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Risk assessment after syncope in adult emergency care

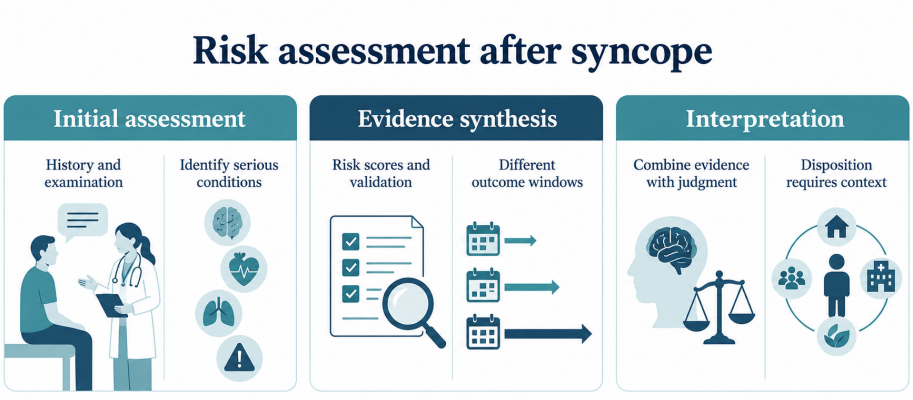
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STRUCTURED ABSTRACT



Graphical abstract

Background. Emergency assessment of syncope must identify serious causes and mimics before using a prediction score. Decision rules differ in populations, thresholds and outcome definitions.

Aim. To critically appraise adult emergency syncope risk assessment, biomarker augmentation and disposition evidence, and identify research priorities for Saudi practice.

Methods. A focused PubMed relevance retrieval on 6 October 2026 combined syncope with risk, score, prediction and guideline concepts. The Canadian Syncope Risk Score (CSRS) validation and SAEM GRACE systematic review were inspected through PMC; other selected sources were verified through metadata and abstracts. This

narrative synthesis produced no new pooled estimates or formal GRADE ratings and used no registered protocol or dual human extraction.

Findings. The San Francisco Syncope Rule, CSRS and OESIL have the broadest external-validation coverage in the inspected review, but heterogeneous endpoints and thresholds impede direct comparison. The review's pooled negative likelihood ratios exceed 0.1, while individual validation estimates vary. These rules have not demonstrated uniform superiority to clinical judgment across settings. A recent older-adult validation found a FAINT sensitivity advantage for cardiac outcomes, which does not establish outcome benefit from score-guided care. NT-proBNP adds limited reclassification beyond CSRS in selected evidence. Admission is associated with greater serious-event detection, without establishing a causal benefit. A two-variable candidate quality measure identified low event frequency in one cohort; it is not a validated stand-alone discharge rule.

Conclusion. History, examination, orthostatic evaluation and ECG provide the initial framework. Scores can support subsequent disposition decisions when their population and endpoint match the clinical question. Saudi research should examine local validation, calibration, comparison with clinical judgment and observation pathways before inferring patient benefit.

Source and interpretation note for Figure 1. Author synthesis of the evidence presented in the text and the source-specific citations in the manuscript tables. Pictograms and arrows are conceptual and do not depict measured results, new patient data, or proven local benefits.

Keywords: syncope; risk assessment; emergency care; decision rules; biomarkers

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Introduction

Syncope is a sudden, transient loss of consciousness with inability to maintain postural tone, followed by spontaneous and complete recovery, attributable to global cerebral hypoperfusion [1,2,3]. The symptom is common yet treacherous because, while the majority of presentations reflect benign reflex or orthostatic mechanisms, a clinically important minority (about 10% across contemporary cohorts) harbor serious underlying conditions including arrhythmia, acute coronary syndromes, pulmonary embolism, structural heart disease, and major hemorrhage [4,5,6,7,8]. These serious conditions may not be evident during the initial ED evaluation but declare themselves within hours to weeks, sometimes with fatal consequences [1,9,10].

The fundamental purpose of ED risk assessment is not to produce a number but to make safe, efficient disposition decisions. Three overlapping tasks must be accomplished in sequence. First, dangerous conditions that mandate immediate treatment must be excluded or identified. Second, the etiology of the syncopal event should be sought through a focused clinical evaluation, including detailed history, examination with orthostatic vital signs, and a 12-lead ECG. Third, when a clear cause remains elusive, formal risk stratification can be applied to estimate the probability of a serious adverse event over the next 30 days and to inform the decision to discharge, observe, or admit [1,3,4,11]. Folding prognostic scores into the process before the first two tasks are completed risks premature closure and inappropriate use of tools outside their derivation settings [5,8,12].

Decision rules formalize subsequent prognostic assessment, but heterogeneous definitions, endpoints and comparators impede comparison. SAEM GRACE found low-certainty evidence for the most frequently validated rules and no high-certainty demonstration of uniform superiority over clinical judgment [5,9,13]. Prediction accuracy and improved care are separate questions.

External validation depends on case mix, available workup and disposition thresholds [4,5,9,14,15]. Saudi applicability requires measurement of those variables rather than assuming national differences or outcome benefit.

This focused critical narrative examines decision rules, biomarkers, disposition and outcomes beyond short-term composites, then identifies questions for Saudi evaluation. It supplies no new patient data or pooled estimates.

