

REVIEW ARTICLE

Evaluating the triage risk screening tool with a cutoff score of ≥ 2 for identifying elderly inpatients at risk of 30-day unplanned emergency department readmissions: a systematic review and meta-analysis

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ABSTRACT

Background: Unplanned emergency department (ED) readmissions within 30 day remain a major challenge in geriatric care, contributing to increased morbidity, mortality, and healthcare utilization. The triage risk screening tool (TRST) is frequently used to identify older adults at risk of adverse outcomes. However, its predictive accuracy at the conventional cutoff score of ≥ 2 remains uncertain, raising concerns about its standalone reliability. To systematically evaluate the diagnostic performance of the TRST (cutoff ≥ 2) in identifying elderly inpatients at risk of unplanned 30-day ED readmissions.

Methods: A systematic review and meta-analysis were conducted in accordance with Preferred Reporting Items for Systematic Reviews and Meta-Analyses 2020 guidelines. Searches were performed in PubMed, Scopus, Embase, Web of Science, and the Cochrane Library. Eligible studies included cohort designs assessing the TRST in adults aged ≥ 65 years for predicting 30-day unplanned ED readmissions. Pooled estimates of sensitivity, specificity, diagnostic odds ratio (DOR), and likelihood ratios were obtained using a random-effects bivariate model.

Results: Six studies with a total of 5,638 participants met the inclusion criteria. The pooled sensitivity was 0.705 [95% confidence intervals (CI): 0.612-0.783], and specificity was 0.443 (95% CI: 0.332-0.561), indicating moderate sensitivity but low specificity. The DOR was 1.902 (95% CI: 1.016-3.562), with likelihood ratios (positive likelihood ratio = 1.27, negative likelihood ratio = 0.67) suggesting limited discriminatory ability. Substantial heterogeneity was observed ($I^2 = 78.9\%$ for sensitivity; 97.5% for specificity), reflecting variability between studies.

Conclusion: The TRST at a cutoff score of ≥ 2 demonstrates moderate sensitivity but low specificity for predicting 30-day unplanned ED readmissions in older adults. While it may be useful as an initial screening tool, its clinical value is maximized when integrated into comprehensive geriatric assessments and structured transitional care programs to enhance prediction accuracy and reduce preventable readmissions.

Keywords: Triage risk screening tool, TRST, elderly, emergency department, readmission, diagnostic accuracy, systematic review, meta-analysis.

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Introduction

Older adults account for a substantial proportion of emergency department (ED) visits, representing approximately 20%-41% of all emergency presentations worldwide [1]. With the continuing growth of the aging population, the demand for emergency care services among older adults is expected to increase further in the coming years [2]. There is also a 12% to 20% chance of patients aged 65 and older returning to the emergency room after discharge [3], and with the increasing number of patients, the need for a medical triage tool has become urgent and important, as it identifies critical cases and prioritizes them [1].

One such tool is the triage risk screening tool (TRST). It is a screening tool that categorizes elderly patients in emergency rooms as high risk [4]. In this tool, a score of ≥ 2 indicates an increased risk of functional decline. It has demonstrated moderate sensitivity and specificity in predicting hospital readmission [3,5].

Previous studies have evaluated the predictive performance of the TRST, particularly using a cutoff score of ≥ 2 , by assessing its sensitivity, specificity, and overall prognostic accuracy for adverse outcomes among older adults in the ED. Several studies reported that the TRST demonstrated good sensitivity for identifying high risk elderly patients, supporting its use as a practical screening and risk stratification tool [6]. However, other investigations found relatively low specificity and inconsistent predictive performance across different healthcare settings and patient populations, limiting its generalizability and clinical utility [7,8]. Despite these conflicts, a systematic review and meta-analysis is needed to synthesize the existing evidence and determine whether TRST with a cutoff score of ≥ 2 is a reliable tool for predicting 30-day unplanned ED readmissions in the elderly.

Therefore, this systematic review aimed to evaluate the diagnostic accuracy and clinical usefulness of the TRST (cutoff ≥ 2) in determining elderly patients who have unplanned ED readmissions within 30 day of admission. The results may provide clinicians, hospital administrators, and policymakers with evidence-based guidance for including TRST into discharge planning and transitional care protocols.

