significantly more likely than those without to receive tPA within 3 hours of stroke onset (73% vs 64%, p<0.001).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Patel et al. 2011 **US** **Prospective registry**	NA	13,894 patients with any type of stroke were identified from prospective stroke register of which, 6300 (45%) patients arrived by private means and 7594 (55%) by EMS in 2008 and 2009.	Comparison of outcomes between three groups of patients (those arriving via private means, by EMS with pre-notification and EMS with no pre-notification). Note: 44% of patients did not have a time recorded for when their imaging results were interpreted.	**Primary outcomes**: Time between hospital arrival and completion of brain imaging and time between hospital arrival and interpretation of brain imaging. **Secondary outcome**: administration of t-PA. Cut points for outcomes: based on targets of 25 minutes for imaging completion and 45 minutes for image interpretation.	<u>Adjusted analysis:</u> **Primary outcomes:** Patients arriving by EMS with hospital pre-notification had a greater likelihood of having brain imaging completed within 25 min (RR=3.0, 95% CI 2.1-4.1) and a greater likelihood of having brain imaging interpreted within 45 min (RR= 2.7, 95% CI 2.3-3.3) compared to arriving by private means. Patients arriving by EMS with no hospital pre-notification had a greater likelihood of having brain imaging completed within 25 min (RR= 1.9, 95% CI 1.6-2.3) and a greater likelihood of having brain imaging interpreted within 45 min (RR= 1.7, 95% CI 1.4-2.1) compared to arriving by private means. **Secondary outcome:** Patients eligible for t-PA were more likely to receive treatment if arriving by EMS with pre-notification (RR 1.5, 95% CI 1.1-1.9) and EMS with no pre-notification (RR=1.6, 95% CI 1.4-2.0) compared to patients arriving by private means.
Gladstone et al. 2009 **Canada** **Retrospective study**	NA	Patients with suspected stroke (unilateral weakness or drift, facial droop or slurred speech and the ability to be transported to hospital within 2 hours of symptom onset), who presented to the ED of a regional stroke centre	Comparison of process indicators during the 4 months before (n=217) and the 4 months after (n=290) the implementation of a new stroke triage protocol, which included paramedic prenotification, a hospital bypass protocol and a hospital code “stroke” paging system.	**Primary outcomes:** Number of patients transported to hospital within 2.5 hours of symptom onset, arrival times and t-PA use	The number of patients arriving to the ED with suspected stroke increased significantly after the new triage system (48.6% vs. 30.4%, p<0.0001). The number of patients with ischemic stroke who received t-PA increased significantly after the new triage system (23.4% vs. 9.5%, p<0.01). The median stroke onset-to-needle time (t-PA patients) decreased significantly after the new triage system (195 vs. 141 minutes, p=0.003). The median stroke onset-to-ED arrival time (t-PA patients) did not differ significantly after the new triage system (46 vs. 63 minutes, p=0.83). The median ED arrival-to-needle time (t-PA patients) decreased significantly after the new triage

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					system (128 vs. 83 minutes, p=0.007).

Validity & Reliability of the Canadian Triage Acuity Scale

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Validity					
Lee et al. 2011 **South Korea** **Retrospective study**	NA	1,903 consecutive patients who were admitted to the emergency department of a tertiary care centre over a 3-month period, who were ≥ 65 years of age. Mean age was 74.3 years, 54.2% were women.	The accuracy of the CTAS levels was established by comparing the score recorded by the triage nurse at the time of the initial patient visit with the results of a review of the patient's medical record including disposition, discharge outcome and resource utilization.	**Primary outcome:** Sensitivity/specificity for the need for identifying patients who received an immediate life-saving intervention	CTAS scores were: Level 1: 113 (5.9%) Level 2: 174 (9.1%) Level 3: 1,154 (60.6%) Level 4: 347 (18.2%) Level 5: 115 (6.0%) 94 patients received immediate life-saving intervention. Of these, 46 patients (48.9%) were classified as level 1, 46 patients (48.9%) as level 2 and 2 patients (2.1%) as level 3. Sensitivity and specificity were 48.9% (95% CI 38.5%-to 59.5%), and 96.3% (95% CI 95.3% to 97.1%, respectively), for immediate life-saving intervention for CTAS level 1. Sensitivity and specificity were 97.9% (95% CI 92.5% to 99.7%), and 89.2% (95% CI 87.7% to 90.6%, respectively), for immediate life-saving intervention for CTAS level ≤2.
Reliability					
Mirhaghi et al. 2015 **Iran** **Systematic review & meta-analysis**	Articles were selected based on a high score using the Guidelines for Reporting Reliability	14 studies reporting on the reliability of CTAS, with methodological quality scores ≥6/8, of which 9 included adults and 5, pediatric patients. 13 trials were conducted in Canada, 1 in Sweden.	As available, 3 types of reliability data were extracted from individual studies and pooled: inter-rater reliability, intra-rater reliability and internal consistency.	**Primary outcomes:** Reliability estimates	No studies reported internal consistency. Weighted kappa coefficient for inter-rater reliability was the most commonly-reported statistic. The pooled estimate of inter-rater reliability including the results from 22 pairs, using weighted (n=17) and unweighted (n=5) Kappa was 0.708

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
	and Agreement Studies (GRRAS).		Raters included nurse practitioners, nurses, and physicians. The most common rater pair was nurse/nurse.		(95% CI 0.629-0.773). Agreement was higher among studies reporting weighted Kappa compared with unweighted Kappa (0.714 vs. 0.475). The weighted Kappa for the one study that reported intra-rater reliability was 0.800 (CI 95% 0.773-0.824).

EMS Interventions to Increase Thrombolysis Treatment

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Price et al. 2020 **UK** **Cluster RCT** ***Paramedic Acute Stroke Treatment Assessment (PASTA)***	CA: ☒ Blinding patient: ☒ assessor: ☑ ITT: ☒	1,214 patients with confirmed stroke, last known to be well within the previous 4 hours attended to by 597 paramedics from 3 ambulance services, representing 15 hospitals with acute stroke units, from 2015 to 2018. Mean age of patients was 74.7 years, 48.6% were women.	Paramedics at the station level were randomized to participate in the PASTA pathway or standard care. The PASTA pathway included structured pre-hospital information collection, prompted pre-notification, structured handover of information in hospital and assistance with simple tasks during the initial hospital assessment. Standard care reflected national guidelines	**Primary outcome:** Treatment with thrombolysis **Secondary outcomes:** Process times, stroke severity 24 hours after thrombolysis, 90-day dependency, 90-day mortality	500 patients were assessed by 242 paramedics in the PASTA group. 714 patients were assessed by 355 paramedics in the standard care group. Paramedics in the PASTA group took an average of 13.4 minutes longer to clear a care episode. Mean on scene times did not differ between groups (PASTA group 26.0 minutes vs. standard care group, 24.2 minutes; mean difference=1.61, 95% CI, −0.2 to 3.4 minutes). Among all patients, there was no significant difference between groups in the proportion of patients who received thrombolysis (39.4% [PASTA] vs. 44.7% [standard care], adjusted OR=0.81, 95% CI 0.61-1.08). Among patients with ischemic stroke, there was no significant difference between groups in the proportion of patients who received thrombolysis (49.7% [PASTA] vs. 52.6% [standard care], adjusted OR=0.84, 95% CI 0.60-1.17). There were no significant differences between

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					groups for any of the secondary outcomes, except mean time from a paramedic on scene to thrombolysis was significantly longer in the PASTA group (98.1 vs. 89.4 minutes; p = 0.01).

Mobile Stroke Units

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Turc et al. 2022 **France** **Systematic review & meta-analysis**	Among the 5 studies used in the primary outcome analysis, 2 studies were at low risk of bias using the Cochrane's Risk of Bias 2 (RoB2) and the Risk of Bias in Non-Randomized Studies of Interventions (ROBINS-I) tools	14 controlled studies, (3 RCTs) including persons with acute ischemic stroke.	Studies compared MSU deployment and usual care for prehospital management within a 6-hour window of symptom onset.	**Primary outcome:** Excellent outcome (mRS 0-1) at 90 days **Secondary outcomes:** Good outcome (mRS 0-2) at 90 days, reduced disability (improvement of ≥1 points over the range of mRS), the proportion of patients treated with intravenous thrombolysis (IVT), and the proportion of thrombolysis started within 60 minutes of symptom onset, among IVT-treated patients, process times.	In adjusted analysis, the pooled odds of the primary outcome were significantly higher in the MSU group (OR=1.64, 95% CI 1.27-2.13, 5 studies, n=3,228 patients). In adjusted analysis, the pooled odds of the reduced disability were significantly higher in the MSU group (OR=1.39, 95% CI 1.14-1.70, 3 studies, n=1,563 patients). In crude analysis, the pooled odds of a good outcome were significantly higher in the MSU group (OR=1.29, 95% CI 1.09-1.44, 6 studies, n=3,266 patients). In crude analysis, the odds of treatment with IVT were significantly higher in the MSU group (OR= 1.83, 95% CI 1.58-2.12, 7 studies, n=4,790 patients). In crude analysis, the odds of treatment with IVT within 60 minutes were significantly higher in the MSU group (OR= 7.71, 95% CI 4.17-14.25, 8 studies, n=3,351 patients). Median onset-to-IVT time and median alarm-to-IVR times were significantly shorter in the MSU group, while there was no significant difference between groups in median onset-to mechanical

