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Can I send this patient with stroke home? Strategies Managing Transient Ischemic Attack and Minor Stroke in the Emergency Department

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Abstract

Background: While transient ischemic attack and minor stroke (TIAMS) are common conditions evaluated in the emergency department (ED), there is controversy regarding the most effective and efficient strategies for managing them in the ED. Some patients are discharged after evaluation in the ED and cared for in the outpatient setting, while others remain in an "observation unit" without being admitted or discharged, and others experience prolonged and potentially costly inpatient admissions.

Objective of the Review—The goal of this clinical review is to summarize and present recommendations regarding the disposition of TIAMS patients in the ED (e.g. admission versus discharge).

Discussion—An estimated 250,000–300,000 TIA events occur each year in the U.S, with an estimated near-term risk of subsequent stroke ranging from 3.5% to 10% at 2 days, rising to 17% by 90 days. While popular and easy to use, reliance solely on risk stratification tools such as the

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ABCD2 should not be used to determine if TIAMS patients can be safely discharged. Additional vascular imaging and advanced brain imaging done may improve prediction of short term neurologic risk. We also review various disposition strategies (e.g. inpatient versus outpatient/ED observation units) with regards to their association with neurological outcomes, such as 30 or 90-day stroke recurrence or new stroke, in addition to other outcomes such as hospital length of stay and healthcare costs.

Conclusion: Discharge from the ED for rapid outpatient followup may be a safe and effective strategy for some forms of minor stroke without disabling deficit and TIA patients after careful evaluation and initial ED workup. Future research on such strategies has the potential to improve neurologic and overall patient outcomes, reduce hospital costs and ED length-of stay.

Keywords

TIA minor stroke; clinical review

Introduction

Stroke is the leading cause of serious disability and the fifth leading cause of death in the United States, with nearly 800,000 new cases annually.(1) The public health burden of stroke is high and is anticipated to increase dramatically by 2030.(2) Ischemic stroke makes up nearly 87% of all stroke.(3) One of the major precursors of ischemic stroke is a transient ischemic attack (TIA), defined as a “transient episode of neurological dysfunction caused by focal brain, spinal cord, or retinal ischemia, without acute infarction”.(4) There are an estimated 250,000–300,000 TIA events occurring each year in the U.S., with a median survival of 8 years. The estimated near-term risk of subsequent stroke risk after TIA ranges from 3.5% to 10% at 2 days, rising to 17% by 90 days.(5)

TIA represents a significant healthcare burden in the emergency department (ED), with over 297,000 annual ED visits attributed to TIA in the United States,(6) nearly 200,000 total inpatient admissions (via the ED and outpatient direct admission), and annual associated healthcare costs totaling $2.6 billion.(1, 7) The number of patients with minor stroke has also grown considerably. While a consensus definition of “minor stroke” is lacking,(8) for the purpose of this paper we adopt a commonly used definition of stroke syndromes with nondisabling deficits and NIH stroke scale of ≤ 5).(9, 10) (11) In an analysis of the AHA Get with the Guidelines (GWTG) Stroke database, 7621 out of 33,995 patients (22.4%) arriving within 4.5 hours of symptom onset had an NIHSS of 5 or less.(12)

In approaching TIA and minor stroke (collectively referred to as TIAMS), it is appropriate to consider TIAMS together. For example, a brief episode of a focal neurological complaint that previously would have been classified as a TIA is now called a minor stroke if accompanied by abnormal findings on diffusion-weighted MRI sequences.(13) Recurrent stroke rates among patients with TIA are also very similar to those of patients with minor stroke.(14) From the stroke neurologist’s perspective, the duration of symptoms is often less important than the cause of the event and what can be done to prevent a recurrence.(15) Among minor stroke patients with non-disabling symptoms (e.g., isolated sensory loss, isolated facial droop, isolated dysarthria), moreover, it could be argued that the risks of

thrombolytic therapy may outweigh potential benefits, and that such patients may be potentially treated conservatively, as are patients with TIA.(16) (10)

The ED is the primary clinical setting where TIAMS are frequently evaluated for the first time [12], and emergency clinicians play a critical role in the diagnosis and early management of TIAMS. While evidence-based guidelines for the emergency management of moderate to severe stroke are well-accepted within the medical community,(13, 14) there is less consensus regarding the optimal triage and management of TIAMS. Considering the potential risk of short-term (e.g. 30 or 90 day) mortality, or recurrent stroke after TIAMS, (15, 16) a key concern for treating physicians in the ED is the execution of a safe and appropriate disposition plan. While most studies agree that urgent and timely evaluation for TIAMS is warranted(17–19), variations in clinical practice exist between inpatient and outpatient disposition of patients with TIAMS.(20) Some patients are discharged after evaluation in the ED and cared for in the outpatient setting, others remain in an “observation unit” without being admitted or discharged, while others experience prolonged and potentially costly inpatient admissions.