Methods

Protocol and registration

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines were followed in the making of this systematic review [9].

Study selection

We searched five databases, which included Scopus, Cochrane, Web of Science, Embase, and PubMed. Our search strategy combined words that are associated with our research questions. These words are present in Table S1. We reviewed the reference list to ensure that we included all relevant studies based on our inclusion and exclusion criteria.

Inclusion and exclusion criteria

We included studies that evaluated the TRST in elderly patients (with or without comparison to other triage or risk stratification tools) and reported diagnostic accuracy outcomes for 30-day unplanned ED readmission, including sensitivity, specificity, area under the curve, positive predictive value, and negative predictive value. We excluded studies that were case reports, reviews, letters, or book chapters, as well as studies that did not use the TRST or applied a cutoff other than ≥ 2 .

Data extraction

First, titles and abstracts were screened for relevance to the research question. Full texts were screened afterward. The data extraction were done on an extraction sheet that was adapted to the objectives of this study. The extracted variables were sensitivity, specificity, area under the curve, positive predictive value, and negative predictive value from the included studies.

Statistical analysis

A diagnostic test accuracy meta-analysis was conducted to evaluate the predictive performance of the TRST for 30-day hospital readmission among elderly patients at a predefined cutoff value of ≥ 2 . Pooled estimates of sensitivity and specificity, along with their corresponding 95% confidence intervals (CIs), were calculated using a bivariate random-effects model, which accounts for the potential correlation between sensitivity and specificity across studies. Summary measures of diagnostic performance were derived, including the diagnostic odds ratio (DOR), positive likelihood ratio (LR+), and negative likelihood ratio (LR-). These metrics were used to quantify the overall discriminatory ability of the TRST. A summary receiver operating characteristic (SROC) curve was constructed, and the area associated with the 95% prediction ellipse was reported to reflect the expected dispersion of true study effects.

Heterogeneity across studies was assessed using multiple complementary approaches. Variance components for logit-transformed sensitivity and specificity were estimated to evaluate between-study variability. The median odds ratio was calculated to provide an interpretable measure of heterogeneity on the odds ratio scale. Statistical inconsistency was quantified using the I^2 statistic, with higher values indicating substantial heterogeneity. All analyses were performed using Meta-Disc (version 2.0; Clinical Biostatistics Unit, Hospital Universitario Ramón y Cajal, IRYCIS, Madrid, Spain) [10], which is specifically designed for diagnostic test accuracy meta-analysis. A random-effects framework was applied throughout to account for clinical and methodological diversity among the included studies.

Quality assessment

The National Institutes of Health (NIH) quality assessment tool was used to assess risk of bias in the included studies. The NIH quality assessment tool evaluates the reliability of the study design and the validity of its reports.

Results

Search results

A total of 804 records were identified across databases: PubMed ($n = 308$), Cochrane Library ($n = 12$), Scopus ($n = 256$), Embase ($n = 157$), and Web of Science ($n = 71$). After removing 416 duplicates, 388 unique records remained for title and abstract screening. Of these, 378 were excluded based on the prespecified eligibility criteria. Ten full-text reports were assessed for eligibility, with four excluded for reporting the wrong outcome. Ultimately, six studies met the inclusion criteria and were included in the review [3,5,8,11-13]. The identification, screening, and inclusion flow are summarized in Figure 1, following PRISMA 2020 guidance.

Characteristics of the included studies

The review included six studies; five of them were prospective cohort studies, while the last one was a

historical cohort study. The total sample comprised 5,638 participants, with sample sizes ranging from 83 to 2,057 individuals per study. Participants' mean age ranged from 74.4 to 83.9 years. All studies evaluated the predictive ability of various screening tools [Identification of seniors at risk (ISAR), TRST, variable indicative of placement (VIP), Rowland, and Runciman] for identifying older adults at risk of unplanned readmissions or health-related events following an ED visit. The follow-up durations varied, ranging from 30 day to 12 months (Table 1).