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					thrombectomy (MT) time or alarm-to-MT time. MSU use was not associated with an increased risk of all-cause mortality at 7 days or at 90 days or with higher proportions of symptomatic intracranial hemorrhage after IVT.
Grotta et al. 2021 **USA** **RCT** ***BEnefits of Stroke Treatment Delivered Using a Mobile Stroke Unit (BEST-MSU)***	CA: ☑ Blinding patient: ☒ assessor: ☑ ITT: ☑	1,515 adult patients with acute stroke symptoms (within 4.5 hours) who were identified as a potential stroke code by 911 dispatchers. Mean age was 66 years, 48% were women. Median baseline NIHSS score was 9.5. 32% of patients had a previous stroke or TIA.	Patients are being randomized (by week) to treatment with a MSU, equipped with a CT scanner and a point-of-care lab, staffed by a Vascular Neurologist, RN and CT technician (n=886) or standard EMS transport to the Emergency Department of a Comprehensive Stroke Centre for possible treatment with t-PA or endovascular therapy (EVT)(n=624)	**Primary outcome:** Utility-weighted mRS (UW-mRS) score at 90 days **Secondary outcomes:** 30% reduction in NIHSS scores at 24 hours, mRS at 90 days, time from symptom onset to tPA treatment or EVT, symptomatic ICH and mortality during hospitalization	617 patients were eligible to receive t-PA in the Mobile stroke group and 430 in the EMS group. The median time from stroke onset to administration of t-PA was 72 minutes in the MSU group vs. 108 minutes in the EMS group. Of patients eligible for t-PA, 97.1% in the MSU group received t-PA vs. 79.5% in the EMS group. The mean UW-mRS score at 90 days in t-PA eligible patients was significantly higher in the MSU group (0.72 vs. 0.66; adj OR for a score of ≥0.91, 2.43; 95% CI 1.75 to 3.36; p<0.001). Among all patients, the mean UW-mRS score at 90 days was significantly higher in the MSU group (0.57 vs. 0.51; adj OR for a score of ≥0.91,1.82; 95% CI 1.39 to 2.37; p<0.001). Among the patients eligible for t-PA, 53.4% in the MSU group and 43.0% in the EMS group had a mRS score of 0 or 1 at 90 days. The odds of a 30% reduction in NIHSS scores at 24 hours were significantly higher in the MSU group (75% vs. 67.8%, adj OR= 1.45, 95% CI, 1.09 to 1.91). 23.7% of patients in the MSU group and 27.0% in the EMS group were treated with EVT. Mortality at 90 days was 8.9% in the MSU group and 11.9% in the EMS group.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					sICH was approximately 2% in each group.
Ebinger et al. 2021 ***Berlin_PRehospital Or Usual Delivery in stroke care (B_PROUD) Study Group.*** **Germany** **Controlled trial**	NA	1,543 adult patients with stroke symptoms of <4 hours duration and within a 30-minute drive to hospital whose emergency medical call prompted MSU dispatch code. Mean age was 74 years, 47% were women. Median baseline NIHSS score was 4.	Conventional ambulances and/or MSU were dispatched, depending on the availability of MSU. Either the MSU or conventional EMS workers assumed responsibility for care under a variety of scenarios (eg. ambulance arrives on scene first and concludes likely diagnosis was not stroke, MSU dismissed. Ambulance arrives before MSU and concludes likely diagnosis was stroke, ambulance dismissed after providing initial care). Regardless of who assumed care, all patients were transported to nearest hospital.	**Primary outcomes:** Distribution of mRS scores at 3 months, 3-tier disability scale (no to moderate disability, severe disability, or dead) **Secondary outcomes:** Rates of thrombolysis and mechanical thrombectomy, process times, for those patients eligible for treatment	The distribution of mRS scores at 3 months favoured the MSU group (common OR for worse functional outcome= 0.73; 95% CI, 0.54-0.99). Median mRS scores at 3 months were 1 (MSU) vs. 2 (conventional ambulance; adj common OR=0.71, 95% CI 0.58 to 0.86). The same result using the 3-tired functional outcome produced similar results (adj common OR=0.73, 95% CI 0.54 to 0.99). Significantly more patients received treatment with t-PA in the MSU group (451 vs. 382, p<0.001). 103 patients in each group received EVT. Median time from dispatch to imaging was significantly shorter in the MSU group (45 vs. 60 minutes, p<0.001). Median time from dispatch to t-PA was significantly shorter in the MSU group (50 vs. 70 minutes, p<0.001). The distribution of mRS scores favoured the MSU group (adj common OR=0.71, 95% CI 0.58 to 0.86). 7-day mortality was similar between groups, as was the incidence of symptomatic ICH.
Fatima et al. 2020 **USA** **Systematic review & meta-analysis**	NA	11 studies (7 RCTs and 4 non-RCTs) including 21,297 patients with acute stroke (including ischemic stroke, TIA, ICH, seizures, subarachnoid hemorrhage, subdural hematoma, and neurological noncerebral vascular pathology). Mean age was 70.5 years, mean NIHSS score was 9.6.	The clinical outcomes between patients treated on a mobile stroke unit with thrombolysis (MSU, n= 6065, 28.4%) and those receiving conventional care with in-hospital thrombolysis (n=15,232, 71.6%), were compared	**Primary outcomes:** Clinical outcome at days 1 and 7 (mRS 0-2 [good outcome], vs. mRS 3-6 [poor outcome]) **Secondary outcomes:** All-cause mortality at day 7, stroke-related or neurological death, and other adverse events	The mean time from alarm to end of CT scan was significantly shorter in the MSU group (28.6 vs. 37.5 minutes, p=0.04). The mean time from alarm to treatment with IV thrombolysis and/or intra-arterial recanalization (where applicable) was significantly shorter in the MSU group (62 vs. 75 minutes, p=0.03). The odds of a good clinical outcome at 7 days were significantly higher among patients in the MSU group (OR=1.46, 95% CI 1.306–2.03, p=0.02, n=3 studies).

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					The odds of in-hospital mortality and adverse events were not reduced significantly in the MSU group (OR=0.98, 95% CI 0.81-1.18, p=0.80, n=6 studies and OR=0.69, 95% CI 0.39-1.20, p=0.19, n=4 studies, respectively). The odds of stroke related, or neurological death were not increased significantly in the conventional care group (OR=1.37, 95% CI 0.81-2.32, p=0.24, n=5 studies).
Zhao et al. 2020 **Australia** **Prospective study**	NA	100 patients with acute ischemic stroke who were transported to hospital by MSUs during a one-year period and who received thrombolysis (n=73), or thrombolysis +/- EVT (n=41). Mean age for whole cohort was 73.8 years, 62% were men. During the same period 278 patients were transported to hospital via EMS and received thrombolysis.	During its first year in operation, treatment times for MSU patients receiving reperfusion therapy were compared with control patients who presented to stroke units arriving by standard ambulance within MSU operating hours.	**Primary outcome:** Process times, disability-adjusted life years (DALYs)	The median time savings per MSU patient, compared with the control cohort, was 26 minutes (p<0.001) for dispatch to hospital arrival and 15 minutes (p<0.001) for hospital arrival to thrombolysis. The overall time saving from dispatch to thrombolysis was 42.5 minutes (95% CI, 36.0–49.0). During the same period, 41 MSU patients received EVT. The median dispatch-to-puncture time saving compared with control patients was 51 minutes (95% CI, 30.1–71.9, p<0.001). The median time saving from centre arrival to puncture was 17 minutes (95% CI 7.6 to 26.4, p=0.001). Based on the estimate that for every minute of treatment delay, a median of 1.8 days of healthy life are lost for thrombolysis, and a median of 4.3 days of healthy life are lost for EVT, using ambulance dispatch-to-treatment time savings for MSU patients, an estimated overall median of 20.9 DALYs were saved through providing thrombolysis 42.5 minutes earlier for 100 patients, and a median of 24.6 DALYs were saved through providing EVT 51 minutes earlier for 41 patients.
Helwig et al. 2019 **Germany** **RCT**	CA: ☑ Blinding patient: ☑ assessor: ☑	116 patients with suspected acute stroke (≥1 FAST symptom, identified by EMS personnel), with	On a weekly basis, patients were randomized to receive either optimized prehospital management	**Primary outcome:** Accuracy of the triage decision for LVO or ICH (i.e. transfer to the target hospital offering the	39 patients (73.6%) in the OPM group had a final diagnosis of stroke vs. 32 (50.8%) in the MSU group. Of these, 9 (17%) of OPM stroke were LVO vs. 3 (4.8%) in the MSU group.