Recent work by Edlow, along with a 2016 ACEP clinical policy on TIA provides an excellent overview of the approach to TIA evaluation and care in the ED. However questions remain regarding the ultimate disposition for these potentially high-risk patients.(21, 22) In addition, we expand on prior work by considering non-disabling minor strokes alongside TIA patients, and thus address the disposition of a larger population of ED patients. In this clinical review, we discuss current controversies regarding the management and disposition of patients with TIAMS presenting to the ED, namely whether such patients can be safely discharged home for urgent followup from the ED versus inpatient admission. We draw on data regarding the potential utility of common prediction tools, such as the ABCD and ABCD2 scores in helping to screen for such patients, and their association with near-term neurologic outcomes. We then summarize and describe previous studies on the safety and efficacy of different disposition approaches (e.g. hospital admission versus outpatient management, including ED observation unit management) for TIAMS patients evaluated in the ED, with regards to neurologic and overall patient outcomes.

Ultimately, our hope is by sharing our clinical review with the broader emergency medicine community, we may aid emergency clinicians and administrators in the safe and timely management of patients with TIAMS.

Weighing the Evidence for Discharging or Admitting TIAMS

Can we rely on risk stratification scores to guide ED disposition?

Several prediction scores have been developed using community and hospital based cohorts of TIA patients to determine which patients are at highest short-term risk for ischemic stroke and potentially which patients can safe for discharge.(23–27). Among the most commonly used prediction tools is the ABCD2 score, (24, 25, 28) which incorporates age, blood pressure, history of diabetes and clinical features of the event.(23, 24). Such scores are simple to use, do not require specialized skill to obtain;(23–25) and allow for easy scoring

allowing the potential use of cut-point (e.g. score of ≥4), to identify high-risk patients who may require rapid diagnostic testing.(29)

Despite the advantages of its ease of use and simple interpretation, the utility of the ABCD2 score in helping guide admission versus discharge decisions for TIAMS is limited. Recommendations from the American Heart Association suggest that hospitalization may be reasonable for TIA patients with an ABCD2 score ≥3 presenting within 72 hours of symptoms, albeit with a low level of evidence (Class IIa recommendation, level C evidence).(4) However, the National Stroke Association does not endorse a specific cut-off in determining disposition.(30) Furthermore, following a systematic review of studies examining pretest probability for near term stroke risk in patients as assessed by the ABCD2, a clinical policy paper on TIA management in the ED by the American College of Emergency Physician concluded that adult patients with suspected TIA should not rely exclusively on screening instruments such as the ABCD2 in making decisions regarding admission or discharge from the ED(level B recommendation).(22) This conclusion was based in part on the concern that while the ABCD2 score accounts for history and symptoms, it excludes diagnostic test results that may identify the etiology and potential treatments of TIAMS. Approximately 20% of patients with ABCD2 scores <4 have high-risk conditions that require urgent treatment decisions, such as large artery atherosclerosis (LAA), which confers the highest risk of stroke recurrence and has the potential to be modified with early revascularization. (31–35) The ABCD2 score does not reliably distinguish among stroke subtypes,(36) and in patients with stroke attributable to LAA, a significant proportion of subsequent and recurrent strokes occur in patients who originally presented with low ABCD2 scores.(36–38) Thus, triage decisions based only on ABCD2, therefore, do not fully account for the cause or potential mechanism of ischemic injury, which largely determines the risk of recurrence following TIAMS.(39)