Review approach

A focused PubMed retrieval on 6 October 2026 combined title-field syncope with risk, score or prediction terms, or guideline publication type, with dates from 1 January 2000 to 6 October 2026 and exclusion of animal-only records. Selection emphasized clinical assessment, derivation/external validation, biomarkers, disposition and patient outcomes. Full-text sections of Canadian CSRS validation (PMC7091474) and SAEM GRACE (PMC11726151) were inspected. Other sources, including CSRS derivation, international validation and primary adjunctive studies, were verified through PubMed metadata and abstracts. No registered protocol, dual human extraction, exhaustive screening, new pooling or formal GRADE assessment was performed. Source uncertainty is retained rather than replaced with invented precision; the international validation's inconsistent event fraction is discussed under Limitations [6].

Initial clinical assessment must precede any score

Every contemporary review of ED syncope management emphasizes that structured history, physical examination including orthostatic vital signs, and a 12-lead ECG are the foundation of risk assessment, and that decision rules are adjuncts rather than substitutes [1,2,3,4,8,11,16]. The history should characterize the prodrome, the circumstances of the event (exertion, posture, cough, micturition), the presence of palpitations or chest pain, the rapidity of recovery, the medication list (especially antihypertensives, QT-prolonging agents, and glucose-lowering drugs), and family history of sudden cardiac death [1,16]. The examination should include postural blood pressure and heart rate measurement, cardiac auscultation, and a focused neurologic assessment [1,4]. A 12-lead ECG is a core initial investigation, and an abnormal ECG is a near-universal component of high-risk stratification, embedded in the SFSR, CSRS, OESIL, and FAINT scores alike [5,9,10,17,18].

Multiple reviews explicitly caution that prognostic scores are derived for patients in whom no serious condition has been identified on the initial evaluation [1,4,5,13]. Applying a score to a patient with obvious ST-elevation myocardial infarction, massive pulmonary embolism, or overt gastrointestinal hemorrhage is misapplication; these conditions are managed according to their own protocols. The CSRS derivation explicitly excluded patients with a clear serious cause of syncope identified in the ED, and the score predicts outcomes that are not already evident on initial evaluation [10,17]. The SFSR should similarly be applied only after initial evaluation, with a meta-analysis showing that the post-test probability of a serious outcome after a negative SFSR was 2% or lower in the unexplained-syncope subgroup, though higher (up to about 5%) when applied to unselected patients [13]. Reflex, orthostatic, and clearly cardiac pathways should be preserved in parallel with, not replaced by, prognostic scoring.

The European Society of Cardiology (ESC) framework, summarized in a 2022 narrative review, organizes risk assessment around identifying low-risk features (consistent with reflex syncope), high-risk features (suggestive of cardiac syncope or serious underlying disease), and an intermediate group requiring structured expert evaluation [1]. This three-tier model is broadly compatible with the CSRS, which operationalizes high-risk features (heart disease, abnormal ECG, elevated troponin, extremes of blood pressure, ED diagnosis of cardiac syncope) and low-risk features (predisposition to vasovagal syncope, ED diagnosis of vasovagal syncope) into an integer-weighted score [1,10,17].

The Canadian Syncope Risk Score: derivation, validation, and limits

The CSRS was derived in a prospective six-center Canadian cohort of 4030 adults aged 16 years or older presenting within 24 hours of syncope, with 43 candidate predictors reduced to nine: predisposition to vasovagal syncope, heart disease, any systolic blood pressure in the ED below 90 or above 180 mm Hg, troponin level above the 99th percentile, abnormal QRS axis (< −30° or > 100°), QRS duration greater than 130 ms,

corrected QT interval greater than 480 ms, ED diagnosis of cardiac syncope, and ED diagnosis of vasovagal syncope [17]. The model achieved a C-statistic of 0.88 (95% CI 0.85–0.90) with an optimism of 0.015 and good calibration (goodness-of-fit p = 0.11) in derivation, and the predicted risk of a 30-day serious adverse event ranged from 0.4% at a score of −3 to 83.6% at a score of 11 [17]. At a threshold of −2 or higher, sensitivity was 99.2%, and at −1 or higher, 97.7% [17]. Serious adverse events were adjudicated and included death, myocardial infarction, arrhythmia, structural heart disease, pulmonary embolism, serious hemorrhage, and procedural interventions within 30 days [17].

The CSRS was then prospectively validated in a nine-center Canadian cohort of 3819 patients enrolled from March 2014 to April 2018 [10]. The empirical probability of a 30-day serious outcome was 3.64% (95% CI 3.09%–4.28%), not significantly different from the model-predicted 3.17% (95% CI 2.66%–3.77%; p = 0.26), with a calibration slope of 1.0 and an area under the receiver operating characteristic curve (AUC) of 0.91 (95% CI 0.88–0.93) [10]. The proportion of patients with serious outcomes rose from 3 of 1,631 (approximately 0.2%) in the very-low-risk group to 51.3% in the very-high-risk group (Cochran-Armitage trend p < 0.001), and at a threshold score of −1 (which captured 2145 of 3819 patients, or about 56%), sensitivity was 97.8% (95% CI 93.8%–99.6%) and specificity 44.3% (95% CI 42.7%–45.9%) [10]. The authors concluded that very-low- and low-risk patients can generally be discharged, while brief hospitalization can be considered for high-risk patients [10].

The validation cohort excluded patients with identified serious index causes, prolonged loss of consciousness, features suggesting seizure, persistent altered mental status, major trauma-associated loss of consciousness, or inability to obtain a reliable history; the score applies to adults aged 16 years or older presenting within 24 hours of syncope in whom initial evaluation has not identified a serious cause [10]. Troponin and ECG variables that were missing were handled by treating unmeasured results as normal in the study protocol, a methodological choice that supports calculation of the score but should not be read as an instruction to measure troponin in every patient or a reason to omit a clinically indicated test [10,17].