Quality assessment

The risk of bias for the six included cohort studies was appraised using the NIH quality assessment tool for observational cohort and cross-sectional studies. Based on the tool's criteria, all six studies were judged to be of good methodological quality, indicating a low overall risk of bias. A study-by-study summary of the appraisal, including item-level judgments and overall ratings, is provided in Table S2.

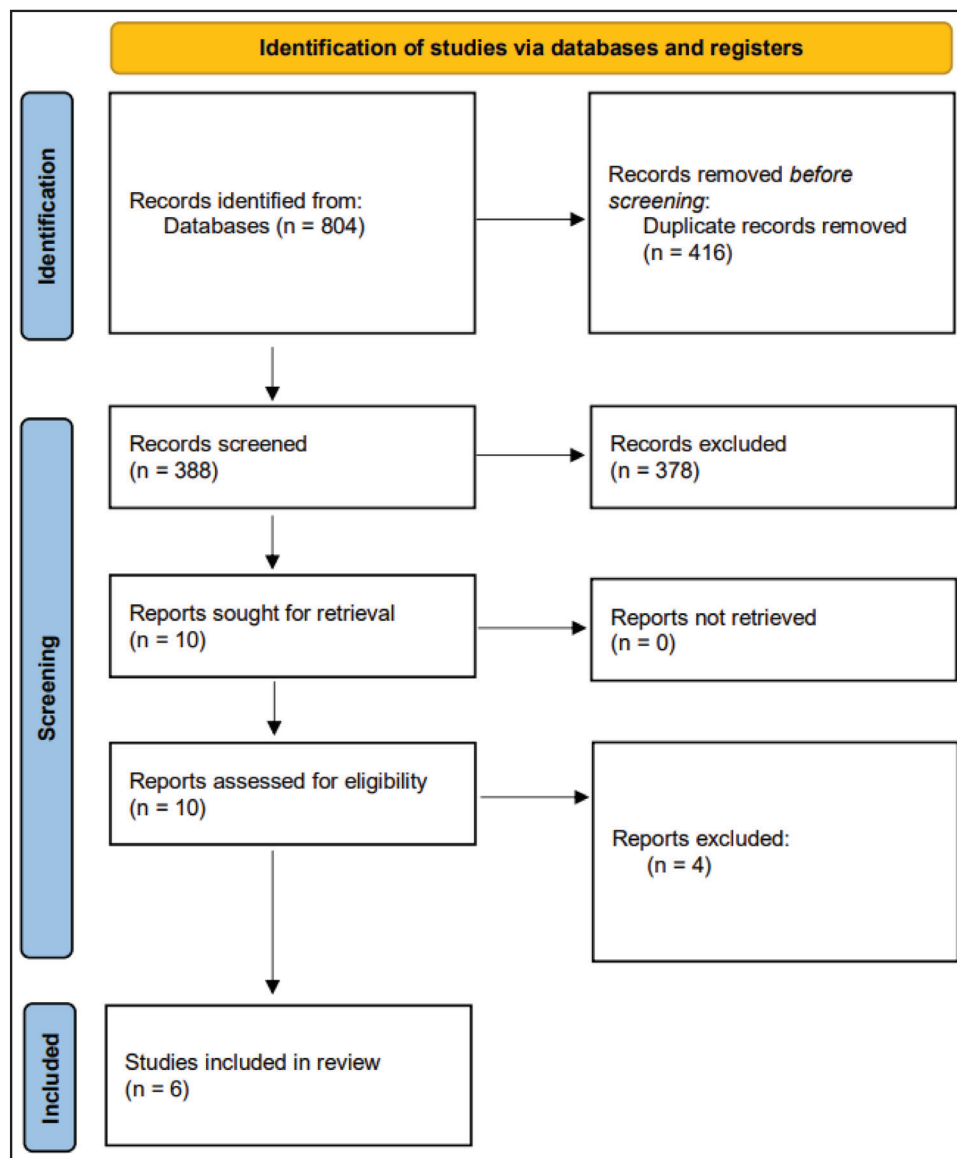


Figure 1. Flow chart of the selection process.

Table 1. Baseline characteristics of included studies.

