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The Impact of Prehospital Stroke Recognition and Management on Patient Outcomes: A Systematic Review

تأثير التعرف على السكتة الدماغية وإدارتها قبل دخول المستشفى على نتائج المرضى: مراجعة منهجية

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Abstract:

Background. Recognition of stroke by emergency medical services (EMS), advance notification, transport decisions, and treatment initiated before hospital arrival may change access to time-sensitive stroke care. Their impact on patient disability and survival depends on the intervention, the type of stroke, and the healthcare system.
Objective. To evaluate the impact of prehospital stroke recognition and management strategies on clinical outcomes among adults with suspected or confirmed acute stroke, while distinguishing patient-centered benefits from changes in diagnostic accuracy and treatment time.
Methods (planned). A systematic review will search MEDLINE/PubMed, Embase, Scopus, Web of Science, CINAHL, and the Cochrane CENTRAL database from inception through the documented final search date. Eligible comparative studies will be screened independently by two reviewers. Outcomes will include functional status at 90 days, mortality, symptomatic intracranial hemorrhage, access to reperfusion therapy, and care-delivery intervals. Risk of bias and the feasibility of pooling will be evaluated by study design, and reporting will follow PRISMA 2020.
Results status. Formal search results, study counts, study-level quality assessments, and pooled or narrative findings from a completed review are not yet available. The present draft summarizes selected published studies as contextual examples only, not as an exhaustive or systematically selected evidence set.
Preliminary interpretation. Published evaluations suggest that mobile stroke units may improve access to thrombolysis and selected functional outcomes; however, effects of transport bypass and blood-pressure interventions vary, and no single prehospital strategy has uniform benefit in all stroke populations.
Conclusion. The clinical value of prehospital stroke care should be established through a completed systematic synthesis that considers stroke subtype, regional stroke-center capabilities, bias, and patient-centered outcomes.

Keywords: Acute stroke; prehospital care; emergency medical services; stroke recognition; mobile stroke unit; triage; reperfusion; functional outcome; systematic review.

الملخص:

الخلفية:

قد يسهم تعرّف خدمات الطوارئ الطبية (EMS)على حالات السكتة الدماغية، والإخطار المسبق للمستشفى، وقرارات النقل، وبدء العلاج قبل الوصول إلى المستشفى، في تغيير فرص الحصول على الرعاية العلاجية للسكتة الدماغية في الوقت المناسب .ويعتمد تأثير هذه التدخلات على الإعاقة لدى المرضى ومعدلات بقائهم على قيد الحياة على نوع التدخل، ونوع السكتة الدماغية، والنظام الصحي المعني.

الهدف:

تقييم تأثير استراتيجيات التعرّف على السكتة الدماغية وإدارتها في مرحلة ما قبل المستشفى على النتائج السريرية لدى البالغين المشتبه بإصابتهم بسكتة دماغية حادة أو المؤكدة إصابتهم بها، مع التمييز بين الفوائد المرتبطة بالمرضى أنفسهم والتغيرات في دقة التشخيص والوقت اللازم لتقديم العلاج.

المنهجية:

ستبحث هذه المراجعة المنهجية في قواعد البيانات MEDLINE/PubMedو Embaseو Scopusو Web of Science و CINAHLوقاعدة بيانات Cochrane CENTRAL، منذ بدء إتاحتها وحتى تاريخ آخر بحث موثّق .وسيقوم مراجعان بصورة مستقلة بفرز الدراسات المقارنة المؤهلة .وستشمل النتائج الحالة الوظيفية للمرضى بعد 90يومًا، ومعدلات الوفيات، والنزيف داخل الجمجمة المصحوب بأعراض، وإمكانية الحصول على علاج إعادة التروية، والفترات الزمنية المرتبطة بتقديم الرعاية .كما سيُقيّم خطر التحيز وإمكانية إجراء التحليل التجميعي وفقًا لتصميم كل دراسة، وسيتم إعداد التقرير وفقًا لإرشادات PRISMA 2020.