External validation outside Canada has been less uniformly positive. The international BASEL IX cohort of 2283 patients aged 40 years or older across eight countries found an AUC of 0.85 (95% CI 0.83–0.88) for the primary composite outcome (serious clinical plus procedural events) and 0.80 (95% CI 0.75–0.84) when procedural interventions were excluded, both superior to OESIL but with a critical caveat: a simplified model using only the clinician's classification of syncope at ED discharge (cardiac, vasovagal, other) achieved a similar AUC of 0.83 (95% CI 0.80–0.87), suggesting that much of the CSRS performance may be carried by the clinician's gestalt [6]. The authors explicitly stated that the clinical utility of the CSRS remains uncertain [6]. A multicenter Italian study of 345 patients reported an AUC of 0.75 (95% CI 0.68–0.81) for the CSRS versus 0.68 (95% CI 0.61–0.74) for clinical judgment, and noted that low-risk classification by clinical judgment was associated with a lower 30-day serious event rate (2%) than low-risk classification by the CSRS (6.7%), without implying that clinical judgment is statistically more specific in the formal sense [12]. A small single-center Australian study of 283 patients reported a sensitivity of 71.4% (95% CI 30.3%–94.9%) at a threshold score of 1 or higher, with wide confidence intervals reflecting few events, but found no clinically relevant outcomes missed in the low-risk group [19]. A recent US multicenter study of 1263 patients aged 40 years or older reported a CSRS AUC of 0.72 (95% CI 0.67–0.78) for any serious cardiac or noncardiac outcome, with a sensitivity of 91.9% (95% CI 85.7%–98.1%) and a negative predictive value of 97.5% (95% CI 96.4%–98.8%) at a CSRS below 0 [18]. Importantly, this same US study evaluated the FAINT score for serious cardiac outcomes only and reported an AUC of 0.76 (95% CI 0.71–0.81), with a low-risk sensitivity of 96.7% (95% CI 92.4%–100%) and an FAINT score sensitivity that exceeded unstructured physician-estimated risk for cardiac outcomes by 18.7 percentage points (95% CI 6.8%–30.6%, p = 0.002); the CSRS was not significantly more sensitive than physician estimates for any serious outcome in the same cohort [18]. The endpoint families differ between the two scores in that study, so direct comparison of the AUC point estimates is not appropriate, and the FAINT sensitivity advantage over physician gestalt does not by itself demonstrate that score-guided care improves patient outcomes [18].

Two SAEM GRACE–era observations are critical for interpretation. First, in the systematic review and meta-analysis of 31 studies encompassing 13 CDRs and 14,845 validation participants, the CSRS had the highest pooled sensitivity and lowest pooled specificity of the three most-validated rules, but the positive likelihood ratio ranged from 1.15 to 2.58 and the negative likelihood ratio from 0.05 to 0.50 across validations; the SFSR and OESIL ranges overlap with these, so all three rules show substantial heterogeneity and do not uniformly cross conventional likelihood-ratio thresholds for clinical decision-making [5]. Second, the SAEM GRACE review explicitly cautioned that, under GRADE, the certainty of evidence for predicting all adverse events using any of the three rules is low, with downgrades for indirectness and publication bias [5].

The San Francisco Syncope Rule and the OESIL score in context

The SFSR was one of the earliest ED syncope decision rules, identifying high-risk patients by the mnemonic CHESS (history of Congestive heart failure, Hematocrit below 30%, abnormal ECG, Emergency department shortness of breath, and Systolic blood pressure below 90 mm Hg at triage). A 2011 meta-analysis of 12 studies and 5316 patients found a pooled sensitivity of 0.87 (95% CI 0.79–0.93) and specificity of 0.52 (95% CI 0.43–0.62), with substantial between-study heterogeneity (95% prediction interval for sensitivity 0.55–0.98) [13]. The probability of a serious outcome after a negative SFSR was at most 5% in unselected patients and 2% or lower when the rule was applied only to patients without an identified cause after initial evaluation, and the most common cause of false-negative classification was cardiac arrhythmia [13]. The SFSR has therefore been described as a useful rule-out tool when applied to the unexplained-syncope subgroup, but its modest specificity implies that many low-risk patients are still flagged for admission, and it should not be used in isolation to mandate admission [13].

The OESIL score combines four variables (abnormal ECG, age above 65, history of cardiovascular disease, and lack of prodromal symptoms) and has been validated in five external studies with positive likelihood ratios between 1.16 and 3.32 and negative likelihood ratios between 0.14 and 0.46 [5]. A single-center Italian validation of 200 patients found that the OESIL threshold of ≥3 (rather than the more commonly used ≥2) was the optimal cut-off for predicting one-month adverse events, severe outcomes at one year, non-syncopal readmission, major procedures, cardiovascular events, and all-cause death, likely because the validation cohort was considerably older than the derivation cohort (mean 72.4 vs 59.5 years) [20]. An earlier Italian study from Parma confirmed that the OESIL score was associated with cardiogenic syncope and was useful in a short-stay observation ward context [14]. A systematic review of unexplained-syncope multivariable risk scores pooled 17 studies of 9 scores covering 24,234 patient visits (7.5% adverse event rate, 95% CI 5.3%–10%) and reported that a CSRS of 4 or more had a high likelihood of an adverse event (LR 11, 95% CI 8.9–14) and a CSRS of 0 or less had a low likelihood (LR 0.10, 95% CI 0.07–0.20), but other scores were either unvalidated or had likelihood ratios that were not clinically decisive [9].