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
	ITT: ☑	symptom onset ≤8 hours previously, or those with wake-up stroke. Mean age was 74 years, 38% were men.	(OPM, n=53) based on standard practice that included the use of the LAMS (cut point ≥4) to identify LVO or ICH or management in an MSU (n=63). Patients in both groups were transported to either 2 comprehensive stroke centres (CSCs) or 8 primary stroke centres (PSCs)	required level of care) **Secondary outcomes:** Accuracy of the triage decision for LVO, process times and mRS score at 3 months	For the primary outcome, the triage decision was accurate for 37 patients (69.8%) in the OPM group and for 63 patients (100%) in the MSU group (difference, 30.2%; 95% CI, 17.8%-42.5%; P < .001). 7/17 OPM patients (41.2%) with LVO or ICH required secondary transfers from a PSC to a CSC, vs. 0/11 MSU patients (0%) required such transfers (difference= 41.2%; 95% CI, 17.8%-64.6%; P = .02). For the secondary outcome, the triage decision was accurate for 41 patients (77.4%) in the OPM group and for 63 patients (100%) in the MSU group (difference, 22.6%; 95% CI, 13.2%-35.9%; P < .001). Among persons with a confirmed stroke, median 3-month mRS scores did not differ between groups (3 vs. 3).
Taqui et al. 2017 **USA** **Prospective study**	NA	100 patients treated using a mobile stroke treatment unit (MSTU) and 53 control patients presenting conventionally via EMS to a hospital emergency department (ED). Mean ages were 62 and 63.4 years. 54% and 56.6% were women, Initial median NIHSS scores were 6 and 7.	The evaluation and treatment of the first 100 patients treated by a MSTU, outfitted with a mobile CT scanner, after its establishment in July, 2014 to November 1, 2014 was compared to a control group of 53 patients brought to the ED via a traditional ambulance during the calendar year in 2014. These patients had a stroke alert activated within 30 minutes of arrival to the ED.	**Primary outcome:** Process times	During the study period, there were 317 alerts and 217 cancellations. Of the 100 remaining alerts, there were 63 possible or probable acute ischemic strokes, 4 TIAs, 5 ICHs and 28 noncerebrovascular events. 16 (16%) MSTU patients received thrombolysis vs. 12 (22.6%) of controls. Median alarm to CT completion time was significantly shorter for MSTU patients (33 vs. 56 minutes, p<0.0001). Median alarm-to-thrombolysis time was significantly shorter for MSTU patients (55.5 vs. 94 minutes, p<0.0001), as were median door-to-thrombolysis times (31.5 vs. 58 minutes, p< 0.0012), and symptom-onset-to-thrombolysis times (97 vs. 122.5 minutes, p< 0.0485). Patients evaluated in the MSTU received thrombolysis 25.5

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					minutes earlier
Kunz et al. 2016 **Germany** **Retrospective study**	NA	Patients who were living independently prior to stroke, who received thrombolysis following acute stroke. Mean age was 70.5 years, 42% male, Median baseline NIHSS score was 8.	The outcomes of patients who received thrombolysis therapy using the mobile stroke unit, STEMO from 2011-2015 (n=505) were compared with patients who received thrombolysis but arrived to hospital via EMS (n=353). Patients from the EMS group were only included if they were treated during the hours that STEMO operated (0700-2300 h)	**Primary outcome:** Excellent functional outcome at 3 months (mRS 0-1) **Secondary outcomes:** Proportion of patients living without severe disability, or able to ambulate independently (mRS 0-3) at 3 months, 3-month mortality **Safety outcomes:** Intracranial hemorrhage, 7-day mortality	The median time from stroke onset to thrombolysis was significantly shorter in the STEMO group (73 vs. 115 minutes, p<0.0005. A significantly higher proportion of patients in the STEMO group were treated ≤ 90 minutes of stroke (62% vs. 35%, p<0.0005). There was no significant difference in the number of patients who achieved an excellent outcome at 3 months (53% STEMO vs. 47% conventional, p=0.14). A significantly higher proportion of patients in the STEMO group were living without severe disability at 3 months (83% vs. 74%, p=0.004). 3-month mortality was significantly lower in the STEMO group (6% vs. 10%, p=0.022). There were no significant differences in the safety outcomes between the 2 groups (sICH 3% vs. 5%, p=0.27 and 7-day mortality 2% vs. 4%, p=0.23) Adjusting for baseline characteristics, STEMO was an independent predictor of living without severe disability at 3 months (OR=1.86, 95% CI 1.20-2.88, p+0.006), but was not an independent predictor of the primary outcome (OR=1.40, 95% CI 1.00-1.97, p=0.052).
Ebinger et al. 2014 *PHANTOM-S* **Germany** **Open-label RCT**	CA: ☒ Blinding patient: ☒ assessor: ☒ ITT: ☒	7,986 patients, who lived within 16 minutes' travel time from the fire station were STEMO was based, within symptom onset <4 hours. Treated at one of 14 hospitals. Mean age was 74 years, 44.5% were male.	Patients were randomized to receive response from a Stroke Emergency Mobile (STEMO) ambulance, equipped with a CT scanner, point-of-care-lab and a specialized pre-hospital stroke team	**Primary outcome:** Time from alarm to t-PA treatment **Secondary outcomes:** Thrombolysis rate, in-hospital mortality, symptomatic ICH, adverse events	Of 3,213 patients who suffered a stroke during an on- STEMO week, STEMO was deployed in 1,804 cases. In most of the cases when STEMO was not deployed, it was already in use and was not available. Of the patients with ischemic stroke, t-PA was used in 32.6% of STEMO deployment cases, 29% during STEMO weeks, and 21.1% during control

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
			including a paramedic, neurologist and neuroradiologist or to routine care (n=2,969) on alternating weeks.		weeks. Mean alarm to treatment time was significantly shorter in the STEMO deployed group compared with the control weeks (51.8 vs. 76.3 min, p<0.001). The proportions of patients treated with t-PA within 90 minutes of stroke were significantly higher when STEMO was deployed (58%), compared with 48% during STEMO weeks (i.e., STEMO not deployed) and 37% during control weeks. There were no significant differences among groups in hospital mortality, sICH or LOS.
Walter et al. 2012 **Germany** **RCT**	CA: ☑ Blinding patient: ☒ assessor: ☒ ITT: ☑	100 patients 18-80 years with ≥1 stroke symptoms using the modified ROSIER criteria, beginning within the previous 2-5 hours. Median age was 71 years, 62% were male. Median baseline NIHSS scores were 5 (MSU) and 6 (control)	Patients were randomized to a mobile stroke unit (MSU) group (n=53) or a control group (n=47). The MSU response consisted of a paramedic, neurologist and neuroradiologist and the ambulance was equipped with a portable CT scanner, a telemedicine system and a point-of-care laboratory. Patients in the control group received optimized conventional stroke management in hospital, which included point-of-care laboratory	**Primary outcome:** Time from alarm to treatment decision **Secondary outcomes:** Number of patients treated with t-PA, time from alarm to t-PA, number of patients with t-PA or intra-arterial recanalization, time from alarm to t-PA or to intra-arterial recanalization. NIHSS, BI and mRS scores at days 1 and 7.	The trial was stopped early after interim analysis, which demonstrated pre-specified superiority of the MSU. 200 patients were planned. 29 MSU patients (55%) and 25 (53%) control patients were diagnosed with ischemic stroke. Median time from alarm to treatment decision was significantly shorter in the MSU group (35 vs. 76 min, p<0.0001). Median time from stroke onset to treatment decision was significantly shorter in the MSU group (56 vs. 104 min, p<0.0001). Similar proportions of patients were treated with t-PA (23% vs. 17%, p=0.30). Median times from alarm and symptom onset to treatment with t-PA were significantly shorter in the MSU group (38 vs. 73 min, p<0.0001, and 73 vs. 153, p=0.0011, respectively). 23% of patients in both groups were treated with t-PA or endovascular therapy. Median times from alarm and symptom onset to therapy were significantly shorter in the MSU group. There were no significant differences in

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
					neurological outcomes between groups, assessed using NIHSS, BI or mRS at either day 1 or 7. Survival at day 7 was 89% (MSU) and 96% (control). CT scanning was unavailable for 8 patients in the MSU group due to technical problems.

Thrombolysis Delivered in Mobile Stroke Units

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Bivard et al. 2022 **Australia** **Phase 2 RCT** ***Tenecteplase Versus Alteplase for Stroke Thrombolysis Evaluation Trial in the Ambulance (TASTEa)***	Concealed Allocation: ☑ Blinding: Patient ☑ Assessor ☑ ITT: ☑	104 patients with suspected acute ischemic stroke (within 4.5 hours), who were eligible for thrombolytic therapy who were attended to via a mobile stroke unit, which serviced 5 hospitals. Median age was 73 years, 60% were men. Median baseline NIHSS score was 8.	Patients were randomized to receive intravenous tenecteplase (0.25mg/kg, maximum 25mg, n=55) or 0.9 mg/kg alteplase (n=49).	**Primary outcome:** Volume of the perfusion lesion on arrival at hospital, assessed by CT-perfusion imaging. **Secondary outcomes:** mRS score of 5 or 6 at 90 days, symptomatic intracerebral haemorrhage and any hemorrhage within 36 hours, and death at 90 days	The median time from stroke onset to treatment was 95 minutes. On arrival at the hospital, the perfusion lesion volume was significantly smaller with tenecteplase (median 12 mL vs. 35 mL: adjusted incidence rate ratio 0·55, 95% CI 0·37–0·81). At 90 days, 15% of patients in the tenecteplase group had an mRS of 5 or 6 compared with 20% of patients in alteplase group (adjusted OR= 0·70, 95% CI 0·23–2·16; p=0·54). There were no cases of sICH in either group. 90-day mortality was 9% for the tenecteplase group compared with 10% in the alteplase group. Serious adverse events were reported in 5% of the patients in the tenecteplase group compared with 8% in the alteplase group.

