

Cost Benefits of an Outpatient Diagnostic Pathway for Low-Risk Transient Ischemic Attack: A Narrative Review

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Abstract

Transient ischemic attack (TIA) affects at least 240,000 people in the United States each year, and most of them are still admitted to the hospital for a workup that takes one to two days. The main reason for admission is rarely treatment. It is diagnostic convenience: inpatient echocardiography, cardiac telemetry, and specialist consultation. Over the past two decades, rapid-access TIA clinics and emergency department (ED) observation protocols have shown that the same evaluation can be completed without a hospital bed, with 90-day stroke rates of 1% to 2% that compare favorably with predicted rates of 6% to 10%. This review examines the financial case for an ED-based discharge pathway in which low-risk patients (ABCD2 score <4, no infarct on imaging, no severe vascular stenosis) complete brain and vessel imaging and laboratory studies in the ED, then obtain echocardiography, ambulatory cardiac monitoring, and structured follow-up as outpatients within days of discharge. Published comparisons consistently show cost reductions of 40% to 80% per patient when hospitalization is replaced with urgent outpatient evaluation, with no measurable loss of safety. A decision analysis found that hospitalization costs \$5,573 more per patient than urgent clinic evaluation while adding only 0.00026 quality-adjusted life-years. Using a national average hospital expense of \$3,297 per inpatient day, a program discharging 100 low-risk patients annually can be expected to free roughly \$330,000 to \$660,000 in hospital production costs and 100 to 200 bed-days each year. The pathway also reduces out-of-pocket costs for insured patients, who avoid inpatient deductibles and coinsurance. Cost savings, bed capacity, and patient preference align in the same direction, and the remaining barriers are organizational rather than clinical.

Keywords: *Transient Ischemic Attack; Outpatient Pathway; Cost Analysis; ABCD2 Score; Emergency Department; Health Care Utilization*

1. Introduction

A transient ischemic attack is defined, in current tissue-based terms, as a transient episode of neurological dysfunction caused by focal brain, spinal cord, or retinal ischemia without acute infarction.¹ The event itself resolves; the risk does not. Early studies estimated that 12% to 20% of patients suffer a stroke or acute coronary event within 90 days of a TIA or minor stroke, with nearly half of that risk concentrated in the first 48 hours.^{2,4} That front-loaded risk shaped a generation of practice: if the danger is highest in the next two days, the reasoning went, the patient belongs in a hospital bed.

The evidence that has accumulated since tells a more specific story. What protects patients after TIA is the speed of evaluation and the immediate start of secondary prevention, not the building in which those things happen.^{5,6} The EXPRESS study reduced 90-day recurrent stroke risk by 80% simply by collapsing the interval between symptom onset and treatment initiation, entirely in an outpatient clinic.⁵ SOS-TIA achieved a 90-day stroke rate of 1.24%, against a predicted 5.96%, while sending 74% of patients home the same day.⁶ In the modern TIAregistry.org cohort, cared for in systems built around urgent specialist evaluation, the one-year stroke rate was 5.1%, roughly a third of the historical figure.⁴

Meanwhile, hospitalization for TIA has never demonstrated an outcome benefit of its own. In a propensity-matched analysis of 3,623 veterans presenting to EDs with TIA, admitted patients underwent more testing but had no better one-year composite outcome than those discharged.¹² Admission, in other words, is a costly container for a set of tests, most of which the ED can complete before discharge and the rest of which can be scheduled within days.

This is the premise of the outpatient TIA pathway reviewed here: a protocol in which carefully selected low-risk patients, identified by an ABCD2 score below 4 and unremarkable brain and vessel imaging, complete MRI, computed tomography (CT) and vessel imaging, and laboratory studies during the ED encounter, and are then discharged with expedited outpatient echocardiography, ambulatory cardiac event monitoring when indicated, and structured early follow-up. The clinical safety of this general approach has been reviewed elsewhere and is summarized briefly below.^{2,11} Our focus is the cost analysis part of the discussion for the outpatient TIA pathway: what the pathway costs, what it saves, and for whom.

2. Why Rapid Outpatient Evaluation Became Defensible

Three lines of evidence support moving the TIA workup out of the hospital.