An Iranian prospective cohort of 356 patients proposed a new four-item score (presenting symptoms, cardiovascular history, ejection fraction below 50%, and predefined ECG abnormalities) with an AUC of 79.8 for three-month adverse events, outperforming SFSR (66.3), OESIL (72.8), and the ROSE (Risk stratification Of Syncope in the Emergency department) decision support in their population [21]. These results reinforce a recurring theme: rule performance is heavily context dependent, and external validation in the population of intended use is essential before adoption.

Table 1 compares the three most extensively validated rules. Thresholds, populations and endpoints differ, so the rows do not establish instrument superiority or new pooled estimates.

Table 1. Selected operating characteristics of the three most-validated ED syncope decision rules*

Decision rule	Derivation setting	Patients in external validations	Sensitivity (estimate, CI or threshold)	Specificity (estimate, CI or threshold)	Positive likelihood ratio	Negative likelihood ratio	Best-fit use
San Francisco Syncope Rule (SFSR)	US, 2000 s, single center	~5,300 across 12 studies [13]	0.79–0.93 (pooled 0.87; prediction interval 0.55–0.98) [13]	0.43–0.62 (pooled 0.52) [13]	1.15–4.70 [5]	0.03–0.64 [5]	Rule-out after initial evaluation when no cause identified; arrhythmia monitoring essential [13]
Canadian Syncope Risk Score (CSRS)	Canada, six centers, 2010–2014 [17]	5 CSRS validation studies in the inspected review; 14,845 participants is the total across 24 validations of all rules [5]	Threshold-dependent: 97.8% at ≥−1 in Canadian validation; 99.2% at ≥−2 in derivation; 91.9% at ≥0 in recent US validation [10,17,18]	44.3% at ≥−1 in Canadian validation; pooled comparisons have different thresholds [5,10]	1.15–2.58 [5]	0.05–0.50 [5]	Risk stratification of unexplained syncope in adults ≥16 years after initial evaluation; guides disposition but does not establish treatment effect [6,10,17]
OESIL risk score	Italy, Lazio region [14]	~1,500 across 5 studies [5]	Variable; older cohorts may benefit from ≥3 cut-off [20]	Varies by threshold and validation [5]	1.16–3.32 [5]	0.14–0.46 [5]	Useful in older European cohorts; threshold tuning may be required for local case mix [14,20]

*Source/interpretation note: Source-specific citations identify the derivation, validation and pooled estimates. The CSRS and FAINT outcomes in the recent US study differ, and validation thresholds vary. The 14845 total belongs to all-rule validations, not CSRS alone. No new certainty rating or direct cross-study accuracy comparison is supplied [5,18].

Biomarkers: troponin, high-sensitivity troponin, natriuretic peptides

A systematic review of cardiac biomarkers in syncope risk stratification identified 11 studies with 4246 patients and reported pooled sensitivities and specificities for major adverse cardiovascular events of 0.29 (95% CI 0.24–0.34) and 0.88 (95% CI 0.86–0.89) for contemporary troponin, 0.77 (95% CI 0.69–0.85) and 0.73 (95% CI 0.70–0.76) for natriuretic peptides, and 0.74 (95% CI 0.65–0.83) and 0.65 (95% CI 0.62–0.69) for high-sensitivity troponin, concluding that natriuretic peptides and high-sensitivity troponin had the best diagnostic characteristics for both primary and secondary outcomes [7]. The contemporary troponin finding is mechanistically important: a single elevated contemporary troponin alone is sensitive for only 29% of major adverse cardiovascular events, so a normal contemporary troponin cannot reliably rule out serious events [7]. High-sensitivity troponin performs substantially better in sensitivity but at the cost of specificity, and its incremental value over clinical assessment in real-world practice is unclear.

A subsequent prospective study of 1452 patients across six Canadian EDs found that adding NT-proBNP to the CSRS did not significantly improve prognostication (c-statistic 0.89 without NT-proBNP vs 0.90 with NT-

proBNP; p = 0.12 for difference) and that the net reclassification index showed only 3% of patients with serious adverse events correctly reclassified at the cost of 2% of patients without serious adverse events incorrectly reclassified, leading the authors to recommend against routine use of NT-proBNP for ED syncope prognostication [22]. This is consistent with the SAEM GRACE review's broader caution that biomarker augmentation is incremental at best on top of a well-calibrated clinical rule [5]. A practical implication is that elevated high-sensitivity troponin or NT-proBNP should prompt further cardiac investigation, but neither is sufficient or necessary to mandate admission in isolation, and routine biomarker panels for all syncope patients are not supported by current evidence [7,9,22].

Older adults: a population in which the rules underperform

Older adults present particular challenges because syncope is often multifactorial, polypharmacy is common, and a single rule may not capture the additive risk from cognitive impairment, frailty, and prior injury. A single-center cohort study of 404 ED visits in adults aged 60 years or older (mean age 75.5 years) evaluated the SFSR, CSRS, and a modified FAINT score (with NT-proBNP largely unavailable, so the score was effectively FAI(N)T) and reported sensitivities of 86.4% (95% CI 72.0%–94.3%) for the SFSR, 88.6% (95% CI 76.4%–95.7%) for the CSRS, and 90.9% (95% CI 77.4%–97.0%) for the modified FAI(N)T, with negative likelihood ratios of 0.53, 0.50, and 0.53, respectively, leading the authors to conclude that existing rules are suboptimal to predict 30-day serious outcomes in older adults presenting with syncope or near syncope to the ED in that cohort [15]. These conclusions apply to a single-center cohort with 5.9% incomplete 30-day follow-up and should not be generalized to all older-adult ED populations without further validation [15].