Considering the limitations of the ABCD2 score in identifying modifiable etiologies of ischemic stroke, and the fact that certain stroke mechanisms (such as large artery atherosclerosis or cardioembolism) have been associated with diffusion weighted imaging (DWI) positive lesions on brain magnetic resonance imaging (MRI), modified ABDC2 scores incorporating results of vascular or brain imaging, such as the ABCD3-I scores, have been developed. The ABCD3-I adds brain imaging, carotid imaging, and recurrent TIA to the traditional ABCD2 score,(40) assigning points for ipsilateral carotid stenosis of ≥50% (2 points), acute infarct on MRI (2 points), and “dual TIAs” (defined as two or more TIAs in the preceding 7 days, including the index event) (2 points). The 13-point ABCD3-I score improved prediction of recurrent stroke at 7 days compared with the ABCD2 score (C statistic for ABCD2 vs. ABCD3-I 0.54 vs. 0.61, p<.02). Th e ABCD3-I score does have several limitations for use in rapid triage, including few validation studies, as well as reliance on MRI and vessel imaging that may not be readily available in all EDs, or may result in prolonged ED evaluations, making widespread adoption of these approaches potentially challenging.(40–42) Ultimately, however, such strategies of integrating medical evaluation alongside diagnostic and vessel image may help identify TIAMS patients potentially safe for discharge from the ED.

Do we have to admit all TIAMS patients?

Given the significant near-term risk of recurrent cerebral ischemia in the first 24–72 hours following TIAMS,(16, 43) a broad consensus exists for the need for timely and expedited evaluation of TIAMS. A less clear consensus, however, exists around the care setting (such as inpatient or outpatient) in which the evaluation is conducted. Over the last decade, the overall proportion of inpatient admissions among patients presenting to the ED in the U.S. with TIA has risen from 70% to 91%.(44) Data from the National Emergency Department Sample found that 63.5% of patients presenting with a primary diagnosis of TIA to the ED were admitted from 2006–2008, compared to 36.5% that were discharged.(45) Multiple reasons have been proposed for the trend toward admission. Inpatient admission of patients with TIAMS may facilitate early and timely administration of thrombolytic therapy for recurrent cerebral ischemia following TIAMS, as well as the initiation of secondary prevention strategies specific to the underlying cause, theoretically making inpatient management of TIAMS both safer and more cost-effective. In a retrospective study of 1,687 TIA patients evaluated in the ED, factors associated with hospital admission in the 243 TIA patients that were admitted included atrial fibrillation, prior TIA, symptoms persisting on arrival to the ED, or persistent neurologic deficit.(39) In another study, the authors argued that the additional costs of inpatient hospitalization for TIA patients (estimated $588 net cost at a single academic site in Northern California) would be offset by the potential gains in quality of life from the rapid administration of thrombolysis and the reduction of long-term healthcare costs of untreated stroke.(46) However, the authors noted that other means of follow-up, including ED observation, could potentially be more cost-effective. For example, other research comparing rapid (24 hour) TIA clinic follow-up compared to inpatient admission found that in a cohort of TIA patients, hospitalization yielded only an added 0.00026 quality-adjusted life years at 1 year, with an additional cost of $5,573 per patient compared to urgent clinic evaluation, suggesting that hospitalization was not cost effective compared to rapid 24 hour TIA outpatient followup.(47)

A recent observational study of 8,540 patients with TIAMS either admitted or discharged from EDs in Canada showed that admitted patients were more likely to obtain recommended interventions (e.g. brain imaging, cardiac monitoring, secondary medication, etc.). The hazard of mortality in admitted patients was similar to that in discharged patients (adjusted hazard ratio [AHR] for admitted vs discharged patients 1.11; 95% confidence interval [CI] 0.92–1.34). Furthermore, in the subgroup of patients discharged from the ED, the adjusted hazard of mortality was 50% lower in those referred to stroke prevention clinics compared to those not referred (AHR 0.49; 95% CI 0.38– 0.64).(48)

A retrospective study reviewed 260 patients (176 admitted, 84 discharged; no significant difference in NIHSS scores between groups: chi-square p=.30) diagnosed with TIA in the ED to determine whether hospital admission improved 90-day readmission rates after TIA. (49) Of the 260 patients, 117 returned to the hospital within 90 days, 40% for neurologic reasons, and 11 (9%) ultimately were diagnosed with recurrent cerebrovascular events. Of the 117 patients that returned to the hospital, 58% had been admitted at their first ED encounter, suggesting that inpatient admission for TIA was not associated with a reduction in post-TIA outcomes such as 90-day readmission. Of note, the authors also found that

patients who were evaluated in a specialized neurologic ED with emergency physicians with additional neurology training at the same institution had significantly lower inpatient admission rates for TIA compared to the main ED (35% versus 65%), as well as lower 90-day rehospitalization and stroke rates.(50)