Study ID	Country	Study design	Sample size (n)	Age	Gender distribution (M/F)	Tool/instruments used	Follow-up duration	Readmission rates reported	Aim	Conclusion
Braes et al. [13]	Belgium	Prospective cohort	213	≥65 years	106/ 107	ISAR, TRST, VIP	at 14, 30, 90 days	6.8%, 14.7%, and 23.5% readmission rates at 14, 30, and 90 days	We compared the predictive accuracy of the ISAR, the Flemish version of the TRST, and VIP risk in assessing unplanned readmissions.	Due to their moderate to low sensitivity, and low specificity and positive predictive value, none of the instruments was capable of accurately predicting unplanned readmission in older, hospitalized patients.
Meldon et al. [11]	USA	Prospective cohort	647	74.4± 6.9	262/ 385	TRST	at 30 and 120 days	26%, 48% at 30, 120 days	To evaluate the predictive ability of a simple six-item TRST to identify elder ED patients at risk for ED revisits, hospitalization, or nursing home (NH) placement within 30 and 120 days following ED discharge.	Older ED patients with two or more risk factors on a simple triage screening tool were found to be at significantly increased risk for subsequent ED use, hospitalization, and nursing home admission.
Moons et al. [3]	Belgium	Prospective cohort	83	Median: 74 years	38/45	ISAR, TRST, Rowland, Runciman	at 14, 30, 90 days	Readmission rates were 10%, 15.8%, 32.5% after 14, 30, 90 days	To compare the abilities of four different screening tools to predict return visits of older persons after they have been discharged from the ED.	Repeat visits in older persons admitted to an ED seemed to be most accurately predicted by using the Rowland questionnaire, with an acceptable number of false positives. This instrument can be easily integrated into the standard nursing assessment.
Salvi et al. [5]	Italy	Prospective observational study	2057	81.7 ± 7.7	824/ 1233	ISAR, TRST	6 months	10% of ISAR-negative 21% of ISAR-positive 11% of TRST-negative / 21% of TRST-positive at 30 day. 32% of ISAR-negative / 46% of ISAR-positive patients. 32% of TRST-negative / 47% of TRST-positive patients after 6 months.	This study aimed to compare the ISAR and TRST, based on direct patient evaluation.	Risk stratification of elderly ED patients with ISAR or TRST is substantially comparable for selecting elderly ED patients who could benefit from geriatric interventions. ISAR had slightly higher sensitivity and lower specificity than TRST.
Graf et al. [8]	Switzerland	Historical cohort study	345	83.9 ±5.7	128/ 217	ISAR, TRST	at 1, 3, 6, 12 months	Readmission rates were 25%, 38%, 49%, and 60% at 1, 3, 6, and 12 months	The ISAR and the TRST are the two most studied screening tools to detect high-risk patients for unplanned readmission after an ED-visit. Their performance was unclear among ED patients over 75 years.	1- Both ISAR and TRST tools predicted modestly unplanned readmission after an ED-visit among patients over 75 years. 2- Nevertheless, due to their low specificity and high NPV these screening tools are useful to select elderly ED-patients who can safely return home without any further CGA.
Lee et al. [12]	Canada	Prospective observational study	788	Mean: 76.6 years	329/ 459	TRST	at 30, 120, 365 days	18.7% readmission by 30 days, 31.1% at 120 days, and 43.9% by 365 days	To assess the predictive validity of the TRST to identify return to the ED or hospitalization in a multicenter patient sample.	1- The TRST demonstrated only moderate predictive ability, and ideally, a better prediction rule should be sought. 2-Future studies to develop better prediction rules should compare their performance with that of existing prediction rules, including the TRST and Identifying Seniors at Risk tool, and assess the effect of any new prediction rule on patient outcomes

Meta-analysis

The meta-analysis evaluating the role of the TRST in predicting 30-day hospital readmission among elderly patients at a cutoff value ≥ 2 demonstrated modest diagnostic performance. The pooled sensitivity was estimated at 0.705 (95% CI: 0.612-0.783), suggesting that the tool was able to correctly identify approximately 70% of older adults at risk of readmission (Figure 2). However, the specificity was considerably lower at 0.443 (95% CI: 0.332-0.561), indicating a relatively high false-positive rate (FPR = 0.557) (Figure 3).