A Danish nationwide cohort of 125,763 first-time syncope patients aged 18 years or older (median age 65 years) found a one-year absolute risk of fall-related injury requiring hospitalization of 6.7%, with an absolute risk ratio of 1.79 (95% CI 1.72–1.87) compared with matched controls, and emphasized that increased risk was not confined to older patients, with independent predictors including injury in the past 12 months, injury related to the syncopal event, and depression [23]. These findings highlight that for older adults, prognostic scores capture only one dimension of risk, and that falls, injury, and functional status are independent outcomes that should be incorporated into disposition planning.

Disposition: evidence on admission and detection

A propensity-score-matched analysis of 8183 patients from the CSRS derivation and validation cohorts compared 743 admitted patients with matched discharged controls and found that admission was associated with higher odds of detection of any serious adverse event (OR 5.0, 95% CI 3.3–7.4), nonfatal arrhythmia (OR 5.1, 95% CI 2.9–8.8), and nonarrhythmic serious events (OR 6.3, 95% CI 2.9–13.5), with no significant difference in death (OR 1.0, 95% CI 0.4–2.7) or ventricular arrhythmia (OR 2.0, 95% CI 0.7–6.0) [24]. The association between admission and event detection was greater for patients with medium to high CSRS risk (interaction p = 0.04), reinforcing the principle that admission is most useful for detecting undiagnosed serious conditions when pretest probability is non-negligible and least useful in the CSRS very-low- and low-risk strata [10,24]. The study is observational, and detection associations are subject to residual confounding and differential observation opportunities; the absence of a significant mortality difference should not be read as evidence of safety equivalence between admission and discharge [24].

In a single-center before-and-after study of 1092 admitted syncope patients, intensive education on evidence-based guidelines did not reduce the use of head CT (52.3% vs 55.5%) or MRI (20.2% vs 16.7%), but increased referral for electrophysiology study (6.4% to 11.3%) and increased electrophysiology referral within the structural-heart-disease subgroup from 5.7% to 19.0%, showing a change in referral processes without demonstrating diagnostic yield or patient benefit [25]. The imaging-utilization result is a process measure and does not establish diagnostic yield or outcome benefit of routine head imaging for syncope [25].

A US quality-measure development study used the National Emergency Department Sample (NEDS) to identify a very-low-risk cohort (age below 50 and no history of heart disease) comprising an estimated 566,031 patients, of whom 15,507 (2.7%, 95% CI 2.48%–3.00%) were hospitalized, with a median hospital-level hospital-

ization rate of 1.7% (range 0%–100%, IQR 0%–3.9%) [26]. In the prospective development cohort, 0.46% of this very-low-risk group experienced a 30-day serious adverse event (15 of 3,292), a sparse event count that supports the cohort as a candidate low-value hospitalization target in administrative data but is not, on its own, a validated safe-discharge rule [26]. The NEDS hospitalization data and the prospective outcome cohort are different datasets, and factors such as ED volume above 80,000 per year and metropolitan teaching status were independently associated with higher hospitalization rates, indicating that local context shapes disposition behavior [26].

Driving, falls, and the patient-centered outcomes beyond the composite

Most ED syncope research uses a 30-day composite of death, arrhythmia, myocardial infarction, structural heart disease, pulmonary embolism, hemorrhage, and procedural intervention as the primary outcome [5,6,10,17]. Yet several patient-centered outcomes fall outside this composite and warrant attention.

A systematic review of motor vehicle collision (MVC) risk in syncope patients identified 11 studies of moderate quality with 42,972 patients and reported that prospective MVC risk was 0.0%–0.31% per driver-year for vasovagal syncope (3 studies, 782 patients) compared with 0.49%–2.29% per driver-year in general populations, while arrhythmic syncope carried 1.9%–3.4% per driver-year MVC risk (2 studies, 730 patients), and syncope of undetermined cause was more variable (0.0%–6.9% per driver-year) [27]. The review concluded that vasovagal syncope patients are at very low MVC risk, supporting current guidelines that do not recommend driving suspension for these patients in most cases, while arrhythmic syncope appears to be associated with non-trivial risk and warrants individualized assessment [27]. Driving rules vary by jurisdiction and are not established by international syncope risk-stratification evidence; responsible clinicians must check local driving regulations for any specific patient [27].

The fall-injury association described above adds a longer-horizon patient outcome to short-term cardiac risk assessment [15,23]; it does not establish that a particular fall-prevention intervention improves outcomes after syncope.

Guideline frameworks and the algorithm question

Multiple reviews describe an algorithm in which detailed history, supine and standing blood pressure, ECG, and targeted laboratory tests identify three groups: high-risk (immediate hospitalization and cardiac workup), intermediate-risk (structured syncope unit or outpatient evaluation), and low-risk (discharge with education) [1,2,3,4,8,11,16]. A 2024 narrative review proposed the mnemonic RED-SOS (Recognize syncope; Exclude life-threatening conditions; Diagnose; Stratify the risk of adverse events; Observe; decide on the Setting of care) to operationalize this approach [11]. The ESC framework, as summarized in a 2022 narrative review, places the identification of high-risk features (suggestive of cardiac syncope or serious underlying disease) and low-risk features (consistent with reflex syncope) ahead of any score [1]. A 2014 review noted that despite a decade of decision rules, no single protocol has achieved universal application and that the next essential step is a consensus recommendation integrating scores with structured syncope unit pathways [3,16]. The SAEM GRACE initiative has begun to address this gap by providing GRADE-rated evidence syntheses for use in guideline development, although the certainty of evidence remains low [5].