حالة النتائج
لم تتوفر حتى الآن نتائج البحث الرسمية، أو أعداد الدراسات، أو تقييمات الجودة على مستوى الدراسات، أو النتائج المجمّعة أو السردية المستخلصة من مراجعة مكتملة .وتلخّص المسودة الحالية دراسات منشورة مختارة بوصفها أمثلة سياقية فقط، وليست مجموعة أدلة شاملة جرى اختيارها بصورة منهجية.
التفسير الأولي
تشير التقييمات المنشورة إلى أن وحدات السكتة الدماغية المتنقلة قد تُحسّن فرص الحصول على العلاج الحالّ للخثرة وبعض النتائج الوظيفية المحددة؛ إلا أن تأثيرات تجاوز المستشفيات أثناء النقل والتدخلات المتعلقة بضغط الدم تتباين، ولا توجد استراتيجية واحدة للرعاية السابقة للوصول إلى المستشفى تحقق فوائد موحّدة لدى جميع فئات مرضى السكتة الدماغية.
الخاتمة
ينبغي تحديد القيمة السريرية للرعاية المقدمة لمرضى السكتة الدماغية في مرحلة ما قبل المستشفى من خلال توليف منهجي مكتمل للأدلة، يأخذ في الاعتبار نوع السكتة الدماغية، وإمكانات مراكز السكتة الدماغية الإقليمية، ومخاطر التحيز، والنتائج التي تركز على المرضى.

الكلمات المفتاحية :السكتة الدماغية الحادة؛ الرعاية السابقة للوصول إلى المستشفى؛ خدمات الطوارئ الطبية؛ التعرّف على السكتة الدماغية؛ وحدة السكتة الدماغية المتنقلة؛ الفرز الطبي؛ إعادة التروية؛ النتائج.

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1. Introduction

Stroke is a time-critical neurological emergency in which prompt assessment, accurate recognition, and efficient access to suitable treatment pathways can influence disability and survival. Prehospital care begins with the emergency call and continues through dispatch, on-scene recognition, clinical stabilization, choice of destination, and communication with the receiving hospital. These stages may determine the time to brain imaging, intravenous thrombolysis, or mechanical thrombectomy.

The prehospital pathway includes several distinct activities that should not be conflated. Recognition tools such as the Face, Arm, Speech, Time (FAST) and Cincinnati Prehospital Stroke Scale (CPSS) aim to identify patients with possible stroke, whereas scales such as Rapid Arterial Occlusion Evaluation (RACE) can support assessment of possible large-vessel occlusion (LVO). These scales are screening or triage aids, not definitive diagnoses. The 2026 American Heart Association/American Stroke Association guideline emphasizes structured EMS assessment, hospital prenotification, destination protocols, and systems of care (Prabhakaran et al., 2026).

One potential strategy is rapid identification and conventional ambulance transport to an appropriate stroke center. Another is direct transport to a thrombectomy-capable center for patients suspected of having LVO, which may shorten the path to endovascular treatment but delay intravenous thrombolysis when a nearer stroke center is bypassed. A third involves a mobile stroke unit (MSU), equipped in some systems for on-board brain imaging and early intravenous treatment. These approaches differ substantially in cost, staffing, geography, and accessibility.

Clinical evidence highlights the importance of examining both benefits and trade-offs. The BEST-MSU study reported shorter onset-to-thrombolysis times and more favorable disability outcomes among eligible patients assessed by MSUs compared with standard EMS (Grotta et al., 2021). Conversely, the RACECAT randomized trial in nonurban Catalonia did not show a significant overall improvement in 90-day disability from routine direct transport to a distant thrombectomy-capable center, despite differences in treatment use and timing (Pérez de la Ossa et al., 2022). These results cannot be summarized as a universal advantage for bypass or MSUs in all settings.

Prehospital physiological interventions also require particular caution because suspected stroke may ultimately be ischemic, hemorrhagic, a transient ischemic attack, or a stroke mimic. The RIGHT-2 trial found no overall functional improvement with ambulance-initiated transdermal glyceryl trinitrate in presumed stroke (Bath et al., 2019). The INTERACT4 trial found no overall benefit of intensive prehospital blood-pressure reduction in undifferentiated stroke and reported divergent associations by stroke subtype (Li et al., 2024).

The proposed review therefore asks not merely whether EMS can recognize stroke faster, but whether specific prehospital recognition and management interventions improve patient-centered outcomes, and under which clinical and service conditions those effects are seen.

2. Review Objectives and Research Questions

Primary objective. To determine whether prehospital recognition and management interventions, compared with standard prehospital care or alternative prehospital strategies, improve functional outcomes and survival among adults with suspected or confirmed acute stroke.

Secondary objectives. To examine effects on treatment eligibility and delivery, time to imaging and reperfusion, complications, and accuracy of identifying stroke or possible LVO; and to explore whether intervention effects differ by stroke type, setting, and care pathway.