Drip & Ship vs. Mothership Models for Patients with Suspected Large Vessel Occlusion

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
NCT03542188 **RCT** ***TReatment Strategy In Acute Ischemic larGE Vessel STROKE: Prioritize Thrombolysis or Endovascular Treatment (TRIAGE)***	CA: ☑ Blinding patient: ☒ assessor: ☑ ITT: ☑	600 patients aged ≥18 years, with symptoms of acute stroke, a PASS score ≥2, and where it is possible to start IV thrombolysis within 4.5 hours at a CSC.	Patients are randomized to transport to a primary stroke center for early IV-thrombolysis followed by a secondary transport to a comprehensive stroke center for EVT, if needed or direct transport to a comprehensive stroke center (CSC) for IV-thrombolysis and early EVT.	**Primary outcome:** Ordinal shift analysis of mRS scores at 90 days (for all patients with a final diagnosis of ischemic stroke) **Secondary outcomes:** Ordinal shift analysis of mRS scores at 90 days for other groups (e.g., all randomized patients), mRS 0-2 at 90 days, severe dependency or death after 90 days, process times, successful re-perfusion in EVT treated	TBA Estimated study completion is August 2022
De la Ossa et al. 2022 **Spain** **RCT** ***Direct Transfer to an Endovascular Center Compared to Transfer to the Closest Stroke Center in Acute Stroke Patients with Suspected Large Vessel Occlusion (RACECAT)***	Concealed Allocation: ☑ Blinding: Patient ☒ Assessor ☑ ITT: ☑	1,401patients with suspected acute large vessel occlusion (LVO) identified by EMS at first assistance on the field, defined as a RACE Scale score between 5 and 9, with an estimated arrival time at a thrombectomy-capable center < 7 hours after symptom onset (for witnessed onset) or last time seen well. Median age was 76 years, 45% were women. Median RACE score was 7. Median baseline NIHSS score was 16.	Following EMS triage, patients were randomized to 6 thrombectomy-capable centers or 22 local stroke centers (including 8 primary stroke centers and 14 telestroke centers). Telestroke centers were capable of initiating intravenous thrombolysis. Prenotification criteria for the EMS coordination center were established to provide high sensitivity in identifying potential candidates.	**Primary outcome:** Ordinal shift in distribution of mRS scores at 90 days **Secondary outcomes:** 90-day mortality, clinical deterioration at 24 hours.	Enrollment was halted for futility following a second interim analysis. Among the 949 patients in the target population (those with confirmed stroke or TIA), 482 were allocated to thrombectomy capable centers and 467 were allocated to local stroke centers. Among patients who received vascular imaging at the first hospital, LVO was detected in 333 at thrombectomy capable centers and in 198 patients (76%) at local stroke centers. A significantly higher percentage of patients referred to a thrombectomy capable centre were treated with thrombectomy (48.8% vs.39.4%) Among the target population, 47.5% of patients allocated to a thrombectomy-capable center received intravenous tPA vs. 60.4% allocated to a local stroke center (absolute difference, −12.9%; 95% CI, −19.2% to −6.6%; OR, 0.59; 95% CI,

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					0.45-0.76). There was no significant difference between group in ordinal shift analysis of mRS scores (median of 3 in both groups, adj common OR=1.0, 95% CI 0.82-1.29). There was no significant difference in 90-day all-cause mortality between groups (27.2% vs. 27.3%).
Mohamed et al. 2021 **Canada** **Systematic review & meta-analysis**	NA	19 studies (2 RCTs, 5 prospective studies and 10 retrospective studies) including 7,824 patients with acute ischemic stroke, potentially eligible for treatment with mechanical thrombectomy. Mean age was 70 years, mean baseline NIHSS score was 15.7.	The outcomes of patients treated with a mothership model (59.3%), who received t-PA +/- mechanical thrombectomy (where appropriate) were compared with those of a drip-and-ship model (40.7%), whereby treatment with t-PA was provided at the closest hospital, prior to transport to a comprehensive stroke centre.	**Primary outcome:** Poor functional outcome (mRS 3-6) at 90 days **Secondary outcomes:** Mortality, stroke-related death, critical times (symptom's onset to IV thrombolysis, symptom's onset-to-groin puncture and symptom's onset-to-successful recanalization), and adverse events	The odds of poor functional outcome were significantly higher in the drip & ship model (OR=1.47, 95% CI 1.13–1.92, p< 0.004). The odds of a good functional outcome at 90 days (mRS 0-2) were significantly lower in the drip & ship model (OR=0.74, 95% CI 0.65-0.84). The odds of symptomatic ICH were significantly higher in the drip & ship model (OR=1.49, 95% CI 1.22-1.81). There were no significant differences between groups for the outcomes of mortality or successful recanalization. There was no significant difference in the mean symptom's onset to IV thrombolysis time (mothership 117.0 vs. drip & ship 128.25 minutes, p=0.205). Both the mean symptom's onset-to-groin puncture time and time to successful recanalization were significantly shorter in the mothership group (159.6 vs. 223.9 minutes, p< 0.001 and 206.1 vs. 129.7 minutes, p<0.001, respectively).
Ismail et al. 2019 **France** **Systematic review**	Newcastle Ottawa Scale scores ranged from 6-9	8 studies (n=2,068) including patients with acute ischemic stroke, eligible for treatment with mechanical	The outcomes of patients who underwent mechanical thrombectomy: a) preceded by IV	**Primary outcomes:** Successful reperfusion (mTICI ≥2b), functional independence at 90 days (mRS score ≤2),	Mean difference in time from symptoms onset to puncture was significantly shorter in the CSC group (MD= -83.0 5minutes, 95% CI –89.09 to -77.01).

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& meta-analysis		thrombectomy.	thrombolysis in a primary stroke center with transport to a comprehensive stroke centre (CSC), or b) IV thrombolysis and direct transport to a CSC, were compared.	symptomatic intracranial hemorrhage (sICH), and 90-day mortality	Mean difference in time from symptoms onset to successful reperfusion was significantly shorter in the CSC group (MD= -94.33 minutes, 95% CI –100.42 to 88.24). Patients in the CSC group had better functional outcomes at 90 days (RR=0.87, 95% CI 0.77 to 0.98). There were no significant differences between groups in successful reperfusion (RR=1.00, 95% CI 0.92 to 1.10), 90-day mortality (RR=1.21, 95% CI 0.89 to 1.64), or sICH (RR=1.53, 95% CI 0.79 to 2.98).
Kaminsky et al. 2019 **France/USA** **Retrospective study**	NA	207 consecutive large vessel occlusion (LVO) patients ≥18 years who were admitted to one of 6 spoke centers or to the regional comprehensive stroke centre (CSC) within 6 hours of symptom onset from September 1, 2015 to August 31, 2017. Mean age was 73.5 years, 42% were men. Mean baseline NIHSS was 15.8.	The outcomes of patients who were admitted to a spoke center using telestroke were compared with first CSC admission.	**Primary outcomes:** Favourable outcome (mRS 0-2) at 90 days **Secondary outcomes:** mRS scores at 3 months	132 (63.8%) patients were first admitted to the CSC and 75 (36.2%) to spoke centers before transfer to the CSC. Mean distance between spoke centers and the CSC was 54 miles (range 36–77 miles) with a mean road transport time of 77minutes. IVT was administered significantly more often in the group admitted to spoke centers (81.3% vs 53.8%, p=0.001). MT was performed more frequently in patients admitted to a CSC (49.2% vs. 26.7$, p=0.001). Mean time from onset to groin puncture was significantly shorter for patients admitted to the CSC (200±72min vs 303±44min, p<0.0001). There was no significant difference between groups in the percentage of patients who achieved a good outcome (32% spoke center vs 35.1% CSC) or in the mean mRS score (3.8 vs. 3.4)
Weber et al. 2016 **Germany**	NA	643 patients consecutively admitted from 2012-2013, to 17 stroke units with acute	The outcomes of patients treated in house at 8 centres with expertise to perform endovascular	**Primary outcome:** In-hospital mortality and mortality at 3 months	50.3% of patients in the in-house received bridging therapy with t-PA vs. 46.9% of referred patients (p=0.39).

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Retrospective study		ischemic stroke treated with intravenous thrombolysis and/or thrombectomy. Median age was 71 years, 50% were men. Median baseline NIHSS sore was 15.	procedures (n=300) were compared with those of patients from 9 centres who had been transferred from another hospital to undergo mechanical thrombectomy (n=343).	**Secondary outcomes:** Functional outcome at 3 months (mRS 0-2) and peri-procedural times	Canalization (TICI 2B or 3) was achieved in 73.9% of in-house patients and 76.3% of referred patients (p=0.67). Median periprocedural times were significantly shorter for in-house group (e.g., symptom onset to groin puncture 150 vs. 233 min, p<0.001). 3-month mortality data were available for 76.4% of patients. There was no significant difference between groups in the proportion of patients with in-hospital mortality (14.8% in-house vs. 11.7%, referred p = 0.26) or 3-month mortality (21.9% in-house vs. 24.1% referred, p=0.53). Functional outcome data were available for 63% of patients. There was no significant difference between groups in the proportion of patients with a good outcome at discharge (46% in-house vs. 35.1%, referred; p value not reported) or at 3-months (44.0% in-house vs. 35.7% referred, p=0.08).