Table 2 summarizes adjunctive investigations in ED syncope with their evidence-based utility and limits. Imaging is targeted (focal neurology, trauma, concerning presentation, or anticoagulation with head injury) rather than used as an automatic trigger; an abnormal ECG is interpreted in clinical context, including the suspected cause and the patient's stability, rather than used in isolation to mandate admission. Orthostatic vital signs help investigate orthostatic mechanisms but do not by themselves establish a vasovagal diagnosis. The before-and-after education study is a process measure and does not establish diagnostic yield of routine imaging [25].

Table 2. Adjunctive investigations in ED syncope: evidence-based utility and limits*

Investigation	Evidence of prognostic value	Where it shifts management	Limits and pitfalls
12-lead ECG	Universal component of SFSR, CSRS, OESIL, FAINT [5,9,17,18]	Identifies high-risk patients requiring further workup	Should be obtained within initial evaluation; interpretation depends on clinical context, lead set, and timing
Orthostatic vital signs	Standard in initial assessment per ESC and RED-SOS [1,11]	Helps investigate orthostatic mechanisms; interpret with symptoms and clinical history	Sensitivity for predicting 30-day events not formally established; reproducibility of drop thresholds is variable
Contemporary troponin	Pooled sensitivity 0.29, specificity 0.88 for MACE [7]	Identifies patients needing ACS workup	Cannot rule out serious events in isolation; missing data sometimes treated as normal in CSRS derivation [17]
High-sensitivity troponin	Pooled sensitivity 0.74, specificity 0.65 for MACE [7]	Better sensitivity for short-term events than contemporary assay	Specificity loss; clinical implications of minimally elevated values unclear
NT-proBNP	Improves CSRS only marginally (c-statistic 0.89 vs 0.90; NRI 3% correct reclassification at 2% incorrect) [22]	Not recommended for routine use; consider in selected cardiac-suspicion cases	Adds cost without clear outcome benefit; do not use as a stand-alone disposition trigger [9,22]
Head CT / MRI	No reduction in use after intensive guideline education (52.3% vs 55.5% for CT) [25]	Indicated for focal neurology, trauma-associated loss of consciousness, or anticoagulation with concerning head injury, not for routine syncope workup	Education study assessed utilization, not a definitive imaging-selection rule; clinical indications remain necessary [4,11,25]
Carotid sinus massage, tilt-table, electrophysiology study	ESC-endorsed cause-specific tests for suspected reflex or arrhythmic syncope [1]	Referral rate for EPS increased from 6.4% to 11.3% after education without overuse of device therapy [25]	Should be ordered based on initial evaluation, not as screening; some require specialist setting

*Sources: systematic review of biomarkers [7]; NT-proBNP augmentation study [22]; CSRS derivation and validation [10,17]; ESC framework summary [1]; SAEM GRACE systematic review [5]; before-and-after education study [25]; unexplained-syncope systematic review [9]; RED-SOS narrative review [11]. No new aggregate effect estimates are produced; rows are summarized qualitatively from the cited evidence.

Prediction evidence and the care decision

The comparisons already described show why a uniform hierarchy of scores is misleading. A low negative likelihood ratio can be useful at one threshold and population, yet uncertain at another. It is not itself a discharge threshold: baseline risk, the outcome to avoid and follow-up arrangements also matter [5,9]. The recent US FAINT sensitivity advantage concerns cardiac outcomes, whereas CSRS assessed any serious outcome [18]. This qualifies blanket claims that no score can outperform judgment on any metric, without establishing improved care from either score.

An impact study should define how the score changes management and measure resulting benefits and harms. A score may provide a shared language for risk, but documentation consistency is different from avoided mortality, fewer readmissions or safer discharge. Structured clinical assessment is a meaningful comparator and should be distinguished from an unspecified usual-care pathway [1,10,17,26].

Saudi applicability: cautious interpretation and research priorities

A critical narrative review tailored to a Saudi readership must avoid claiming local validation, outcome improvements, national burden, or institutional endorsement that the source evidence does not support. None of the cited primary studies or systematic reviews were conducted in Saudi Arabia, and the case mix, ED throughput, comorbidity prevalence, climate, and pilgrimage-related mass gatherings may plausibly alter the distribution of

syncope mechanisms and disposition thresholds. The variables below are framed as targets of investigation, not as established local facts.

First, local validation could assess discrimination and calibration separately, recording age, comorbidity, event circumstances and follow-up access. Lower AUC in an external cohort does not alone prove calibration failure or establish the suitability of a local disposition pathway [6,10,12,17,18,19].

Second, the two-variable candidate hospitalization metric could be audited locally with reliable outcome follow-up. Its sparse prospective events and separate administrative utilization data must remain distinct; it is not a stand-alone discharge rule [26].

Third, selected observation-unit reports offer designs for local appraisal: an Italian short-stay observation ward achieved a mean length of stay of 3.5 days and a definite diagnosis in 60% of patients, with non-cardiogenic syncope being the most common etiology [14]. Any local evaluation would first document staffing, monitoring and follow-up capacity. The Italian single-center report does not establish Saudi pathway feasibility or benefit [14].