The first is risk stratification. The ABCD2 score, derived and validated in 4,809 patients from four cohorts, assigns points for age, blood pressure, clinical features, symptom duration, and diabetes.³ Patients scoring 0 to 3, about a third of TIA presentations, carried a 2-day stroke risk of 1.0%, compared with 4.1% at scores of 4 to 5 and 8.1% at 6 to 7.³ Imaging sharpens the estimate further. In TIAregistry.org, infarction on brain imaging and large-artery atherosclerosis each independently more than doubled recurrence risk; their absence identifies a group whose short-term risk is low enough that a monitored bed adds little.⁴ A pathway that requires both a score below 4 and normal imaging with no severe stenosis is therefore selecting the patients for whom admission had the weakest rationale in the first place.

The second is the demonstrated performance of urgent outpatient models. EXPRESS and SOS-TIA, both published in 2007, are the anchor studies.^{5,6} EXPRESS was a before-and-after comparison nested in a population-based cohort in Oxfordshire: when the study clinic moved from appointment-based to same-day assessment and immediate treatment, median time to first prescription fell from 20 days to 1 day, and 90-day recurrent stroke fell from 10.3% to 2.1%.⁵ SOS-TIA, a Paris clinic with 24-hour access, evaluated 1,085 suspected TIA patients, started prevention immediately, and observed a 90-day stroke rate of 1.24% with three quarters of patients home the same day.⁶ A subsequent scoping review of eight ED- and primary-care-based referral pathways found the same pattern across settings: actual 90-day stroke rates of 1.3% to 2.1% against predicted rates of 6% to 10%.¹¹

The third line of evidence is the only randomized comparison, and it was designed around cost. Ross and colleagues randomized 149 ED patients with TIA to an accelerated diagnostic protocol in an ED observation unit versus conventional inpatient admission.⁸ The protocol arm received serial clinical assessment, cardiac monitoring, carotid imaging, and echocardiography, and could be escalated to admission when testing was positive. Median length of stay was 25.6 hours versus 61.2 hours for the admitted group, and 90-day costs were \$890 versus \$1,547, with no difference in return visits or 90-day clinical events.⁸ The trial shows that compressing the TIA evaluation does not degrade it. The pathway examined in this review extends the same logic one step further: for the lowest-risk stratum, the remaining cardiac studies do not need to be completed on hospital property at all.

3. The Pathway

The protocol under review operates as follows. A stroke physician evaluates the patient in the ED and confirms eligibility: ABCD2 score below 4, no severe vascular stenosis, and no acute infarct on imaging. During the ED encounter the patient completes MRI and vessel imaging, laboratory studies (comprehensive metabolic panel, complete blood count, lipid panel, hemoglobin A1c, and thyroid-stimulating hormone), and a full neurology consultation. Secondary prevention is started before discharge in accordance with current guidelines.¹⁵

If the patient consents to outpatient completion, the ED discharge orders include a STAT outpatient transthoracic echocardiogram, with bubble study when indicated, to be performed within one week under the TIA diagnosis; a cardiologist reads the study and contacts the on-call neurologist directly with any urgent finding. When ambulatory rhythm monitoring is indicated, a cardiac event monitor is ordered at discharge and completed in the same outpatient window. Follow-up with the patient's primary care physician is arranged within one to three weeks to review results; patients without a primary care physician receive a referral to an internal medicine clinic with explicit instructions on the required timeframe. Every discharged patient is added to a shared electronic list maintained by the stroke service, which calls each patient within seven days of discharge. Patients receive printed education on stroke symptoms and TIA before leaving the ED. Patients without insurance are admitted rather than discharged, because the pathway depends on reliable outpatient access; the implications of that criterion are discussed in Section 7.

Two features distinguish this design from a freestanding TIA clinic of the EXPRESS or SOS-TIA type. First, the diagnostic heavy lifting, brain and vessel imaging, happens before discharge rather than at a clinic visit, so the studies with the greatest urgency are never deferred. Second, the safety net is redundant by design: a hard-scheduled echocardiogram with direct cardiology-to-neurology communication, a tracked list with a stroke-team phone call, and an explicit primary care handoff. The pathway is, in effect, an observation unit protocol in which the observation happens at home.

4. What the Admission Was Actually Buying

The honest way to frame the economics is to ask what the avoided hospitalization was purchasing. For a low-risk, imaging-negative patient, the answer reduces to three things: inpatient echocardiography, continuous telemetry, and proximity to thrombolysis should a stroke occur during the stay.

The echocardiogram is the clearest case for deferral. In a real-world cohort of 674 patients with stroke or TIA of undetermined cause, routine transthoracic echocardiography identified a major cardioembolic source in 1.9% of those tested, and all but 0.4% of those findings were already suspected from the electrocardiogram or cardiac symptoms.¹⁴ Findings that change management within 48 hours are rare; findings that change management within a few weeks, patent foramen ovale in selected patients, structural sources, valvular disease, remain fully actionable when the study is done within a week of discharge. Keeping a patient in a bed for one to two days to obtain a test whose urgent yield is under 1% is difficult to defend on clinical grounds.