On Scene Management (Blood Glucose Abnormalities)

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Ohshita et al. 2015 **Japan** **Retrospective study**	NA	11 patients admitted to a single institution with hypoglycemia (<50 mg/dl) and focal neurological signs, excluding those with coma or seizures. Mean age was 73.2 years, 6 were men. Age ranged from 54 to 92 years, 6 were men. 9 patients	After hypoglycemia was diagnosed, all patients were treated immediately with 40 mL of 50% glucose. Medical records were reviewed to evaluate initial blood glucose level, neurological signs, past history and comorbidity, MRI findings, and outcome of recovery after treatment.	**Primary outcome:** Resolution of symptoms	9 patients had unilateral weakness. Other neurological symptoms included neglect, apraxia, and dysarthria. 8 patients had mild or moderate alteration of consciousness. The mean initial blood glucose level was 27.9 mg/dL. All patients had improved initial neurological

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		had pre-existing diabetes (all treated with oral glycemic medications).			signs within 1 h of glucose injection In 2/11 patients (18%), the initial DWI showed a hyperintense lesion in the contralateral internal capsule, which was faint on repeat scan one day later.
Wallis et al. 1984 **New Zealand** **Retrospective study**	NA	16 patients with definite (n=10) or probable (n=6) hemiplegic hypoglycemia (HH). Patients with probable HH did not have a blood glucose reordered at the time of hemiparesis. Persons with definite HH had blood glucose of <45 mgldl). Ages ranged from 27 to 73 years, 50% were men.	Carotid arteriography, computed tomography (CT) of the brain, radioactive isotope brain scintigrams, and electroencephalography (EEG) were used to investigate patients suspected of having underlying neurological disease.	**Primary outcome:** Resolution of symptoms	Of those with probable HH, 5 were found to be hypoglycemic around the time of the hemiplegia, and the hemiplegia resolved with glucose treatment. One patient with probable hypoglycemia without a blood glucose level determined near the time of the hemiplegia, responded to glucose treatment. Only 2 patients had persistent neurological deficits after correction of hypoglycemia.

On Scene Management (Prehospital Screening Scales to Identify Stroke & Large Vessel Occlusions)

Study/Type	Quality Rating	Sample Description	Method	Outcomes	Key Findings and Recommendations
Scales to Identify Possible Stroke					
Zhelev et al. 2019 **UK/Canada** **Cochrane review**	12 studies were at high risk of bias in the patient selection domain, all studies were at low risk of bias in the index test domain, 14	23 primary studies including 9,230 participants evaluating the test accuracy of stroke recognition scales in a prehospital (n=17) or ER setting (n=6).	The sensitivity and specificity of 8 different stroke recognition scales, was assessed. Scales included Cincinnati Prehospital Stroke Scale (CPSS, n=11), Los Angeles Prehospital Stroke Scale (LAPSS, n=5), Melbourne Ambulance Stroke Scale (MASS, n=3), Ontario Prehospital Stroke Screening Tool (OPSST, n=1), Face Arm Speech Time (FAST, n=5), Recognition of	**Primary outcome:** Sensitivity and specificity	The overall summary sensitivity and specificity for each of the scales was: ROSIER: pooled sensitivity was 0.88 (95% CI 0.84 to 0.91), Specificity was not pooled, ranging from 0.18 to 0.93 within individual studies. CPSS No pooled summary statistics were estimated. Sensitivity ranged from 0.44 to 0.95; specificity from 0.21 to 0.79 within individual studies.

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	were at unclear risk of bias in the reference standard domain and 1 at high risk of bias and another 16 were at unclear risk of bias in the flow and timing domain		Stroke in the Emergency Room (ROSIER, n=8), Medic Prehospital Assessment for Code Stroke (MedPACS, n=1) and the PreHospital Ambulance Stroke Test (PreHAST, n=1). 9 studies compared ≥ 2 scales in the same patients (3 studies each compared FAST vs ROSIER and CPSS vs MASS, 2 studies each compared ROSIER vs CPSS, LAPSS vs CPSS and LAPSS vs MASS, and 1 study each compared some of the remaining pairs		LAPSS: pooled sensitivity was 0.83 (95% CI 0.75 to 0.89), pooled specificity was 0.93 (95% CI 0.88 to 0.96) FAST No pooled summary statistics were estimated. Sensitivity ranged from 0.64 to 0.97; specificity from 0.13 to 0.92 within individual studies MASS No pooled summary statistics were estimated. Sensitivity ranged from 0.74 to 0.90. Specificity was not pooled, ranging from 0.67 to 0.86 within individual studies OPSST: Sensitivity in the single study was 0.92 (95% CI 0.88 to 0.94), specificity 0.86 (95% CI 0.80 to 0.90) MedPACS: Sensitivity in the single study was 0.74 (95% CI 0.67 to 0.80), specificity 0.33 (95% CI 0.27 to 0.39) PreHAST: Sensitivity in the single study was 1.00 (95% CI 0.87 to 1.00), specificity 0.40 (95% CI 0.25 to 0.56) The authors concluded that for use in the ER, ROSIER and FAST have similar sensitivity and specificity. For use in the field CPSS should be used preferentially due to its consistently high sensitivity, although both MASS and ROSIER have higher specificity
Brandler et al. 2014 **USA** **Systematic**	Using the QUADAS-2 tool, areas of bias included one area of the patient	8 studies assessing the performance of prehospital stroke scales by EMTs or paramedics. Sample sizes ranged from 100	Scales identified included the Cincinnati Pre-Hospital Stroke Scale (CPSS), Los Angeles Pre-Hospital Stroke Screen (LAPSS), Melbourne Ambulance Stroke Screen (MASS), Medic Prehospital	**Primary outcome:** Test characteristics	Pooling of sensitivity/specificity (SN/SP) results was not possible. CPSS (3 studies); SNs 0.95, 0.98 and 0.79; SPs 0.56, 0.79 and 0.24

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review & meta-analysis	selection domain (Did the study avoided inappropriate exclusions?) and one area of the reference test domain (Was the reference standard result interpreted without the knowledge of index test results?)	to 11,296. Stroke prevalence ranged from 2.5% to 88%.	Assessment for Code Stroke (Med PACS), Ontario Prehospital Stroke Screening Tool (OPSS), Recognition of Stroke in the Emergency Room (ROSIER), and Face Arm Speech Test (FAST).		FAST (1 study) SN 0.97; SP 0.13 LAPSS (4 studies) SNs 0.78, 0.91, 0.86, 0.78; SPs 0.85, 0.97, 0.99, and 0.90 MASS (2 studies) SNs 0.83, 0.90; SPs 0.86, 0.74 MedPACS (1 study) SN 0.74; SP 0.33 OPSS (1 study) SN 0.92, SP 0.86 ROSIER (1 study) SN 0.97; SP 0.18 Pooling the results from 3 studies, the area under the curve for CPSS was 0.813, and for LAPSS using the results from 4 studies, the AUC was 0.964. Positive likelihood ratios were <10 for most studies/tests. The best result was for LAPSS (31.3 and 71).
Scales to Identify Large Vessel Occlusion					
Duvekot et al. 2021 **The Netherlands** **Prospective study** ***PRESTO***	NA	1,039 adults with suspected stroke and onset of symptoms <6 hours were identified by paramedics, using FAST. Median age was 72 years, 54% were men.	After structured training, paramedics used a mobile app to assess items from 8 prehospital stroke scales designed to identify patients with LVO lesions: Rapid Arterial oCclusion Evaluation (RACE), Los Angeles Motor Scale (LAMS), Cincinnati Stroke Triage Assessment Tool (C-STAT), GazeFace-Arm-Speech-Time (G-FAST), Prehospital Acute Stroke Severity (PASS), Cincinnati Prehospital Stroke Scale (CPSS), Conveniently-Grasped Field Assessment Stroke Triage (CG-FAST), and the FAST-PLUS (Face-Arm-Speech-Time plus severe arm	**Primary outcome:** ROC AUC, Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) for the diagnosis of an anterior circulation LVO at each possible cut point	522 (50%) patients had a confirmed ischemic stroke, 120 patients had a confirmed aLVO. ROC AUCs (95% CI) RACE: 0·83 (0·79–0·86) G-FAST: 0·80 (0·76–0·84) CG-FAST: 0·80 (0·76–0·84) LAMS: 0·79 (0·75–0·83) CPSS: 0·79 (0·75–0·83) PASS: 0·76 (0·72–0·80) C-STAT: 0·75 (0·71–0·80) FAST-PLUS: 0·72 (0·67–0·76) At an optimal cut-point of ≥5, RACE had the highest sensitivity (0·67, 95% CI 0·58–0·75). At an optimal cut point of ≥4 CG Fast had the highest specificity (0·89, 95% CI 0·87-0·91). PPVs from 0·30 (95% CI 0·25–0·35) for C-