Fourth, comparisons should prespecify whether procedural interventions count as outcomes and compare score-guided care with structured clinician judgment [6,10,17]. The BASEL IX clinician-classification result is already informative without repeating its numerical estimates as evidence of an implementation effect.

Fifth, selective investigations and process measures require evaluation. The admitted-patient education study changed electrophysiology referrals without demonstrating imaging benefit [25]. Nursing triage alone had sensitivities of 21% for in-ED and 15% for 10-day events in one study, insufficient to establish an independent disposition gate [28]. Biomarker evidence should guide targeted questions rather than universal panels [7,22].

Table 3 frames research priorities for syncope risk assessment in a Saudi ED context as proposals requiring local evaluation, not as established or presumed safe implementations. Items are designed to be tested rather than adopted; no implementation outcomes, adoption rates, or institutional endorsement are claimed.

Table 3. Research priorities for syncope risk assessment in a Saudi ED context*

Priority	Rationale from cited evidence	Feasibility and design considerations
Prospective local validation/calibration of the CSRS	International validations show modest loss of discrimination (AUC 0.72–0.85) and possible case-mix effects [6,12,18,19]	Multicenter prospective cohort with adjudicated 30-day outcomes; sample size powered for sensitivity at low-risk threshold; compare with structured physician gestalt; consider locally justified updating only after validation
Pragmatic two-variable low-risk identification (age <50, no heart disease)	US NEDS-based quality measure identified a cohort with 0.46% serious event rate and substantial admission variation [26]	Could be implemented as a quality-improvement audit before more complex rule adoption; requires local outcome follow-up; not a validated safe-discharge rule
Head-to-head CSRS vs FAINT vs physician gestalt in older Saudi adults	CSRS and FAINT validated in US adults ≥40 with FAINT outperforming gestalt for cardiac outcomes only [18]; older-adult cohort showed SFSR, CSRS, and FAI(N)T all suboptimal [15]	Single-center or multicenter cohort; pre-specified subgroup analysis by age, comorbidity, and frailty; NT-proBNP availability required for full FAINT
Cost and admission impact of CSRS-guided disposition vs usual care	CSRS validation suggested potential to reduce admissions in very-low/low-risk patients but impact study is lacking [10,26]; admission associated with greater event detection in medium/high risk but with residual confounding [24]	Cluster-randomized or stepped-wedge implementation trial; primary outcome admission rate; secondary outcomes 30-day events, length of stay, cost; account for differential observation opportunities

Priority	Rationale from cited evidence	Feasibility and design considerations
Biomarker strategy in patients with intermediate CSRS	NT-proBNP adds little over CSRS in Canadian cohorts [22]; high-sensitivity troponin has better sensitivity but lower specificity [7]	Nested prospective study within local validation cohort; pre-specified thresholds; adjudication blinded to biomarker
Driving and post-syncope functional outcomes	Vasovagal syncope has very low MVC risk; arrhythmic syncope is higher [27]; fall-related injury risk is elevated for at least one year, not only in older adults [23]	Local cohort with license-holding subgroup analysis; collaboration with driving authority; one-year fall-related injury follow-up; local driving rules must be checked by responsible clinicians
Evaluation of ED observation or syncope unit pathways	Italian observation ward achieved 3.5-day mean stay and definite diagnosis in 60% [14]	Before-and-after or stepped-wedge design; pre-specified process and outcome metrics; cost capture; single-center evidence does not generalize

*Sources: international CSRS validation [6]; Italian CSRS validation [12]; US multicenter validation [18]; Australian CSRS validation [19]; older-adult cohort [15]; quality measure study [26]; admission benefit study [24]; NT-proBNP study [22]; biomarker systematic review [7]; fall-injury cohort [23]; MVC systematic review [27]; Italian observation ward study [14]. No implementation outcomes, adoption rates, or institutional endorsement are claimed; rows are designed to be evaluated rather than presumed.

Limitations of this review and of the underlying evidence

This is a focused narrative review, not a systematic review or new empirical study. The PubMed retrieval was designed to be relevant rather than exhaustive, no protocol was registered, no dual human extraction was performed, and no formal pooled effects or GRADE certainty ratings are produced. Several source-level limitations recur across the cited evidence and should temper any implementation claim.

First, syncope definitions are inconsistent across studies, and distinguishing syncope from other causes of transient loss of consciousness (seizure, pseudosyncope, head trauma) is inherently difficult; misclassification can shift operating characteristics in either direction [5]. Second, methodological quality of both derivation and validation studies is variable, with many lacking 2×2 tables, sample size justification, or blinding of predictors and outcomes [5,9]. Third, the incidence of composite outcomes ranges from 2.1% to 51.4% across studies, suggesting selection bias, differential verification, and outcome heterogeneity, which complicate cross-rule comparison [5]. Fourth, follow-up is typically under 30 days, so the findings of most CDRs apply to short-term outcomes only, and the longer-term prognostic implications for driving, falls, and quality of life are derived from separate cohorts [5,23,27]. Fifth, the operating characteristics reported for any single rule depend on the threshold chosen, the local admission threshold, and the availability of biomarker and imaging data, and external calibration to a new population is not guaranteed [5,6,10,12,17,18]. Sixth, the selected validation and synthesis records do not establish that CSRS-guided management improves patient outcomes compared with structured clinical judgment, so implementation should be paired with evaluation rather than assumed to be beneficial [5,10,18].