Telemetry deserves the same scrutiny. The practical purpose of inpatient monitoring after TIA is atrial fibrillation detection, and the evidence indicates that duration of monitoring, not location, is what detects it. In the EMBRACE trial, a 30-day outpatient event monitor detected atrial fibrillation in 16.1% of patients with cryptogenic stroke or TIA, versus 3.2% with a conventional 24-hour monitor, and nearly doubled the proportion of patients anticoagulated by 90 days.¹³ A day and a half of inpatient telemetry is a weak substitute for a month of ambulatory monitoring. The outpatient pathway does not merely match the inpatient diagnostic strategy on this point; it is positioned to exceed it.

The final consideration, immediate thrombolysis access, is the strongest argument for admission and the reason patient selection matters. It has been examined formally, and the analysis is discussed in the next section, because its conclusion is quantitative: for low-risk patients the probability of benefiting is too small to justify the cost.⁹

5. The Cost Case

5.1 What published comparisons show

Every published comparison of hospitalization against urgent outpatient evaluation for appropriately selected TIA patients has favored the outpatient model on cost, and the margins are not subtle (Table 1).

In the randomized trial by Ross and colleagues, 90-day costs were \$890 for the ED observation protocol versus \$1,547 for inpatient admission, a 42% reduction, in 2007 dollars and with the observation arm still physically inside the hospital.⁸ Martínez-Martínez and colleagues, comparing their hospital's early-management TIA clinic against its prior in-hospital protocol for low- and moderate-risk patients, reported €393 per patient for clinic management versus €1,931 for hospitalization, a nearly fivefold difference, with stroke recurrence statistically equivalent (2.4% vs 1.2%) and 77.8% of hospitalizations avoided.¹⁰

The EXPRESS cost analysis adds a point that is easy to miss: urgent outpatient evaluation does not just avoid the index admission, it prevents downstream admissions by preventing strokes. After the Oxford clinic converted to same-day assessment, hospital bed-days for stroke admissions fell from 1,957 to 672 across the cohort, and faster outpatient care generated savings of £624 per patient referred, driven mostly by strokes that never happened.⁷ The 90-day risk of fatal or disabling stroke fell from 16 in 310 patients to 1 in 281.⁷

The most direct answer to the admission question comes from the decision analysis by Joshi and colleagues.⁹ Modeling patients aged 65 to 74 with TIA, they compared hospitalization against urgent-access clinic evaluation, granting the hospital arm its one real advantage, higher tissue plasminogen activator utilization if stroke occurred during the stay. Hospitalization gained 0.00026 quality-adjusted life-years at an additional cost of \$5,573 per patient: an incremental cost-effectiveness ratio of \$21,434,615 per QALY at one year, and still \$3,473,125 per QALY over a 30-year horizon.⁹ The result was insensitive to varying the 48-hour stroke risk, length of stay, thrombolysis rates, and cost assumptions. The authors' conclusion was blunt: hospitalization is not cost-effective when an urgent-access alternative exists, and a very small fraction of patients benefit from the bed.⁹

Table 1. Published cost comparisons of hospitalization versus urgent outpatient or observation-based evaluation for TIA.

Study (year)	Design and setting	Comparison	Cost result	Clinical result
Ross et al (2007) ⁸	Randomized controlled trial, single US ED (n=149)	ED observation unit accelerated diagnostic protocol vs inpatient admission	90-day costs \$890 vs \$1,547 per patient (2007 USD)	Median stay 25.6 vs 61.2 h; no difference in 90-day events
Luengo-Fernandez et al (2009) ⁷	Population-based before-after study, Oxfordshire, UK	Urgent same-day outpatient clinic vs prior appointment-based care	Savings of £624 per patient referred; cohort bed-days fell from 1,957 to 672	90-day fatal or disabling stroke 1/281 vs 16/310
Joshi et al (2011) ⁹	Decision analysis, US payer perspective	Hospitalization vs urgent-access same-day clinic	Hospitalization cost \$5,573 more per patient; ICER \$21,434,615/QALY at 1 year	Gain of 0.00026 QALY with hospitalization
Martínez-Martínez et al (2013) ¹⁰	Prospective before-after comparison, single center, Spain	Early-management TIA clinic vs in-hospital protocol (low- to moderate-risk)	€393 vs €1,931 per patient; 77.8% of hospitalizations avoided	Recurrence 2.4% vs 1.2% (P=0.65)

ED indicates emergency department; ICER, incremental cost-effectiveness ratio; QALY, quality-adjusted life-year; TIA, transient ischemic attack. Figures are as reported in each source currency and year, without inflation adjustment.