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			or leg motor deficit) test. The performance of each test was assessed using CT confirmed LVO as the criterion standard		STAT to 0·40 (95% CI 0·35–0·45) for RACE; NPV ranged from 0·93 (95% CI 0·92–0·94) for CG-FAST and C-STAT to 0·95 (95% CI 0·93–0·96) for LAMS. The NIHSS score as assessed by a clinician in the emergency department had better performance in predicting LVO (AUC=0·86, 95% CI 0·83–0·89).
Nguyen et al. 2021 **The Netherlands** **Prospective study**	NA	2,007 adult patients who received acute stroke codes (with symptom onset <6 hours) in a region with a population of 2 million people. Mean age was 71.1 years, 50.9% were men. Median NIHSS score was 4	Head-to-head comparisons of 7 LVO prediction scales by EMS was conducted to assess feasibility, defined as the proportion of acute stroke codes for which the authors' prespecified scale's cut point could be determined with the available data, and accuracy. Scales included: The Los Angeles Motor Scale (LAMS), the Rapid Arterial Occlusion Evaluation (RACE), the Cincinnati Stroke Triage Assessment Tool (C-STAT; formerly CPSSS), the Prehospital Acute Stroke Severity (PASS) scale, the gaze face-arm-speech-time (G-FAST) test, the Field Assessment Stroke Triage for Emergency Destination (FAST-ED), and the gaze, facial asymmetry, level of consciousness, extinction/ inattention (GACE) scale.	**Primary outcomes:** Feasibility, test characteristics	158 patients had a confirmed LVO. Of these, 100 patients underwent an EVT procedure. The final diagnosis of the other patients was ischemic stroke (41.9%), ICH (7.4%), TIA 13.2% and stroke mimic 37.5%. Accuracy: ranged from 0.79 for C-STAT ≥2 to 0.89 for LAMS ≥4. High accuracy was also reported for RACE ≥5 at 0.88. Sensitivity: ranged from 0.38 for LAMS ≥4 to 0.62 for C-STAT ≥2. Specificity: ranged from 0.80 for C-STAT ≥2 to 0.93 for LAMS ≥4. Youden's index: ranged from 0.30 for LAMS ≥4 to 0.47 for RACE ≥5. Positive predictive values were low (0.21 to 0.32). Negative predictive values were all ≥0.95. Reconstruction rates ranged from 78.1% for RACE to 87.9% for PASS.
Smith et al. 2018 **Canada/US/UK**	NA	36 studies evaluating the accuracy of LVO prediction scales in patients with suspected stroke or presumed	Forest plots were produced, stratified by LVO prediction instrument and population (suspected stroke or ischemic stroke), when results were	**Primary outcome:** Test characteristics of LVO prediction scales Sensitivity (SN), specificity (SP), area	In 4 studies the prediction scales were applied in the pre-hospital setting (i.e., EMS). In the remaining studies, the scales were used in emergency departments, in mixed settings or the setting was not stated.

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Systematic review & meta-analysis		acute ischemic stroke in pre-hospital or emergency department settings.	available for >1 study. When sufficient data were available for a given LVO prediction instrument, summary receiver-operating characteristics (ROC) curves were produced.	under ROC (AUC)	The most commonly used prediction scales included NIHSS, the Cincinnati Prehospital Stroke Severity Scale, Rapid Arterial oCclusion Evaluation, The Los Angeles Motor Scale and the 3-item stroke scale. In pooled ROC analysis, using the NIHSS in patients with suspected stroke, and a cut-off of 6,8 and 10, the SNs were 0.80, 0.73. and 0.64, respectively. The associated SPs were 0.72, 0.79 and 0.84.7 studies included. In pooled ROC analysis, using the NIHSS in patients with ischemic stroke, and a cut-off of 6,8 and 10, the SNs were 0.87, 0.81 and 0.73, respectively. The associated SPs were 0.53, 0.63 and 0.74. 13 studies included. In pooled ROC analysis, using the CPSSS in patients with ischemic stroke, the SN and SP ranged from 0.95 to 0.69 (cut-off of 0) to 0.15 to 0.93 (cut-off of 4). 6 studies included. AUC for all studies (where reported), using various cut points ranged from 0.65 to 0.85. Given a pre-test prevalence of LVO of 20%, the post-test probability of LVO ranged from 40-50% in suspected stroke using 4 different scales and cut points. Given a pre-test prevalence of LVO of 35%, the post-test probability of LVO ranged from 50-60% in ischemic stroke using NIHSS with cut-points of 6, 8and 10. The authors concluded that no scale had both high sensitivity and specificity to determine the presence vs. absence of LVO, and that in clinical practice that the probability of LVO

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					given a negative test could still be ≥10%.
Mazya et al. 2020 **Sweden** **Prospective study** ***The Stockholm Stroke Triage System***	NA	2,905 patients transported by first priority ("code stroke") ambulance to hospital for suspected acute stroke between October 10, 2017, and October 9, 2018. Median age was 75 years, 49% were women.	Patients were assessed by an ambulance nurse using the FAST test. If positive, the patient was then evaluated for moderate-to-severe hemiparesis using 2 items from the NIHSS (ipsilateral arm and leg), indicating large artery occlusion (LAO). If present, the comprehensive stroke center (CSC) stroke physician was teleconsulted by phone for confirmation of stroke suspicion, assessment of EVT eligibility, and direction to CSC or the nearest primary stroke center. If absent, the nearest hospital was prenotified.	**Primary outcome:** LAO **Secondary outcomes:** EVT initiation, onset-to-puncture time, and onset-to-needle time (ONT).	323 patients were triage positive. Median NIHSS score was 13. Of these 131 patients had ischemic stroke and LAO, of whom 84 went on to EVT. 2,582 patients were triage negative. Median NIHSS score was 3. Of these 185 patients were found to have ischemic stroke and LAO, of whom 35 went on to EVT. The sensitivity and specificity of the triage tool to identify LAO were 41.5% and 92.6%. Overall accuracy was 87.0% The sensitivity and specificity of the triage tool to identify EVT treatment were 70.6% and 91.4%. Overall accuracy was 90.6%. Compared with the previous year before SSTS was implemented, median onset-to puncture time was significantly shorter in patients with a known time of onset (137 vs. 206 minutes, p<0.001). A higher percentage of patients were transported directly to a CSC (73.1% vs. 23.8%, p<0.001) after SSTS.
Noorian et al. 2018 **USA** **Prospective study**	NA	94 patients transported by EMS with suspected stroke who were enrolled in the FAST-MAG trial and in whom an MRA or CTA was obtained within 6 hours of ED arrival and before intravenous tPA or endovascular thrombectomy. Mean age was 70 years, 51% were men.	The performance of the Los Angeles Motor Scale (LAMS) administered by paramedics in the prehospital setting was assessed in identifying 1) LVOs among all patients with ischemic stroke and 2) Comprehensive Stroke Centers (CSC) -appropriate patients (i.e., those with ischemic stroke, ICH or LVO) among all suspected stroke patients. The LAMS administered post arrival in the Emergency	**Primary outcomes:** Test characteristics of scales	Final diagnoses were ischemic stroke (76%), ICH (19%) and stroke mimics (5%). There were 45 (48%) of LVOs, 5 (5%) medium vessel occlusions and 21 (22%) with no vessel occlusions. The test characteristics of LAMS ≥4 to identify LVO among patients with ischemic stroke were: Sensitivity 0.76; specificity 0.65 Positive predictive value (PPV) 0.79 Negative predictive value (NPV) 0.61 Accuracy 0.72

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			Department was compared concurrently with 6 other scales proposed for paramedic use including the Cincinnati Stroke Triage Assessment Tool (C-STAT; formerly CPSSS), Field Assessment Stroke Triage for Emergency Destination, Prehospital Acute Stroke Severity scale, Rapid Arterial Occlusion Evaluation (RACE) scale and the Vision-Aphasia Neglect (VAN) scale; and 2 scales suggested for use in the ED (NIHSS with cut-points of ≥ 7 and 10, and the 3-item Stroke scale (3i-SS)		The test characteristics of LAMS ≥4 to identify patients suitable for transport to a CSC were: Sensitivity 0.73; specificity 0.71 Positive predictive value (PPV) 0.84 Negative predictive value (NPV) 0.56 Accuracy 0.72. For identifying LVOs among those with cerebral ischemia, all scales showed fair to moderate performance (accuracies ranging from 0.62–0.70). The 4 highest accuracy point estimates were for the LAMS (0.70), the C-STAT (0.68), the Prehospital Acute Stroke Severity scale (0.68), and the full NIHSS cutoff at ≥7 (0.68). The 2 lowest accuracies were for the 3i-SS (0.62) and the VAN (0.63). For identifying CSC-appropriate patients among all suspected stroke transports, the scales showed performance ranging from poor to moderate (accuracies ranging from 0.56–0.73). The 4 highest accuracy point estimates were for the LAMS (0.73) and the full NIHSS cutoff at ≥7 (0.73), RACE (0.66), and VAN (0.66). The two lowest accuracy estimates were for the 3i-SS (0.56) and the C-STAT (0.62).
Purrucker et al. 2017 **Germany** **Prospective/ Retrospective**	NA	326 EMS personnel, paramedics, ER physicians and stroke physicians were invited to rate the suitability of each NIHSS item for its suitability for prehospital use on a 6-item scale, ranging from	Test characteristics of the new scale were calculated regarding performance in stroke recognition and prediction of acute LVO, using two clinical cohorts. Cohort 1 included 689 consecutive patients with 'suspected acute CNS disorder' admitted to an ER.	**Primary outcomes:** Sensitivity (SN), specificity (SP), positive predictive value (PPV), negative predictive value (NPV), area under ROC (AUC)	9 NIHSS items formed the sNIHSS-EMS scale: LOC (1a), facial palsy (4). Motor arm-left (5), motor arm-right (5), motor leg-left (6), motor leg- right (6), sensory (8), best language (9), dysarthria (10). Total possible scores ranged from 0-29. *Stroke recognition* 29% of patients admitted to the ER with