The DOR was 1.902 (95% CI: 1.016-3.562), reflecting limited overall discriminatory power. Similarly, likelihood ratios (LR+ = 1.266; LR- = 0.666) highlighted that the TRST tool only slightly increased or decreased the probability of readmission, respectively. The SROC curve (Figure 4) demonstrated a wide 95% prediction ellipse, reflecting substantial between-study heterogeneity in test performance.

Assessment of heterogeneity demonstrated substantial between-study variability. The estimated variances were 0.182 for logit-transformed sensitivity and 0.327 for logit-transformed specificity. Correspondingly,

substantial inconsistency was observed, with I^2 values of 78.9% for sensitivity and 97.5% for specificity.

Discussion

In the meta-analysis focused on the TRST at a cutoff ≥ 2 for predicting 30-day readmission, the pooled sensitivity was moderate (0.705), whereas specificity was low (0.443), yielding a high FPR (0.557). The overall discriminatory ability was limited (DOR = 1.902), and likelihood ratios were only modest (LR+ = 1.266 and LR- = 0.666). Between-study inconsistency was substantial (I^2 = 78.9% for sensitivity and 97.5% for specificity), indicating notable variability in diagnostic estimates. These results show that while TRST ≥ 2 identifies many older adults who will experience 30-day readmission, it does so at the cost of many false positives, limiting its stand-alone clinical usefulness in the ED setting.

Our pooled estimates for TRST at a cutoff ≥ 2 (sensitivity 0.705; specificity 0.443; LR+ 1.27; and LR- 0.67) align closely with prior syntheses showing only modest discriminatory value of brief ED screening tools for older adults. In their meta-analysis of instruments validated in ED settings, Carpenter et al. [14] reported LR+ values generally near 1.0-1.4 and LR- = 0.5-1.1 for TRST, ISAR,

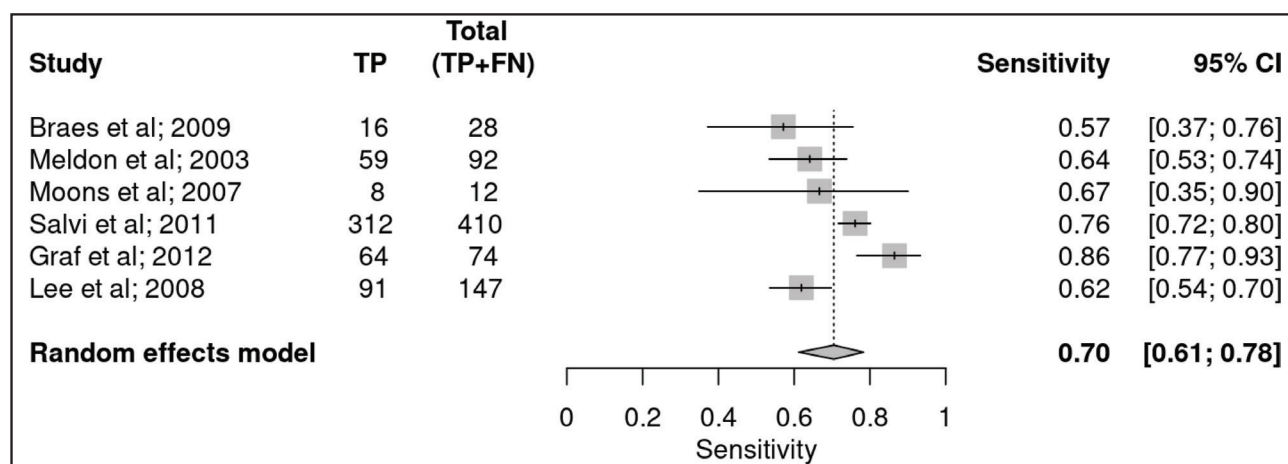


Figure 2. Sensitivity of the TRST for predicting 30-day readmission.