How do EMS recognition tools, dispatch protocols, and hospital prenotification influence time-to-care and clinically relevant outcomes?

Do mobile stroke units or enhanced prehospital clinical pathways improve 90-day functional outcomes and access to reperfusion treatment?

What are the effects and trade-offs of direct-to-thrombectomy-center transport versus initial presentation to a nearer stroke center?

Do physiological or pharmacological treatments initiated before imaging improve outcomes, and are effects different for ischemic and hemorrhagic stroke?

3. Background and Literature Review

3.1. Prehospital recognition and diagnostic uncertainty

Prehospital identification often uses brief neurological screening tools that are feasible under time pressure. Their clinical value depends on sensitivity to true stroke and their impact on care activation, but false positives can consume stroke-response resources and false negatives may delay treatment. A head-to-head study of seven reconstructed prehospital scales in 3,317 suspected stroke cases found generally limited specificity and variable sensitivity; its findings demonstrate that choosing a recognition tool involves trade-offs rather than a uniformly superior instrument (Dekker et al., 2025).

Recognition research frequently reports sensitivity, specificity, or agreement with a final hospital diagnosis. These outcomes establish diagnostic performance but are not direct measures of survival, disability, or quality of life. Accordingly, this review should present diagnostic accuracy as a separate secondary domain and avoid inferring that a highly sensitive scale necessarily improves functional recovery.

3.2. EMS prenotification and integrated stroke pathways

Early warning from field teams can help receiving hospitals prepare stroke teams, imaging access, and rapid treatment decisions. Current professional guidance supports advance notification of suspected stroke arrivals and encourages standardized local EMS protocols (Prabhakaran et al., 2026). In a large US quality-registry study involving 371,988 EMS-transported ischemic stroke patients, Lin et al. (2012) found that prenotification was associated with shorter median door-to-imaging time (26 vs 31 minutes) and improved thrombolysis-related performance. However, improvements in door-to-imaging or door-to-needle times should be evaluated alongside, rather than substituted for, patient-centered outcomes.

The association was derived from an observational registry, so differences in receiving hospitals, documentation, selection and stroke-severity characteristics may explain part of the measured differences. An effectiveness synthesis must therefore distinguish a process improvement association from evidence that prenotification itself produces lower mortality or reduced disability.

3.3. Mobile stroke units and treatment opportunity

MSUs aim to move critical imaging and treatment functions into the prehospital setting. In a controlled multicenter study, Grotta et al. (2021) observed a median onset-to-thrombolysis time of 72 minutes with MSU care compared with 108 minutes under standard EMS among thrombolysis-eligible patients. Corrected 2023 results for BEST-MSU reported a favorable shift in 90-day outcomes, including mRS 0–1 in 53.5% of eligible MSU patients versus 45.5% with standard EMS (Grotta et al., 2021; NEJM Correction, 2023). The Berlin B_PROUD controlled intervention study likewise found an association between MSU dispatch and less disability at three months (Ebinger et al., 2021). These findings require appraisal of selection, site-specific resources, potential residual confounding, and transferability.

3.4. Destination selection for possible large-vessel occlusion

Direct transport to a thrombectomy-capable center may shorten access to endovascular therapy for confirmed LVO, but it may also extend travel time or delay intravenous treatment for patients who could be treated at a nearby center. In RACECAT, prehospital direct transport did not significantly improve the distribution of 90-day disability relative to the initial local stroke-center approach in a nonurban service configuration (Pérez de la Ossa et al., 2022). Any systematic review should examine

geography, travel time, capability of local facilities, secondary transfer performance, and the proportion of true LVO among screened patients.

3.5. Prehospital treatment before stroke subtype confirmation

The diagnostic uncertainty of suspected stroke creates an important distinction between universal supportive measures and subtype-sensitive interventions. The ambulance-based RIGHT-2 trial did not identify functional benefit from routine transdermal glyceryl trinitrate in a broad presumed-stroke population (Bath et al., 2019). In INTERACT4, the overall 90-day functional effect of intensive ambulance-delivered blood-pressure lowering was neutral, while subgroup analyses suggested more favorable outcomes in hemorrhagic stroke and less favorable outcomes in cerebral ischemia (Li et al., 2024). Such findings illustrate why pooled analyses must not collapse stroke subtypes without clinical justification.