5.2 A worked example

The arithmetic for an individual program is straightforward enough to do on one page.

Consider a hospital whose low-risk TIA patients are currently admitted for one to two days, consistent with typical practice.^{8,12} The American Hospital Association survey data compiled by KFF put average US hospital adjusted expenses at \$3,297 per inpatient day in 2024, ranging from roughly \$1,400 to \$4,700 by state.¹⁶ Each avoided admission therefore releases approximately \$3,300 to \$6,600 in hospital production cost at the national average, before accounting for regional variation.

Against that saving, the pathway's incremental costs are modest. The echocardiogram is not avoided but relocated; outpatient technical and professional fees are generally at or below the cost of performing and reading the same study on an inpatient. The added elements, a stroke-team phone call within seven days, list maintenance in the electronic health record, and an early primary care visit, are measured in tens of dollars, not thousands. The ED evaluation itself, imaging, laboratories, and neurology consultation, is identical in both models and cancels out of the comparison.

The net figure aligns well with the published estimates. Joshi's model found hospitalization cost \$5,573 more per patient than clinic-based care in 2011 dollars.⁹ Our own institutional financial modeling, calibrated to these benchmarks and to current reimbursement data, estimated hospital production-cost savings of roughly \$3,500 to \$7,000 per pathway patient, with insured patients avoiding an additional \$1,500 to \$3,500 in out-of-pocket costs (unpublished data). Scaled to a program discharging 100 eligible patients per year, the pathway can be expected to free on the order of \$330,000 to \$660,000 in production cost and 100 to 200 bed-days annually (Table 2).

Table 2. Worked example: expected annual savings for a program discharging 100 low-risk TIA patients per year.

Step	Quantity	Basis
Length of stay avoided per patient	1–2 bed-days	Typical TIA admission duration ^{8,12}
Hospital production cost per bed-day	\$3,297 (US average, 2024; state range ≈ \$1,400–\$4,700)	KFF / AHA Annual Survey data ¹⁶
Production cost avoided per patient	$\$3,297 \times (1-2) \approx \$3,300\text{--}\$6,600$	Multiplication of the two rows above
Incremental pathway costs per patient	Small; echocardiogram relocated rather than added, plus tracking call and follow-up visit	Section 5.2
Net savings per patient (literature benchmarks)	\$657 (2007 USD), ⁸ \$5,573 (2011 USD, modeled), ⁹ €1,538 ¹⁰	Table 1
Annual program savings (100 patients)	≈ \$330,000–\$660,000 in production cost; 100–200 bed-days freed	100 × per-patient figures

AHA indicates American Hospital Association; KFF, Kaiser Family Foundation; TIA, transient ischemic attack. The per-bed-day calculation uses national average production cost and should be recalibrated to local cost accounting and payer mix.

The bed-days deserve emphasis, because in a capacity-constrained hospital they may be worth more than the accounting savings. In our institution's benchmarking, TIA sits among the lowest-reimbursed common medical admissions, and the diagnosis-related group payment frequently fails to cover the cost of the stay (unpublished data); each avoided TIA admission therefore both removes a money-losing encounter and returns a bed to higher-acuity patients who would otherwise board in the ED. The same logic underpinned the EXPRESS finding that clinic-based care freed inpatient capacity systemwide.⁷ A bed released from a low-risk TIA admission is not an empty bed; it is a sepsis, stroke, or heart failure admission that no longer waits in a hallway.

5.3 The patient's side of the ledger

Cost analyses of TIA care usually stop at the hospital's ledger, but the patient's is worth stating plainly. An insured patient admitted for one to two days typically owes an inpatient deductible or coinsurance, estimated at \$1,500 to \$3,500 under prevailing plan designs in our institutional modeling (unpublished data), and loses one to two days of wages, along with the familiar non-financial costs of hospitalization: sleep disruption, exposure to nosocomial risk, and family burden. The same patient managed on the pathway owes outpatient cost-sharing for an echocardiogram and a clinic visit, typically a few hundred dollars, and can usually return to work the next day. For the patient, the pathway converts a four-figure event into a low three-figure one while delivering an equivalent evaluation. Patient-perspective costs of this kind were part of what the EXPRESS investigators captured indirectly through disability reduction,⁷ but for an individual family the immediate arithmetic is simpler: the deductible alone often exceeds the entire cost difference the hospital sees.