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		0 (most suitable) to 5 (most unsuitable). Items which scored a 0 or 1 were included into a newly formed shortened NIHSS-EMS (sNIHSS-EMS) scale.	Cohort 2 (LVO validation cohort) included 741 consecutively admitted patients with ischemic stroke. The sNIHSS-EMS was evaluated against other LVO prediction scales (3-item Stroke Scale, Prehospital Acute Stroke Severity Scale, Cincinnati Prehospital Stroke Severity Scale etc).		suspected stroke (cohort 1) had a discharge diagnosis of stroke. Using an optimal sNIHSS-EMS cut-off score of ≥1, the test characteristics were SN 90.5%, 95% CI 85.6 to 94.2%, SP 51.5%, 95% CI 47.0 to 56.1%, PPV 43.3%, 95% CI 38.5 to 48.2%, NPV 93.0%, 95% CI 89.3 to 95.6%. *LVO Prediction* 39% of patients in cohort 2 had a LVO. Using an optimal sNIHSS-EMS cut-off score of ≥6, the test characteristics were SN 70.3%, 95% CI 64.7 to 75.5%, SP 80.7%, 95% CI 76.8 to 84.3%, PPV 70.1%, 95% CI 64.5 to 75.32%, NPV 80.9%, 95% CI 76.9 to 84.4%, accuracy 76.7%, AUC 0.81, 95% CI 0.78 to 0.84. The AUCs for other prediction scales, calculated using cohort 2 patients were not-significantly different from the sNIHSS-EMS result.

Development of Prehospital Stroke Screening Scales to Identify Large Vessel Occlusions

Author/ Assessment Tool	Purpose of the tool Details of the validation study	Items and Scoring	Results of validation study
Wasyliw et al. 2022 ***Face, Arm, Speech, Time-Vision Aphasia Neglect (FAST VAN)***	**Purpose:** To develop a clinical tool to identify patients with LVO in a prehospital setting **Sample:** 1,080 consecutive patients acute stroke attended to by EMS personnel between April 2017 and Jan 2021	3 components 1. Vision- Is there a gaze preference to either side (usually away from the hemiparesis)? 2. Aphasia- Ask the patient to name simple objects (ie: watch, pen). 3. Neglect- With eyes closed, touch each arm independently and ask which side	Diagnostic criteria: CT angiography. Of 440 patients who were FAST-VAN +ve, 236 (53.6%) had LVO. Of 640 patients who were FAST-VAN -ve, 40 (6.25%) had LVO. Sensitivity was 86%; specificity was 75%. Overall accuracy was 77%.

Author/ Assessment Tool	Purpose of the tool Details of the validation study	Items and Scoring	Results of validation study
		is being touched. Then touch both simultaneously. If neglect is present the patient will only report one side being touched, almost always neglecting the left side. Any single positive response was considered to be positive for LVO	Among the 240 false positives (+ve FAST VAN, no LVO), 69 patients were stroke with no LVO, 47 were ICH, 30 had delirium/encephalopathy, 23 had seizures, 14 had TIA and 21 had other conditions
Okuno et al. 2020 ***Field Assessment of Critical Stroke by Emergency Services for Acute Delivery (FACE$_2$AD)***	**Purpose:** To design a simple prehospital stroke scale for EMS paramedics to identify patients with acute ischemic stroke due to LVO, using a cohort that included stroke mimics and hemorrhagic stroke patients. **Sample**: 1157 patients were included in the derivation cohort. They were patients taken to hospital by EMS because of suspected stroke or consciousness disturbance in the first 24 hours of symptom onset, from 2012 and 2015. 502 patients were included in the validation cohort, using same criteria. Patients were recruited from 4 hospitals during a 5-month period. All the items except eye deviation were evaluated by EMS providers, while eye deviation was evaluated by physicians or nurses.	6 items Facial palsy (0-1) Arm palsy (0-1) Consciousness impairment (0-1) Eye deviation (0 or 2) Atrial fibrillation (0-1) Diastolic blood pressure ≤ 85 mmHg (0-1) Total possible score: 7	Diagnostic criteria: MRA, CTA, digital subtraction angiography (DSA) In the derivation cohort, 416 patients had ischemic stroke of which 149 (13%) patients had LVO. In the validation cohort, at a cut point of ≥3, the sensitivity and specific were 0.85 and 0.80, respectively. PPV and NPV were 0.39 and 0.97, respectively. AUC was 0.88 (95% CI 0.87–0.90). In the validation cohort, 216 patients (43%) had an ischemic stroke, of which 86 (17%) patients had an LVO. In the validation cohort, at a cut point of ≥3, the sensitivity and specific were 0.80 and 0.74, respectively. PPV and NPV were 0.39 and 0.95, respectively. AUC was 0.83 (95% CI 0.81–0.86).
Gong et al. 2020 ***The Conveniently-Grasped Field Assessment Stroke Triage (CG-FAST) scale***	**Purpose:** To modify the G-FAST scale to improve its accuracy **Sample:** 1,355 patients, admitted to a single centre from 2009 to 2018 with confirmed acute ischemic stroke with symptom onset within the previous 8 hours. Median NIHSS on admission was 8 (IQR 3–15).	5 items based on NIHSS Level of Consciousness questions (0-1) Gaze deviation (0-1) Facial palsy (0-1) Arm weakness (0-1) Speech changes (0-1) Total possible score: 5	Diagnostic criteria: CTA or MRA 664 patients (49.0%) were found to have LVO At a cut-point of ≥4 Sensitivity: 61.7% Specificity: 81.0% Positive predictive value: 78.5% Negative predictive value: 69.2%

Author/ Assessment Tool	Purpose of the tool Details of the validation study	Items and Scoring	Results of validation study
	NIHSS data was abstracted from patient records by an experienced neurologist		AUC was 0.758 Youden Index: 0.428 At a cut-point of ≥4, the performance of the CG-FAST was better than FAST-ED≥3, 3-ISS≥3, CPSSS≥2, PASS≥2, RACE≥5, LAMS≥3, and G-FAST≥3
Vidale et al. 2019 ***The Large ARtery Occlusion (LARIO) stroke scale***	**Purpose:** To develop a brief and simple stroke scale to improve identification of patients with LVO, and to test its accuracy against 5 existing stroke scales **Sample:** 145 patients with suspected ischemic stroke presenting to an emergency department of one hospital between April and October 2017. The scale was developed and tested on the same cohort of patients. Both a neurologist and a nurse performed all assessments.	5 items, based on LAMS Facial palsy (0-1) Arm weakness (0-1) Grip strength (0-1) Language (0-1) Neglect (0-1) Total possible score: 5	Diagnostic criteria for LVO: CT and CT Angiography 54 patients (37.2%) were found to have LVO. At a cut point of >3 on The LARIO scale: Sensitivity: 100% Specificity: 83% + LR: 0.77 - LR: 1.0 AUC: 0.951 (95% CI 0.902-0.980) Compared with other scales, NIHSS had the best performance (AUC 0.915). AUC for CPSS (0.896), LAMS (0.832) and VAN (0.884). There was excellent agreement between raters (Cohen's k: 0.963).
Gropen et al. 2018 ***The Emergency Medical Stroke Assessment (EMSA)***	**Purpose:** To develop a brief and simple prehospital stroke scale to improve identification of patients with LVO and all acute stroke. **Sample: LVO cohort** 1,663 consecutive adult patients with stroke enrolled in the Tulane Comprehensive Stroke Center (CSC) registry from 2008 to 2013. Acute stroke cohort: Used to develop the EMSA. 218 patients with stroke in 2010, based on chart review.	5 items, based on NIHSS 1. Eye movement (0-1) 2. Facial weakness (0-1) 3. Arm weakness (0-1) 4. Leg weakness (0-1) 5. Slurred speech or aphasia (0-2) Total possible score: 6	Diagnostic criteria for LVO: MR or CT angiogram LVO was present in 171 patients (10.3%) A cut-point of ≥3 on EMSA had the best performance to identify LVO Sensitivity: 74.5% (95% CI 68.7-80.5) Specificity: 50.3% (95% CI 44.4-56.2) + LR: 1.517 (95% CI 1.356-1.659) - LR: .489 (95% CI .366-0.637) performance of EMSA was also compared with 3I-SS, C-STAT, RACE, FAST-ED, and NIHSS (3 different cut points). An EMSA ≥ 3 had a significantly higher sensitivity for prediction of LVO compared with the other scales at their published cut-points but had lower specificity.