Inpatient hospitalization of TIAMS may also potentially lead to the timely administration of secondary prevention strategies to reduce the risk of recurrent stroke. While several trials have examined both medical and surgical secondary prevention strategies after a stroke or TIA(51),(52),(53) in hospitalized patients, none of these strategies explicitly required hospital admission. For example, two studies carried out in Europe comparing expedited outpatient evaluation of all TIAs within 24 hours to delayed evaluation found a significant reduction in the risk of recurrent stroke in the intervention arm, a benefit that was felt to be driven by the detection and intervention on symptomatic extracranial internal carotid artery disease.(54, 55) These approaches relied on an infrastructure to rapidly identify large artery atherosclerosis, especially in the extracranial carotid artery, for which rapid and effective treatment is available.

Outpatient Management Strategies of TIAMS

There have been several prospective studies evaluating the utility and efficacy of rapid outpatient management strategies for TIA (and to a lesser degree, minor stroke). (see table 1).

The UK-based Early Use of Existing Strategies for Stroke (EXPRESS) study sought to ascertain the effect on 90-day recurrent stroke risk of implementation of a rapid-access TIA clinic that included diagnostic testing (e.g. head CT, vascular ultrasound, EKG) and treatment initiation of secondary preventive measures (including antiplatelet and antihypertensive agents). (55) In the initial phase of the study, before implementation of the TIA clinic, the rate of stroke at 90 days was 10.3% (32/210 patients). After implementation, the stroke rate decreased to 2.1% (6/281 patients, P<.0001). Another study based around an outpatient clinic in France (SOS-TIA) followed 1,085 patients who presented with symptoms of a TIA and were referred to a specialized outpatient neurology clinic with access to vascular neurologists and diagnostic imaging (e.g. MRI/CT, ultrasound, and EKG) over 2 years.(54) Patients were discharged to home and treated as outpatients unless one or more specific conditions were met (increasing TIA frequency, duration, or severity, abnormal cardiac rhythm, high-grade stenosis, potential cardiac source of recurrent embolism). The 1,085 patients with suspected TIA were followed up for a median of 16 months and had a 90-day stroke rate of 1.24%, as compared with a predicted stroke rate of approximately 6% as estimated by ABCD2 score. The 1-year rate of myocardial infarction and non-stroke vascular death (both 1.1%) were also lower than annual risks for myocardial infarction (2.2%) and non-stroke vascular death (2.1%) based on previous studies.(56)

In the United States, ED observation and neurology observation units based in the ED have been developed in certain hospitals as an alternative to inpatient hospitalization for the expedited evaluation of TIA and minor stroke.(57, 58) Similar approaches using an outpatient/ED observation approach for patients with low to intermediate risk of acute coronary events(59) found that observation stays were associated with decreased length of

stay and cost, while improving patient safety outcomes, and patient satisfaction.(60, 61) A prospective, randomized control study evaluated outcomes in 149 ED patients with TIA, randomized to either inpatient admission or ED observation stay for rapid diagnostic testing and imaging (e.g. vessel imaging, echocardiography).(62) Patients in both groups of the study had normal non-contrast CT head imaging, EKG, and laboratory studies; all participants received a neurology consultation, carotid vessel imaging (e.g. ultrasound), echocardiography, and cardiac monitoring. The ED observation group patients with positive testing results (e.g. carotid imaging suggestive of severe stenosis, evidence of thromboembolic source) were admitted. Compared to the inpatient group, patients in the ED observation group had shorter total lengths of stay (mean 26 vs. 61 hours), lower 90-day total direct costs ($890 vs. $1,547), and comparable 90-day clinical outcomes. Another prospective study of 418 ED patients with TIA evaluated in an ED observation unit found that patients treated in the observation unit had a risk of stroke of 0.96% at 48 hours and 1.2% at 7 days,(57) which was lower compared to the estimated overall risk of stroke estimated at 3.1% at 48 hours and 5.8% at 7 days in a systematic review and meta-analysis. (63) Further studies have shown that the use of ED observation units for the management of TIA is also associated with a reduction in length of stay and costs of treatment, as well as similar degree of adoption of secondary prevention medication strategies in comparison to patients who had been admitted for TIA.(58) (57–63)