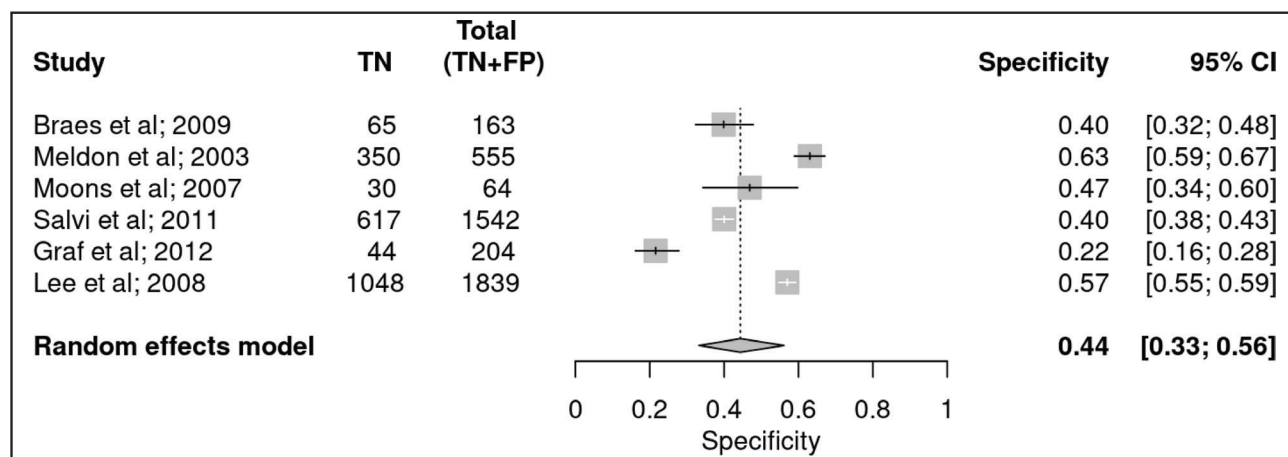


Figure 3. Specificity of the TRST for predicting 30-day readmission.