3.6. Prehospital large-vessel occlusion assessment

LVO recognition scales can be used to identify patients who may benefit from a thrombectomy pathway. The prospective PRESTO study assessed eight prehospital scales in real-world suspected stroke presentations, directly addressing field identification of intracranial LVO (Duvekot et al., 2021). Scale performance should be interpreted using disease prevalence, detection threshold, the cost of false-positive bypass, and the consequences of missing an LVO. A screening score alone cannot establish the correct destination, because center availability and transfer efficiency remain critical.

Diagnostic accuracy studies may be included as supporting evidence in a separate question or accompanying evidence map, but they should not be pooled with trials of patient-level clinical effectiveness. Even a validated LVO scale may lead to different functional outcomes across densely populated urban areas and regions with long interhospital travel times.

3.7. Implementation, equity, and health-system context

The relationship between prehospital intervention and outcome is influenced by dispatch reliability, scene time, telemetry coverage, imaging availability, weather and terrain, language barriers, and the operating hours of specialized resources. These factors particularly affect rural areas and lower-resource systems. Comparisons between EMS models should record intervention fidelity, conventional ambulance coverage, ambulance diversion, and hospital stroke capability rather than assume that the same clinical pathway exists everywhere.

Prehospital quality improvement also requires collaboration between emergency dispatchers, paramedics, neurologists, radiologists, emergency physicians and endovascular teams. Practical implementation may be measured by documented last-known-well time, glucose evaluation, field stroke screen completion, prenotification, door-to-needle performance and follow-up at 90 days. However, a causal claim for an intervention still requires adequately controlled comparisons and clinical endpoints.

3.8. Research gap

The available literature spans diagnostic tests, complex service-level interventions, transport allocation, and pharmacological management. Variation in populations, intervention definitions, comparison pathways, geographic availability, and endpoints makes broad claims about the value of "prehospital management" difficult to interpret. A transparent systematic review should stratify these intervention

classes, prioritize 90-day functional outcomes and mortality, and use a consistent framework for evaluating methodological quality.

4. Methods — Protocol for the Required Systematic Review

IMPORTANT: This section specifies a feasible protocol for the new stroke review. It must be changed to past tense, with exact dates, sources and documented actions, only after the systematic-review work is actually carried out. It is not a claim that the searches or review stages have been completed.

4.1. Review design and registration

A systematic review of intervention effectiveness and related diagnostic/process evidence will be undertaken, reported in accordance with PRISMA 2020 (Page et al., 2021). Before formal screening, the team should finalize and time-stamp a protocol, including definitions of intervention categories and outcomes, and register it on PROSPERO if eligible or a suitable open repository. The protocol registration number and amendments will be stated in the completed manuscript.

4.2. Eligibility criteria

Population: Adults (aged 18 years or older) evaluated by EMS for suspected acute stroke, or with subsequently confirmed ischemic or hemorrhagic stroke. Studies mixing adults and children will be included only if adult data can be separated.

Interventions: Dispatch recognition aids, field stroke screening, LVO assessment, prehospital clinical protocols, hospital prenotification, destination and bypass triage, tele-stroke support, MSUs, and clinically evaluated treatment initiated before hospital arrival.

Comparators: Usual EMS care, alternative validated recognition/triage tools, different transport destination strategies, sham/placebo, or pre-intervention comparison periods, as appropriate for study design.

Primary outcomes: Functional status at approximately 90 days (e.g., modified Rankin Scale or equivalent) and all-cause mortality; patient-centered outcomes reported at other time points will be captured separately.

Secondary outcomes: Thrombolysis or thrombectomy use, onset-to-treatment/door-to-treatment intervals, recognition accuracy, hospitalization, neurological deterioration, symptomatic intracranial hemorrhage, and other adverse events.

Eligible designs: Randomized and cluster-randomized trials, controlled prospective or retrospective cohorts, comparative interrupted time series, and other comparative primary studies. Diagnostic-accuracy designs may be described separately where they inform recognition performance; they will not be treated as trials of clinical benefit.

Exclusions: In-hospital-only interventions without a prehospital component, pediatric-only populations, isolated reviews or commentaries, case reports, conference abstracts without sufficient extractable data, and reports without relevant outcomes or an appropriate comparator for effectiveness questions.**4.3. Information sources and search strategy**

Search MEDLINE/PubMed, Embase, CINAHL, Scopus, Web of Science, and CENTRAL. Search trial registries for completed but unpublished trials; screen the reference lists of included studies and relevant reviews. Databases, interfaces, exact final search dates, and complete reproducible syntax for each

source should be reported in a supplementary appendix. A practical search will cover each database from inception through the final search date and will not use an unwarranted Saudi-only geographic restriction, because the new title does not impose one.