The BASEL IX abstract reports 19 of 1,388 low-risk composite events alongside 0.6%, an arithmetic inconsistency. The same published report's main results and Table 5 report 15 of 1,388 (1.1%) for the primary composite, and 9 of 1,388 (0.6%, as reported) for the composite excluding procedural interventions [6]. The abstract-to-full-text discrepancy remains for source-author clarification; these descriptive findings do not establish clinical safety or a locally validated disposition rule.

Proposed syncope assessment and prognostic score sequence

Figure 2 illustrates a qualitative sequence showing where prognostic scores fit after adult emergency-department syncope assessment.

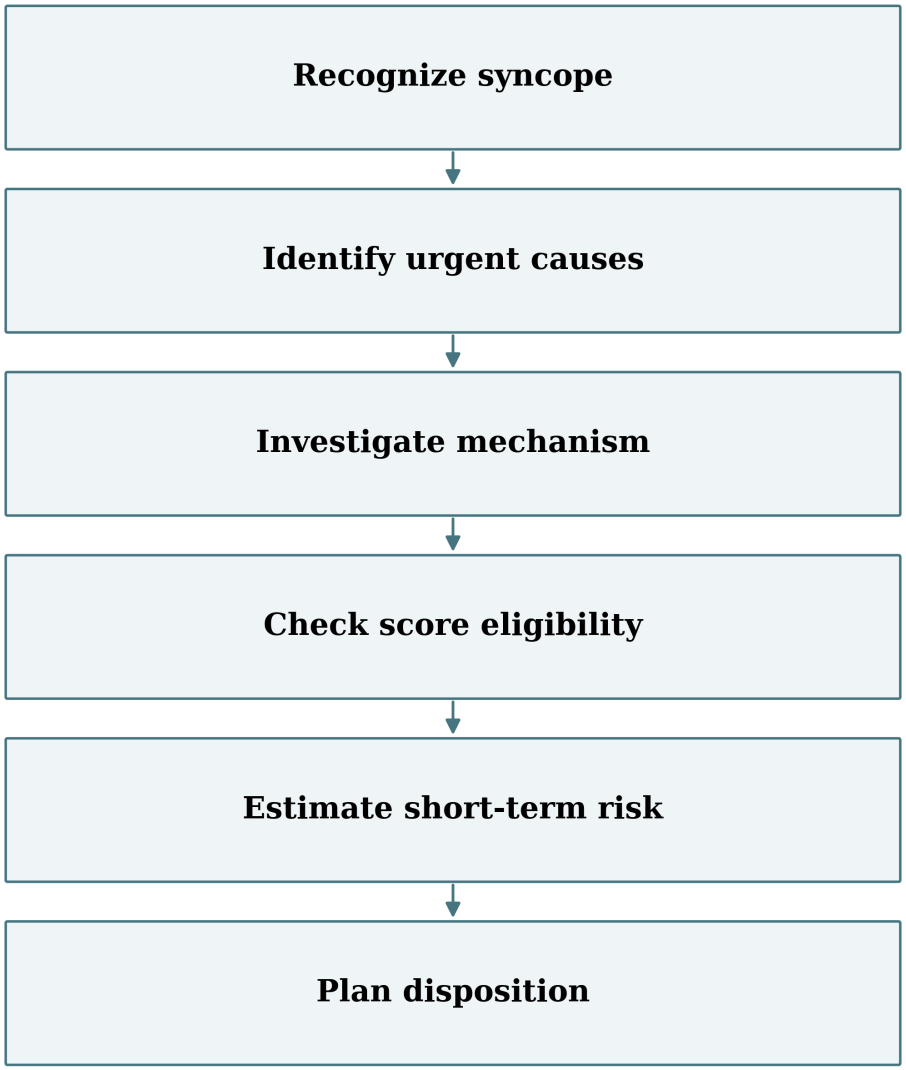


Figure 2. A qualitative sequence showing where prognostic scores fit after adult ED syncope assessment. An identified serious cause directs its own management and is not bypassed by a low score. Score discrimination, calibration and patient benefit are separate questions; the sequence does not claim that scoring or admission causes improved outcomes. No effects, thresholds, local adoption or safe-discharge guarantees are measured in this figure.

Source and interpretation note for Figure 2. Qualitative synthesis only. No measured effects, patient counts, scores or locally observed benefits. Sources [10,5,6]; Initial assessment, score applicability and endpoint distinctions in Tables 1–3.

Conclusion

Risk assessment begins with clinical evaluation and recognition of serious causes before prognostic scoring. The CSRS has substantial validation, but international and older-adult results show why thresholds, endpoints and case mix must accompany any performance claim [5,10,15,17,18]. SFSR and OESIL provide additional evidence with heterogeneity rather than universal disposition rules.

Biomarker augmentation and admission-detection associations do not establish patient benefit from score-guided care. Falls and driving outcomes require additional assessment, including jurisdiction-specific driving rules [23,27]. Saudi evaluation can test local calibration, comparison with structured judgment and observation pathways, while measuring outcomes and service consequences. This narrative supplies an appraisal of those questions without claiming a validated local pathway or an original quantitative synthesis.

Declarations

Ethics and consent. This focused narrative review synthesizes published material and reports no new recruitment, intervention or patient-level data collection. No ethics approval, exemption or consent waiver is claimed.

Data availability. The cited PubMed metadata and abstracts are public. Full-text accessibility and reuse rights depend on each source. The focused search receipts and source-verification records are retained in the author-side work archive. No new patient dataset was created.

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