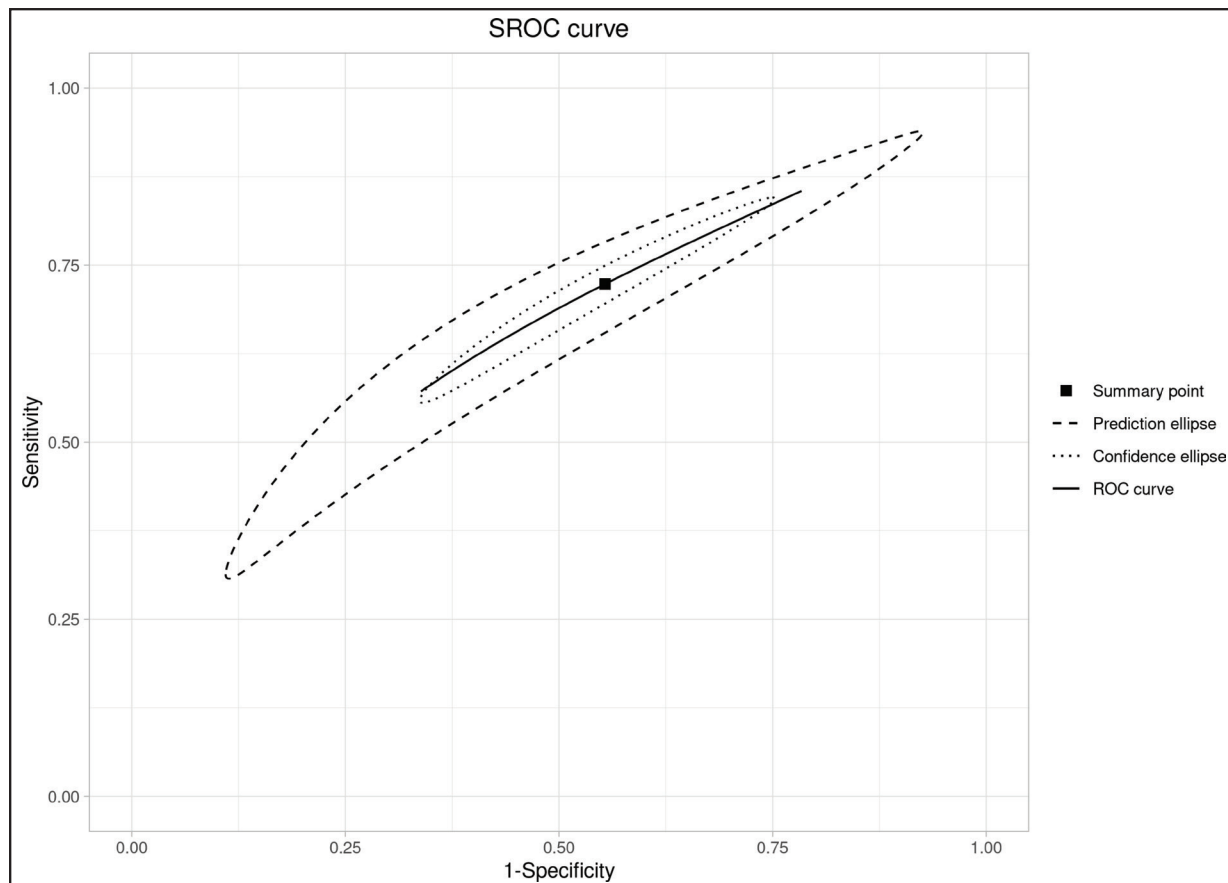


Figure 4. SROC curve.

and VIP, concluding that these tools do not accurately distinguish high- from low-risk patients, which is squarely consistent with our findings. Heterogeneity across studies in that review was substantial, as in our analysis. Single-center cohort studies comparing TRST with ISAR have repeatedly described modest Areas Under the Receiver Operating Characteristic Curves (~ 0.59 - 0.66) for readmission or ED return, with ISAR tending to be slightly more sensitive and TRST slightly more specific, again mirroring our summary sensitivity/specificity pattern and the tradeoff we observed. Graf et al. [8] found AUCs 0.607 - 0.664 and emphasized low specificity with comparatively high Negative Predictive Value (NPV); Salvi et al. [5] likewise reported similar AUCs for early ED revisit and 6-month outcomes, noting ISAR's higher sensitivity but lower specificity than TRST.

The limited specificity we observed for TRST (≈ 0.44) is consistent with the broader literature's recurring signal of over-identification/false positives for brief screens. For example, in a prospective historical cohort over age 75, both ISAR and TRST showed "modest" prediction with low specificity but high NPV; clinically, this has been interpreted as better at ruling out than ruling in. Similarly, Braes et al. [13] documented low PPVs and low-to-moderate specificities for TRST across 14-90 days ($\leq 45\%$) and reported that shifting cutoffs by one point did not meaningfully improve performance [13]. With respect to alternative tools, pooled evidence indicates

that ISAR typically achieves higher sensitivity at the expense of specificity. Galvin et al. [15]'s ISAR meta-analysis (score ≥ 2) found pooled sensitivities around 0.80 - 0.87 for returns, hospitalizations, and mortality at 6 months, with specificities around 0.31 - 0.35 - i.e., even lower specificity than our TRST summary, supporting use as a discharge-safety adjunct rather than a stand-alone rule-in test. VIP tends toward the opposite tradeoff: relatively high specificity but very low sensitivity. In older inpatients admitted via the ED, VIP showed specificity $\geq 80\%$ but sensitivity $\leq 26\%$ for unplanned readmission, yielding high NPVs and low PPVs, characteristics that risk missing many at-risk patients if VIP is used alone. Earlier development work suggested VIP was simple and sensitive for "adverse outcome" more broadly, but ED readmission-focused comparative studies have not borne out strong sensitivity [13,16].

These results are generally in line with those of the previous systematic review and meta-analysis done by Cousins et al. [6], who also studied the predictive capabilities of the TRST among elderly discharged from an ED. In their study, the sensitivity and specificity of the tool in predicting adverse outcomes within 30 days were 0.58 and 0.61 , respectively, also showing that the discriminatory capacity of the tool is rather limited at a cutoff ≥ 2 . Similarly, low c-statistics for all the different adverse outcomes were noted, and the authors concluded that there is very limited ability of the tool in distinguishing patients who would and would not suffer adverse effects.