Illustrative PubMed search string (to be peer reviewed and refined before execution):

((stroke[MeSH Terms] OR stroke*[tiab] OR "cerebrovascular accident"[tiab] OR "large vessel occlusion"[tiab]) AND (prehospital[tiab] OR "pre-hospital"[tiab] OR ambulance*[tiab] OR paramedic*[tiab] OR "emergency medical services"[MeSH Terms] OR "mobile stroke unit"[tiab]) AND (recognition[tiab] OR diagnos*[tiab] OR screening[tiab] OR triage[tiab] OR prenotification[tiab] OR transport*[tiab] OR management[tiab] OR treatment[tiab]) AND (outcome*[tiab] OR mortalit*[tiab] OR disability[tiab] OR thrombolys*[tiab] OR thrombectom*[tiab] OR "modified Rankin"[tiab]))

4.4. Study selection

All search outputs will be exported with source identifiers and de-duplicated reproducibly. Two independent reviewers will screen titles/abstracts and then full texts against prespecified criteria. Disagreements will be resolved through consensus or a third reviewer. Reasons for exclusion at the full-text stage will be retained. The PRISMA 2020 flow diagram will show observed—not assumed—counts for identification, deduplication, screening, eligibility and inclusion.

4.5. Data extraction

Two reviewers will use a piloted standardized form to capture: citation, country, EMS setting, design, sampling period, number of participants, stroke subtype, inclusion criteria, intervention and comparator details, route timings, implementation fidelity, functional outcome definition and time point, mortality, reperfusion use, complications, effect estimates with confidence intervals, and major confounders. Duplicate trial populations and overlapping cohorts will be checked before synthesis.

4.6. Risk of bias and certainty of evidence

Use RoB 2 for randomized trials (including design-specific adaptations for cluster trials), ROBINS-I for nonrandomized intervention studies, and QUADAS-2 for diagnostic accuracy studies as applicable. For other observational designs, a design-appropriate validated tool such as the JBI critical appraisal checklist may be applied if specified in the protocol. Each assessment should be based on the full text, performed by two independent assessors, and reported per study. GRADE should be used when feasible to describe the certainty of clinical outcome evidence by comparison and outcome.

4.7. Data synthesis and planned analysis

Interventions will be grouped by: (1) recognition/dispatch and prenotification; (2) destination triage; (3) mobile stroke units/prehospital imaging and thrombolysis; and (4) other prehospital treatment. Clinical outcomes will be distinguished from process or diagnostic measures. Meta-analysis will be considered only for sufficiently comparable populations, interventions, and outcome definitions; otherwise a structured narrative synthesis with effect estimates will be used. For dichotomous outcomes, report risk ratios or odds ratios with 95% confidence intervals; for functional disability distributions, present reported ordinal effect estimates; for time outcomes, use appropriate mean or median differences without pooling incompatible summaries. Evaluate heterogeneity, baseline disability, stroke subtype, region, and risk of bias. No meta-analysis is assumed in advance.

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4.8. Outcome hierarchy and measurement

The primary clinical endpoint will be the modified Rankin Scale at approximately 90 days after stroke onset, preferably analyzed using an appropriate ordinal method where available. Functional independence (mRS 0–2), excellent outcome (mRS 0–1), mortality and health-related quality of life will be reported using the definitions and follow-up times supplied by each study. Different mRS dichotomies will not be treated as equivalent. Secondary pathway metrics will include symptom onset-to-first medical contact, on-scene time, onset-to-imaging, door-to-needle, door-in-door-out at the first center, and onset-to-groin puncture for thrombectomy.

Stroke subtype, eligibility for reperfusion, transfer status and initial stroke severity will be specified as potential effect modifiers. Serious adverse events, including hemorrhagic complications, should be collected with each study's explicit definition rather than assumed comparable across reports.

4.9. Missing data and publication bias

Investigators will be contacted for critical missing outcome or subgroup data where feasible. Where data remain unavailable, the direction and likely impact of missingness will be described. Selective outcome reporting will be considered during risk-of-bias assessment. Small-study effects and funnel plot asymmetry will be investigated only if a sufficiently large and clinically coherent meta-analysis is possible; statistical tests will not be applied to heterogeneous sets of a few studies.