Disposition of Patients with TIAMS: Summarizing the Evidence

Current National Stroke Association TIA guidelines recommend that hospitalization be “considered” for patients presenting with a first TIA within the past 24 to 48 hours; hospitalization is “generally recommended” for patients with crescendo TIAs, duration of symptoms greater than 1 hour, symptomatic carotid stenosis greater than 50%, a known cardiac source of embolus, or a known hypercoagulable state. (64) Regardless of inpatient versus outpatient management of TIAMS, National Stroke Association guidelines recommend “timely” brain and vascular imaging, as assessed in follow-up, although no specific timeframe is defined.(64, 65) Our review of the literature suggests that while current TIAMS risk prediction schemes are promising in their potential to predict near-term adverse neurologic events, significant limitations (e.g., inability to address etiology of symptoms, inconsistent risk stratification) constrain their ability to guide TIAMS management without additional monitoring and diagnostic studies. Furthermore, indiscriminate admission of all patients with suspected TIAMS is likely to be costlier than outpatient evaluation, without a clear benefit in terms of patient outcomes. An initial evaluation approach focused on identifying those at highest risk for recurrent stroke based on diagnostic testing rather than based on symptoms is likely to identify those who stand the most to benefit from admission vs. discharge to rapid followup (see Figure 1). For example, a patient with short-lived dizziness due to cardioembolism to the posterior circulation from undiagnosed atrial fibrillation may have a higher risk of recurrence than a patient with resolved asymmetric weakness secondary to less than 50% internal carotid artery stenosis. Finally, recent studies have supported the notion that dedicated rapid outpatient neurology follow-up clinics or ED observation protocols may reduce overall length of stays and nosocomial risks, while improving patient satisfaction and neurologic outcomes.(66, 67) ED overcrowding has been

associated with multiple negative outcomes, including delayed time to treatment in stroke, (68) patient dissatisfaction,(69) unfavorable perception of clinician-patient communication, (70, 71) and the development of adverse psychological effects such as post-traumatic stress disorder (PTSD) in stroke survivors, which is associated with increased morbidity and mortality.(71–75) The timely and safe disposition from the ED of TIAMS patients may reduce ED overcrowding, enhance the patient's experience of their ED visit, and improve their overall neurologic outcomes.

In summary, while the evidence in support of ED observation protocols and specialized stroke observation units suggest that some TIAMS may be considered for discharge after ED evaluation, further rigorous study is needed to evaluate more closely the efficacy of such interventions in these population of patients. Future work evaluating strategies such as shared decision making and coordination with outpatient primary care providers may help complement the ongoing efforts in the ED. Additionally, given that broad availability is currently limited for such specialized neurologic observation units, strategies are needed to help guide admission versus discharge approaches in the settings where no such units are available. Future prospective cohort and randomized trials evaluating the safety and utility of rapid outpatient/ED observation strategies versus inpatient admission may guide the development of approaches to the management of TIAMS in the ED that improve both primary and secondary outcomes.

Conclusions

TIAMS are common conditions evaluated in the ED and are associated with significant morbidity and mortality. The management of such patients in the ED should emphasize timely and safe comprehensive evaluation. Strategies aimed at identifying TIAMS patients who would benefit from ED observation or rapid outpatient follow-up rather than inpatient admission have the potential to not only improve patient neurologic outcomes, but also to reduce hospital costs and ED length-of stay. Future research evaluating the potential effectiveness of such strategies is critical and may improve both general stroke knowledge and care for TIAMS in the acute setting.

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Article Summary

Why is this topic important?

Transient ischemic attack (TIA) and minor stroke are common conditions evaluated in the emergency department (ED). The most effective and efficient strategies for managing them in the ED remain undefined.

What does this clinical review attempt to show?

Rapid outpatient care and followup may be a safe and effective management strategy for some minor stroke patients without disabling deficit and TIA patients after focused ED evaluation.

What are the key findings?

While risk prediction schemes such as the ABCD2 score have been validated in observational studies as predictors of short-term risk for stroke in the ED they should not be used in isolation to determine discharge from the ED. The addition of brain/vascular imaging may help identify etiologic factors of TIA and minor stroke. Several prospective studies evaluating the efficacy of rapid outpatient management strategies for TIA and minor stroke have found such ED observation/outpatient strategies associated with shorter total lengths of stay, lower 90-day total direct costs, and comparable 90-day clinical outcomes.

How is patient care impacted?

Future research evaluating the safety and utility of rapid outpatient/ED observation strategies for TIA and minor stroke may improve primary and secondary stroke outcomes.