However, in this study, we have extended the findings to 30-day ED readmissions, which show similar sensitivity (0.705) and very low specificity (0.443).

Findings for the older Rowland and Runciman questionnaires are mixed and less extensively validated. In a small ED cohort ($n = 83$), the Rowland tool showed promising short-term performance (14-day sensitivity 88%, specificity 72%), but performance attenuated by 30 day and has not been widely replicated; broader cohorts comparing Rowland and Runciman with ISAR and TRST reported uniformly low AUCs (≈ 0.43 - 0.60). These data position Rowland/Runciman as historical comparators rather than contemporary alternatives [3,17].

In recent years, there have been no universally endorsed international guidelines recommending the routine use of TRST or ISAR as stand-alone tools in the ED. Instead, the prevailing direction in the literature emphasizes integrating early screening with comprehensive geriatric assessment (CGA) and structured transitional care programs. For example, recent work implementing mobile geriatric teams in France showed that the most effective approach begins with rapid screening in the ED, followed by a full geriatric evaluation and coordinated care planning across hospital and community settings [18]. Similarly, a recent meta-analysis confirmed that CGA significantly reduces both readmissions and mortality compared with usual care in older populations, reinforcing its place as the gold standard of geriatric management [19].

This review has several important limitations that should be considered when interpreting the findings. First, only six studies met the inclusion criteria, which limits the robustness of the pooled estimates and reduces the generalizability of the results. Second, the analysis was based exclusively on published data, introducing the possibility of publication bias, particularly if studies with negative or non-significant findings were less likely to be reported. Third, substantial heterogeneity was observed in diagnostic accuracy measures, most notably for specificity, likely reflecting differences in study populations, clinical settings, follow-up durations, and outcome definitions across the included studies. Finally, although several screening tools were identified in the eligible studies, only the TRST provided sufficient data for quantitative synthesis.

Despite these limitations, the findings have important clinical implications. A TRST threshold of ≥ 2 appears to provide moderate sensitivity for identifying older adults at risk of 30-day readmission, suggesting it may be more useful for ruling out low-risk patients rather than confidently ruling in high-risk cases. However, its limited specificity results in a substantial number of false positives, meaning that many patients classified as “high risk” will not experience adverse outcomes. Therefore, the TRST should not be used as a standalone decision-making tool. Instead, it should be integrated with clinical assessment and additional validated risk predictors to improve overall prognostic accuracy. In clinical practice, TRST may be most valuable as an initial screening tool to identify patients who may benefit from enhanced discharge planning, closer post-discharge follow-up, or

transitional care interventions, where the consequences of over-identification are less harmful than missing truly high-risk individuals.

Conclusion

The findings indicate that while the TRST demonstrates moderate sensitivity, its poor specificity limits its standalone value for predicting 30-day readmissions in older ED patients. High heterogeneity across studies underscores the need for cautious interpretation. Current evidence supports using the TRST as an initial screening instrument, followed by formal CGA for patients who screen positive, to better characterize risk and guide targeted interventions. Integrating TRST within structured transitional care pathways may enhance post-discharge planning and potentially reduce avoidable readmissions.

List of Abbreviations

AUC	area under the curve
CGA	comprehensive geriatric assessment
CI	confidence interval
DOR	diagnostic odds ratio
ED	Emergency Department
ISAR	identification of seniors at risk
LR-	negative likelihood ratio
LR+	positive likelihood ratio
NIH	National Institutes of Health
NPV	negative predictive value
PPV	positive predictive value
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SROC	summary receiver operating characteristic
TRST	triage risk screening tool
VIP	variable indicative of placement

Conflict of interest

None.

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Consent to participate

Not applicable. This study is a systematic review and meta-analysis based on previously published studies and did not involve direct participation of human subjects.

Ethical approval

Ethical approval was not required because this study is a systematic review and meta-analysis of previously published data.

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Supplementary content (If any) is available online.

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