Author/ Assessment Tool	Purpose of the tool Details of the validation study	Items and Scoring	Results of validation study
			The area under the curves for the scales were similar across scales EMSA 0.688 (95% CI .736-0.640) 3I-SS 0.647 (95% CI 0.696-0.597) C-STAT 0.646 (95% CI0.693-0.598) RACE 0.666 (95% CI 0.716-0.616) FAST-ED 0.641 (95% CI 0.690-0.591) NIHSS 0.678 (95% CI 0.723-0.633) A cut point of ≥1 on a variety of scales resulted in sensitivities and specificities (95% CI) of: EMSA 93.3% (86.9-96.7), 46.9% (38.0-56.1) 3I-SS 74.3% (65.2-81.7) 54.0% (44.8-62.9) C-STAT 36.2% (27.6-45.7), 74.3% (65.6-81.5) RACE 84.8% (76.7-90.4), 55.8% (46.6-64.6) FAST-ED 78.1% (69.3-84.9), 54.9% (45.7-63.7)
Lima et al. 2016 ***Field Assessment Stroke Triage for Emergency Destination (FAST-ED)***	**Purpose:** To identify patients with emergent large vessel occlusion. Intended for use by EMS. **Sample:** 741 consecutive patients enrolled in the STOPStroke study, who were admitted to 2 university-based hospitals with unilateral, complete occlusion of the M1 and M2 segments of the MCA or basilar artery, with onset of symptoms within 24 hours.	6-items, 5 based on NIHSS 6. Facial palsy (0-1) 7. Arm weakness (0-2) 8. Speech changes (0-2) 9. Eye deviation (0-2) 10. Denial/neglect (0-2) 11. Time (documentation for decision making) not scored Total possible score: 9	Diagnostic standard: CTA Large vessel occlusion was present in 240 patients (33%) A cut-point of ≥4 on FAST-ED had the best performance Sensitivity: 0.61 Specificity: 0.83 PPV: 0.72 NPV: 0.82 Accuracy: 0.79 AUC:0.813 Performance of FAST-ED was also compared with NIHSS, RACE and CPSS scale
Teleb et al. 2016 ***Vision, Aphasia, and Neglect (VAN)***	**Purpose:** Prediction of emergent large vessel occlusion. Piloted by trained ED nurses. **Sample:** 62 acute stroke codes at a single facility	Patients are asked to raise both arms up and hold them up for 10 s. If the patient demonstrates any level of drift, weakness or paralysis, the assessment continues. Otherwise, patient is VAN -ve and screen ends. Items	Diagnostic standard: CTA Performance was also compared with NIHSS ≥6 Large vessel occlusion was present in 19 patients (30.6%) For VAN +ve patients Sensitivity: 1.00 Specificity: 0.90 PPV: 0.74

Author/ Assessment Tool	Purpose of the tool Details of the validation study	Items and Scoring	Results of validation study
		Visual disturbances: field cut, double vision, new-onset blindness (present/absent) Aphasia: Expressive, receptive, mixed (present/absent) Neglect: Forced gaze, unable to feel both sides at same time or doesn't recognize arm, ignoring one side (present/absent) Scoring: None If weakness present + ≥1 positive finding =VAN +ve	NPV: 1.00 Accuracy: 0.92 NIHSS≥6 Sensitivity: 1.00 Specificity: 0.79 PPV: 0.58 NPV: 1.00 Accuracy: 0.84
Hastrup et al. 2016 ***Prehospital Acute Stroke Severity Scale (PASS)***	**Purpose**: Prediction of emergent large vessel occlusion. Intended for use by EMS. **Sample**: 3,127 patients included in the Danish Stroke Registry (2010-2015) who were treated with t-PA. 2/3 of sample was used for scale development and 1/3 for validation	3 NIHSS items: 1. Incorrect month and/or age? (Level of consciousness (NIHSS item >0) 1 point 2. Gaze palsy and/or deviation (NIHSS item gaze>0) 1 point 3. Arm weakness (NIHSS item arm weakness >0) 1 point Total possible score: 3	Diagnostic standard: CTA/MRA Arterial occlusion was detected in 35% of patients A cut-point of ≥2 on the PASS had the best predictive value: Using the Derivation cohort Sensitivity 0.66, 95% CI 0.62-0.66 Specificity: 0.83, 95% CI 0.81-0.85 AUC: 0.74, 95% CI 0.72-0.76 OR=9.22, 95% CI 7.5-11.40 PPV/NPV: 0.68/0.81 +LR/-LR: 3.84/0.42 The values were similar when using the validation cohort
Katz et al. 2015 ***Cincinnati Prehospital Stroke Severity Scale (CPSSS)***	**Purpose**: Prediction of severe acute ischemic stroke (NIHSS ≥15) and proximal large vessel occlusion (LVO). Intended for use by EMS. **Sample**: Derivation cohort-624 patients with mild to severe stroke from 2 NINDS t-PA trials. Validation cohort-650 patients from the IMS-III trial	3 NIHSS items: 1. Conjugate gaze deviation (≥1 on NIHSS item for gaze) 2 points 2. Incorrectly answers to at least 1 of 2 LOC questions (NIHSS age or current month) and does not follow at least 1 of 2 commands (close eyes, open and close hand) ≥1 NIHSS items LOC 1b and 1c. 1 point 3. Cannot hold arm (left, right or both) up for 10 seconds (≥2 NIHSS motor arm). 1 point	Diagnostic standard: CTA In the validation cohort, 222 (34%) patients had LVO **Severe stroke** AUC: 0.89 A cut point of ≥2 had the best predictive value for severe stroke Using the derivation cohort Sensitivity: 89% Specificity: 73% + LR/-LR: 3.30/0.15 Using the validation cohort: Sensitivity: 92%

Author/ Assessment Tool	Purpose of the tool Details of the validation study	Items and Scoring	Results of validation study
		Total possible score 4	Specificity: 51% + LR/-LR: 1.89/0.1 **LVO** For the detection of LVO (using the validation cohort-220 with confirmed LVO) and a cut point of ≥2 Sensitivity: 83% Specificity: 40% + LR/-LR: 1.4/0.4
Pérez de la Ossa et al. 2014 ***Rapid Arterial oCclusion Evaluation Scale (RACE)***	**Purpose**: Prediction of acute stroke and large vessel occlusion (LVO). For use by EMS **Sample**: Derivation cohort-654 patients with acute stroke or stroke mimic for whom a stroke code had been activated by EMS or a community hospital. Validation cohort-357 patients transferred by EMS to a stroke centre. **Scale tested by:** EMS providers during validation phase	5 NIHSS items: 1. Facial palsy (absent=0, mild=1, mod/severe=2) 2. Arm motor function (normal/mild=0, moderate=1, severe=2) 3. Leg motor function (normal/mild=0, moderate=1, severe=2) 4. Head and gaze deviation (absent=0, present=1) 5. Aphasia (R hemiparesis: performs both tasks correctly=0, performs 1 task correctly=1, performs neither tasks=2); Agnosia (Left hemiparesis: patient recognizes arm/impairment=0, does not recognize arm *or* impairment=1, does not recognize arm *and* impairment=2) Total possible score 9	Diagnostic standard: LVO was detected by transcranial Doppler, CT or MRA. 178 patients (27%) had a LVO in derivation cohort vs. 76 (21.3%) in the validation cohort. In the derivation cohort, there was a strong correlation between RACE and NIHSS (r=0.76, p<0.01) In the validation cohort, a cut point of ≥5 had the best predictive value for detecting LVO. Sensitivity: 85% Specificity: 68% PPV: 42% NPV: 94% The AUC for the RACE scale was 0.82, 95% CI 0.77-0.87 for the detection of LVO
Nazliel et al. 2008 ***The Los Angeles Motor Scale (LAMS)***	**Purpose**: Prediction of persisting large vessel occlusion (PLVO) in acute ischemic stroke. For use by EMS and Emergency Department use **Sample**: 119 patients included in a clinical trials registry at a stroke centre from 1996-2003, and patients included in the Get with the Guidelines Registry in	3 items: 1. Facial droop (absent=0, present=1) 2. Arm drift (absent=0, drifts down=1, falls rapidly=2) 3. Grip strength (normal=0, weak=1, no grip=2) Total possible score 5	Diagnostic standard: MRA/CTA, or catheter angiography PLVO was detected in 74 (62%) patients AUC: 0.854 A cut point of ≥4 had the best predictive value for detecting LVO Sensitivity: 81% Specificity: 89% Accuracy: 85% +LR: 7.36

Author/ Assessment Tool	Purpose of the tool Details of the validation study	Items and Scoring	Results of validation study
	2005. Patients were included if they were last known well within 12 hours of presentation to the ED and had a final diagnosis of ischemic stroke in the anterior circulation		-LR: 0.21
Singer et al. 2005 ***3-Item Stroke Scale (3ISS)***	**Purpose**: Prediction of stroke severity and MCA occlusion. **Patients:** 180 patients presenting to a stroke unit in 2002 with symptoms of stroke within ≤6 hours (28 patients had ICH). **Scale tested by**: Stroke neurologists	3 items: Disturbance of consciousness (no= 0, mild =1, severe= 2) Gaze and head deviation (absent= 0, incomplete gaze/head deviation=1, forced gaze/head deviation= 2) Hemiparesis (absent=0, moderate=1, severe= 2) Total possible score 6	Diagnostic standard: MRI/MRA/CT 27 patients (15%) had distal ICA, M1 or M2 occlusions A cut point of ≥4 had the best predictive value for detecting MCA occlusions Sensitivity: 67% Specificity: 92% PPV: 74% NPV: 89% Accuracy: 86% Inter-rater reliability: Intraclass correlation co-efficient was 0.947; K for individual items were 0.77, 0.77 and 0.84

Abbreviations

AUC: area under curve	CA: concealed allocation	CI: confidence interval
IQR: interquartile range	ITT: intention-to-treat	LR: likelihood ratio
LVO: large vessel occlusion	NPV: negative predictive value	OR: odds ratio
PPV: positive predictive value	ROC: receiver operator curve	RR: relative risk
SN: sensitivity	SP: specificity	

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