4.10. Sensitivity and subgroup analyses

Prespecified analyses, if supported by the number and type of eligible studies, will compare randomized versus nonrandomized evidence; confirmed ischemic versus hemorrhagic stroke; urban versus nonurban systems; direct versus transfer pathways; and higher versus lower risk-of-bias studies. The primary analysis will avoid combining clinical benefit outcomes from different intervention classes in one pooled estimate. Results from diagnostic accuracy studies will be summarized separately.

4.11. Reproducibility and audit trail

A completed review will provide the final search strings and run dates for every database, complete export files, an auditable duplicate-removal count, title/abstract screening decisions, full-text exclusion reasons, a frozen extraction dataset, and per-study risk-of-bias judgments. The PRISMA 2020 checklist and flow diagram will be produced from these records; numerical cells will remain blank until the relevant stages are completed.

4.12. Protocol amendments

Any changes to eligibility, outcomes, analytical approach, or review team after registration will be recorded with a date and a reason. Unplanned, post hoc subgroup analyses will be identified transparently and interpreted as exploratory.

4.13. Ethical considerations

A review of published aggregate data generally does not involve recruitment or intervention and therefore ordinarily does not require patient-level ethics approval; local institutional requirements should nevertheless be checked. Funding, conflicts of interest, data availability, and contributor roles must be declared accurately.

5. Selected Primary Evidence — Contextual Illustration Only

The following studies were individually verified as published literature relevant to the proposed topic. They are examples for drafting the background and discussion. They are NOT a complete set of included studies, NOT the product of a documented database search and screening process, and have NOT received a full formal risk-of-bias assessment for this manuscript.

Study	Prehospital strategy and design	Illustrative published observation
Grotta et al., 2021 (BEST-MSU)	Controlled multicenter MSU vs standard EMS	Onset-to-thrombolysis 72 vs 108 minutes; corrected 90-day mRS 0–1: 53.5% vs 45.5% in eligible patients.
Ebinger et al., 2021 (B_PROUD)	Prospective nonrandomized MSU dispatch comparison	MSU dispatch associated with lower disability at three months; observational design requires confounding appraisal.
Pérez de la Ossa et al., 2022 (RACECAT)	Cluster-randomized direct transfer vs local stroke center	No statistically significant 90-day functional difference in the studied nonurban setting.
Bath et al., 2019 (RIGHT-2)	Ambulance-based randomized GTN vs sham	No improvement in functional outcome among patients with presumed ultra-acute stroke.
Li et al., 2024 (INTERACT4)	Randomized early BP lowering vs usual care	No overall functional benefit; diverging stroke-subtype findings require caution.
Dekker et al., 2025	Head-to-head prehospital stroke scale performance study	Among 3,317 suspected stroke cases, sensitivity 66–84% and specificity 28–49%; accuracy is not itself patient benefit.
Duvekot et al., 2021 (PRESTO)	Prospective field validation of LVO triage scales	Compared eight field scales; identifies diagnostic/triage accuracy, not the causal benefit of a transport policy.
Lin et al., 2012	Large prospective quality-registry analysis of EMS prenotification	Prenotification linked to shorter door-to-imaging (26 vs 31 min) and greater access to timely treatment.
Ebinger et al., 2014 (PHANTOM-S)	Randomized implementation of ambulance-based thrombolysis	Showed faster delivery of thrombolysis when specialized ambulance was available; time is a process endpoint.

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5.1. Recognition and differential diagnosis

The first contribution of prehospital stroke recognition is to identify a possible acute neurological event early enough to activate the appropriate pathway. In the observational validation reported by Dekker et al. (2025), scale sensitivity ranged from 66% to 84%, while specificity ranged from 28% to 49%, depending on the instrument. This diagnostic trade-off is not simply technical: false-negative cases may lose treatment opportunities, while false-positive activations may overload specialized teams. The extent of clinical benefit depends on what happens after the scale is used.

The PRESTO prospective study demonstrates the additional complexity of identifying possible LVO rather than stroke of any type (Duvekot et al., 2021). A successful field protocol would ideally improve downstream reperfusion access while minimizing unnecessary bypass, but the transport strategy requires direct comparison using clinical outcomes before that conclusion can be established.

5.2. Hospital prenotification and emergency-department readiness

In the Get With The Guidelines-Stroke cohort examined by Lin et al. (2012), 67.0% of 371,988 EMS-transported ischemic stroke patients had hospital prenotification. The reported association with shorter door-to-imaging and treatment times provides a strong operational rationale for structured EMS-to-hospital handover. Nevertheless, registry associations can be confounded by institutional organization, stroke severity and selective documentation, and therefore do not prove that notification alone changes long-term disability.