6. Safety: The Cost Argument's Prerequisite

None of the foregoing matters if the pathway harms patients, so the selection criteria carry the whole structure. The available evidence indicates they can.

The 2023 American Heart Association scientific statement on TIA management in the ED explicitly supports rapid-evaluation pathways and ED discharge with expedited outpatient workup for lower-risk patients when reliable follow-up exists, reserving admission for those with high-risk features.² The pathway's criteria map directly onto that framework: ABCD2 below 4 selects the stratum with a 1.0% 2-day stroke risk,³ and the imaging requirements exclude the two features, tissue infarction and large-artery disease, that most strongly predict early recurrence.⁴ The observed performance of comparable models, 90-day stroke rates of 1% to 2% across trial, cohort, and registry data,^{5,6,8,11} and the absence of any outcome benefit from admission in matched observational data,¹² suggest that a properly selected patient loses nothing clinically by sleeping at home.

Two caveats belong in any honest account. First, the ABCD2 score alone is an imperfect triage instrument; the AHA statement is careful to frame it as one input among several, which is why this pathway couples it to imaging criteria and specialist assessment rather than using it as a standalone gate.^{2,3} Second, the model's safety depends on completion: an ordered echocardiogram that never happens converts a planned evaluation into a missed one. This is precisely why the protocol hard-schedules the study before discharge, tracks every patient on a shared list with a seven-day phone call, and admits patients whose outpatient access cannot be assured. Whether these safeguards perform as intended is an empirical question each program should audit prospectively.

7. Implementation and Equity Considerations

The pathway's insurance criterion, uninsured patients are admitted rather than discharged, will strike some readers as inverted, since it directs the more expensive disposition toward the least-resourced patients. The rationale is safety rather than economics: an uninsured patient may be unable to obtain a timely outpatient echocardiogram, and admission guarantees completion of the workup. Still, the criterion means the pathway's financial benefits accrue unevenly, and programs should treat it as a problem to engineer away, through funded fast-track outpatient slots, charity-care echocardiography, or hospital-subsidized follow-up, rather than a fixed feature. The scoping literature on admission-avoiding TIA pathways notes that reliable, rapid follow-up access is the common precondition across all successful models.¹¹

Beyond coverage, the organizational requirements are modest but real: a cardiology service willing to protect next-week echocardiography slots and read them with a direct escalation channel to neurology; an ED culture comfortable discharging a diagnosis that was reflexively admitted for decades; a tracked patient list with assigned ownership; and a primary care or internal medicine clinic able to absorb one- to three-week follow-up visits, including for patients without an established physician. None of these requires capital investment. Most institutions already own every component; the pathway is a reorganization, not a purchase.

8. Limitations

This review has the limitations of its genre and its subject. The cost literature on TIA disposition is thin: one modest randomized trial with cost outcomes,⁸ one decision analysis,⁹ and a handful of observational and before-after comparisons from single centers in different countries, currencies, and years.^{5,6,7,10} Direct comparison across these figures requires caution; we have deliberately presented them as consistent in direction rather than precise in magnitude, and older dollar figures are unadjusted for inflation, which understates contemporary savings. The institutional estimates cited in Section 5.2 are unpublished modeling, calibrated to public benchmarks but not externally validated, and local results will vary with payer mix, cost accounting, and regional prices. Finally, the safety data supporting outpatient evaluation come predominantly from systems with dedicated rapid-access infrastructure; a pathway implemented without functioning follow-up machinery should not expect the same results. Prospective evaluation of this specific protocol, with clinical outcomes, completion rates, and audited costs, is the necessary next step, and is planned.

9. Conclusion

The admission of a low-risk TIA patient purchases an echocardiogram that rarely changes urgent management, a telemetry window too short to find the arrhythmia it seeks, and thrombolysis proximity whose expected value has been priced at more than \$21 million per quality-adjusted life-year. It costs the hospital \$3,300 to \$6,600 in production cost per stay, occupies a bed that a sicker patient needs, and hands the patient a four-figure bill. The alternative, an ED-completed workup with hard-scheduled outpatient cardiac studies and tracked early follow-up, has repeatedly matched the safety of admission at 20% to 60% of its cost. For patients with an ABCD2 score below 4 and reassuring imaging, the evidence supports treating outpatient evaluation not as a compromise but as the default, with hospitalization reserved for those whose risk profile or circumstances actually justify it. The economics and the clinical evidence, unusually, point the same way.

Conflict of Interest

The authors declare no conflicts of interest.

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