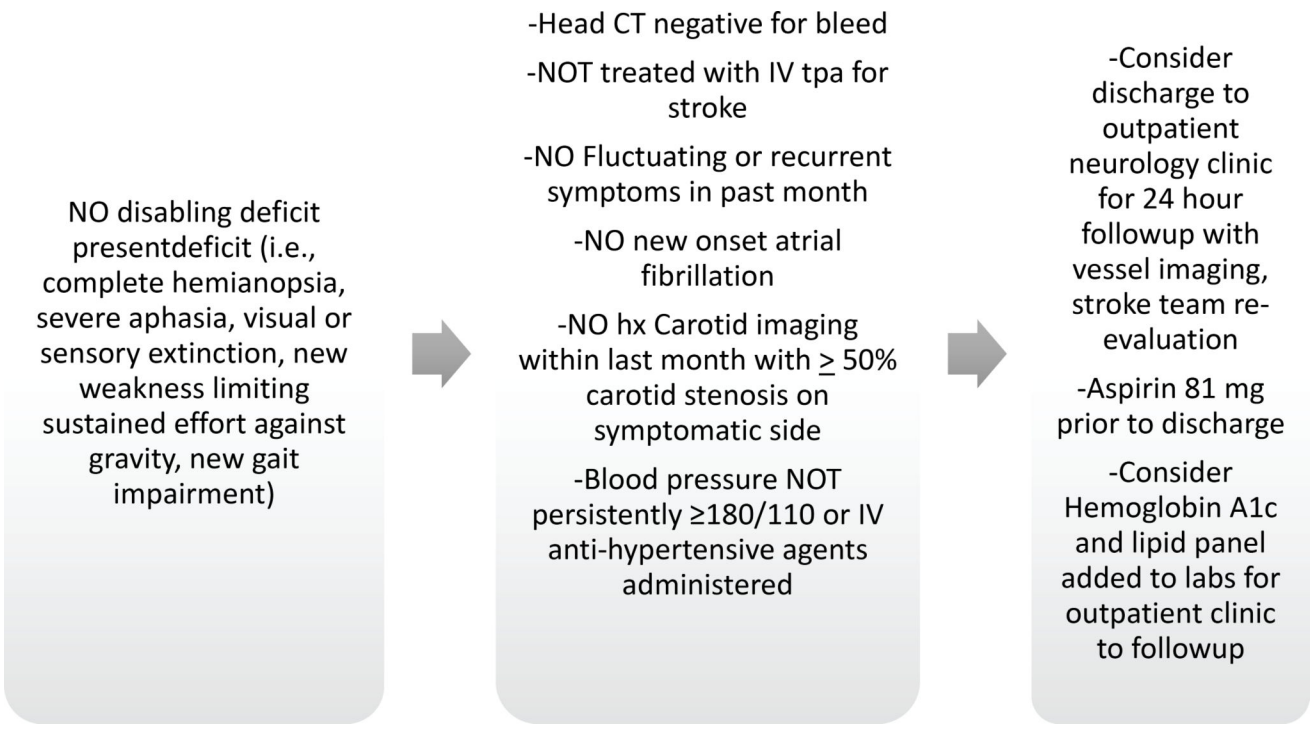

Figure 1:
TIA/Minor Stroke Evaluation Pathway

Table 1:

Studies Evaluating Outpatient Management Strategies for TIA/minor stroke

Study	Type of Study	Sample Size	Excluded Patients	Outcome	Findings
Early Use of Existing Strategies for Stroke (EXPRESS) Rothwell et al, 2007	Prospective Observational Pre-post	1278 (644 post)	-None (all TIA or stroke patients included in study)	90-day stroke risk	90-day stroke Rate of 2.1% compared to 10.3% before implementation
SOS-TIA Lavellée, 2013	Prospective Observational	1085	-persistent symptoms -	90-day stroke risk	90-day stroke risk of 1.24%
Ross et al. 2007	Randomized Control Trial	149	-persistent neurologic deficit -existing condition prohibiting reliable ED testing and outpatient follow-up	90-day stroke risk, length of stay 90-day total direct costs Return Visit Major Clinical Event	Lower 90-day total direct costs ($890 vs $1547) Shorter length of stay (26 v 61 hours) 12% return visits in both groups 4 major clinical events in both groups
Stead et al. 2009	Prospective Observational	418	-Patients with symptoms lasting >24 hours -acute ischemic/hemorrhagic stroke	48-hour and 7-day stroke risk	Risk of stroke of 0.96% at 48 hours and 1.2% at 7 days