5.3. Mobile stroke units and early reperfusion

PHANTOM-S provided randomized evidence of more rapid treatment initiation when an ambulance equipped for stroke diagnosis and thrombolysis was dispatched (Ebinger et al., 2014). BEST-MSU subsequently evaluated patient-centered effects and demonstrated shorter treatment times (72 vs 108 minutes for median onset to thrombolysis) and favorable disability outcomes among eligible patients (Grotta et al., 2021). The 2023 correction to BEST-MSU revised several published outcome estimates: mRS 0–1 at 90 days was 53.5% in the MSU group and 45.5% in the EMS group, not the higher figures in the original abstract (NEJM Correction, 2023).

In Berlin, B_PROUD associated MSU dispatch with a reduced burden of disability at 90 days compared with conventional EMS, with a reported common odds ratio of 0.71 for worse functional outcome (Ebinger et al., 2021). This supports the plausibility of clinical benefit, while the nonrandomized nature of the comparison must remain visible when evaluating certainty.

5.4. Destination decision and thrombectomy access

For suspected LVO, choosing an initial destination is a system-design decision rather than a universal clinical rule. The RACECAT cluster-randomized trial, which examined patients in nonurban service regions, did not show an overall functional advantage from direct transfer to a thrombectomy-capable center versus initial transport to a local stroke center (Pérez de la Ossa et al., 2022). Thus, the time saved for some thrombectomy-eligible patients may be offset by longer travel or deferred intravenous therapy for others.

The 2026 AHA/ASA guideline emphasizes that destination policies should be adapted to regional characteristics and transfer performance, with consideration of direct transport to an EVT-capable hospital when efficient interhospital transfers are not established (Prabhakaran et al., 2026). A review that reports only transport times without final clinical outcomes risks overstating the generalizability of destination policies.

5.5. Drug-based interventions before brain imaging

RIGHT-2 tested ambulance-administered transdermal glyceryl trinitrate in a suspected-stroke population and did not establish improvement in three-month functional outcomes (Bath et al., 2019). INTERACT4 randomized 2,404 patients in China to intensive prehospital blood-pressure management or usual care, reporting no overall difference in functional outcomes (common odds ratio 1.00; 95% CI 0.87–1.15) and signals of different effects by final stroke type (Li et al., 2024). These findings reinforce the necessity of considering the unknown underlying stroke subtype before imaging.

5.6. Cross-cutting interpretation

These selected publications point toward several distinct levels of evidence: scale validation for recognition, quality-registry associations for care processes, comparative studies of service configuration, and randomized trials for some clinical interventions. Treating all of these designs as equivalent evidence for patient outcomes would be methodologically inappropriate. The eventual full review must separate direct evidence of functional or survival benefit from diagnostic precision or care timeliness.

Because no complete systematic search and full-text screening have been performed for this draft, the descriptive patterns in Sections 5.1–5.6 cannot be presented as the distribution of all available studies, as a pooled treatment effect, or as a certainty rating.

6. Preliminary Discussion — Not Final Systematic-Review Findings

The central scientific distinction is between acceleration of care and improvement in a patient's longer-term outcome. A service may shorten an interval to imaging or reperfusion, but its effect on disability depends on baseline stroke severity, eligibility for treatment, final stroke diagnosis, and the overall receiving system. The available studies provide examples of clinically important improvement as well as neutral findings, reinforcing the need for comparison-specific interpretation rather than a single pooled claim for all prehospital initiatives.

First, mobile stroke units represent a potentially effective strategy in resource-rich programs. The BEST-MSU evidence links prehospital imaging and treatment capacity to earlier thrombolysis and improved 90-day functional status in selected patients (Grotta et al., 2021). The association reported by the Berlin B_PROUD study provides further supportive evidence but does not remove questions of generalizability, costs, dispatch availability, and differences between emergency care systems (Ebinger et al., 2021).

Second, transport-destination choices require careful balance. Direct routing to advanced thrombectomy services can reduce delay to an endovascular procedure but may be disadvantageous when local thrombolysis is highly efficient and bypass adds substantial travel time. The neutral overall functional finding from RACECAT is highly informative in this regard and argues against simplistic system-wide recommendations disconnected from travel time and local capability (Pérez de la Ossa et al., 2022).

Third, suspected stroke is heterogeneous before imaging. Intensive blood-pressure treatment cannot be judged solely by its effect on an ambulance vital sign. RIGHT-2 and INTERACT4 show that physiological changes do not consistently produce improved overall 90-day outcomes, and that effects may vary by final ischemic versus hemorrhagic diagnosis (Bath et al., 2019; Li et al., 2024). Any subsequent meta-analysis should retain clinically meaningful subgroups when data permit.

Fourth, assessment scales primarily support the identification and triage process. They can be measured using sensitivity, specificity, and false activation rates, but patient-relevant effectiveness needs evidence linking deployment to downstream care or longer-term outcomes. The head-to-head findings of Dekker et al. (2025) illustrate why increased recognition is not a sufficient proxy for disability reduction.

A completed review should explicitly discuss publication bias, variation in EMS training, differential access to thrombectomy-capable centers, urban versus remote populations, and the implementation challenges of advanced prehospital services. In particular, a future Saudi or Gulf application should be considered only as an implication requiring locally observed resource and transport data, not as a finding established by international stroke studies.

7. Recommendations

7.1. For emergency medical services

Maintain structured stroke recognition training across call-taking, dispatch and ambulance response, with repeat practice in atypical presentations.

Record last-known-well time, glucose findings, neurological screen, anticoagulant information when available, and reasons for destination choice consistently.

Use defined prenotification messages that alert the receiving stroke team without waiting for diagnostic certainty that cannot be achieved in the field.

Audit false-negative and false-positive stroke alerts, reperfusion times, and patient outcomes in addition to response-time targets.

7.2. For hospitals and regional stroke networks

Coordinate EMS routing with real-time stroke-center capability, geography, road access, and transfer efficiency; avoid assuming bypass is optimal everywhere.

Maintain agreed door-in-door-out and telestroke arrangements for patients who need transfer for endovascular thrombectomy.

Evaluate MSU programs using 90-day outcomes, equity of coverage, operating costs, and the opportunity cost of specialized teams.

Integrate EMS and hospital datasets to monitor clinical outcomes and downstream adverse events, not just arrival-to-treatment intervals.

7.3. For researchers and policymakers

Prioritize pragmatic comparisons with patient-centered end points, adequate adjustment for case mix and transparent protocol registration.

Prespecify stroke subtype and pathway subgroup analyses, particularly for medication use before neuroimaging.

Report geographic access and equity, including rural availability and services used by populations with communication barriers.

Use prespecified PRISMA 2020 reporting and appropriate design-specific risk-of-bias tools instead of assigning unverified study counts or quality categories.

8. Limitations of the Current Draft

This file is an evidence-informed subject conversion of a nursing-focused manuscript, not a completed stroke systematic review. The original nursing paper's counts (including its reported 42 included studies and PRISMA flow), nursing-specific findings, citations, and JBI categories have intentionally not been transferred to the stroke topic. No search log, duplicate archive, screened study register, study-level extraction table, completed bias ratings, PRISMA counts, or synthesis dataset for the new topic has been supplied or generated here.

The selected source examples do not establish the totality of available evidence. In addition, differences between stroke screening research and intervention-effectiveness research must be respected in eligibility and analysis. The original author list and institutions must also be confirmed by the people who will undertake and approve the new systematic review.

9. Conclusion

Prehospital stroke care is a multidimensional process encompassing emergency call recognition, field assessment, prenotification, destination selection, and, in some systems, treatment before arrival. Selected published evidence supports benefit from some MSU services, while important randomized evaluations of destination triage and pharmacological management show neutral or mixed overall effects. Accordingly, the effect of prehospital strategies on patient outcomes cannot be characterized by a single undifferentiated conclusion.

The next research step is to execute a reproducible stroke-specific search and study selection process; perform independent extraction and risk-of-bias appraisal; compare coherent intervention categories; and write the final results, discussion, conclusions, and PRISMA diagram from the observed studies. Any practice recommendations must remain consistent with current stroke guideline pathways and the capabilities of local emergency services.

10. Funding, Ethics, and Author Declarations

Funding: To be completed and confirmed by the authors; no source-specific funding information for the revised stroke review has been provided.

Conflicts of interest: Each author should disclose all relevant financial and non-financial relationships before submission.

Ethics: No participants were recruited or primary health records accessed for preparation of this draft. Ethical requirements for the planned review should be checked locally.

Protocol registration: Not supplied; registration must not be claimed until completed.

Author contributions: Must be prepared from actual roles in conception, searching, screening, appraisal, analysis, drafting and final approval.

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