Cureus
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Open Access Original Article

External Evaluation of an Adapted FAINT Score for Short-Term Adverse Events in Older Adults Presenting With Syncope: A Single-Center Retrospective Cohort Study From North Carolina

Review began 08/22/2026
Review ended 10/25/2026
Published 11/08/2026

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DOI: 10.7759/cureus.119312

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Abstract

Background

Risk stratification of syncope in older adults remains challenging in the emergency department (ED). The FAINT score was developed for adults aged ⩾60 years, but external validation remains limited.

Objectives

To evaluate the performance of an adapted FAINT Score in predicting short-term adverse outcomes among older adults presenting to the ED with syncope.

Methods

The parent retrospective cohort comprised 350 patients aged ⩾65 years presenting with syncope to the ED. Of these, 144 patients with complete data for all five adapted FAINT variables were included in the present analysis. Because N-terminal pro-B-type natriuretic peptide (NT-ProBNP) and high-sensitivity troponin assays were unavailable, brain natriuretic peptide (BNP)>100pg/ml and conventional troponin were substituted. Primary outcomes included adverse events within 48 hours and 30 days, including death, major cardiovascular or cerebrovascular events, procedural interventions, or return ED visits. A prespecified FAINT threshold of ⩾1 was assessed using diagnostic accuracy measures and area under the receiver operating characteristic curve (AUC).

Results

Adverse events occurred in 11.8% (n=17) of patients within 48 hours and 23.6% (n=34) within 30 days. No low-risk patients experienced 48-hour events (n=0), whereas 14.0% (n=17) of high-risk patients did (p=0.075). At 30 days, adverse events occurred in 8.7% (n=2) of low-risk and 26.4% (n=32) of high-risk patients (OR 3.7, 95% CI 0.84-17.0; p=0.066). The adapted FAINT score demonstrated high sensitivity (100% and 94.1%) and fair discrimination (AUCs 0.691 and 0.693) for predicting 48-hour and 30-day outcomes, respectively.

Conclusion

In this cohort, the adapted FAINT score demonstrated high sensitivity and negative predictive value but modest overall discrimination. These findings suggest potential utility as an adjunct to clinical judgment rather than an independent tool for determining safe ED discharge. Given the complete-case selection, biomarker substitutions, and broader composite outcome definition from the original study, these findings require confirmation in larger prospective multicenter studies.

Categories: Emergency Medicine, Geriatrics, Internal Medicine
Keywords: adapted faint score, emergency medical services, faint score, older patients, risk stratification, syncope

Introduction

Syncope is the transient loss of consciousness (T-LOC) due to reduced cerebral blood flow associated with postural collapse and rapid spontaneous recovery [1]. The incidence of syncope has been shown to increase with age by Wong et al. [2]. In contrast to young patients, in whom syncope is an isolated occurrence, syncope in the elderly is often multifactorial, prevalent and associated with many predisposing factors [3]. Age-related physiological changes in the cardiovascular system, along with multimorbidity and polypharmacy in the elderly, were associated with the increased incidence of syncope in older adults [4].

In a prospective study Ungur et al. [5] demonstrated that age was a significant predictor of mortality and

How to cite this article
Haris N, Menon S, ATK L (November 08, 2026) External Evaluation of an Adapted FAINT Score for Short-Term Adverse Events in Older Adults Presenting With Syncope: A Single-Center Retrospective Cohort Study From North Carolina. Cureus 18(11): e119312. DOI 10.7759/cureus.119312

syncope recurrence. Comorbidity and disability were other predictors of mortality and syncope recurrence, respectively. Although syncope in the absence of heart disease may be benign, it becomes clinically significant in those with recurrent, unexplained syncope, especially in those with structural heart disease, where mortality may increase up to 40 per cent in two years [1].

Risk stratification and disposition of patients with syncope presenting to the emergency department (ED) is challenging due to the lack of residual complaints of the T-LOC. Effective risk stratification of syncopal patients in the ED can aid in the admission of high-risk patients while discharging low-risk patients, thereby reducing inpatient hospitalization, costs, and ED workload, and improving resource utilization [6,7]. Consequently, several clinical decision rules (CDRs) have been developed to address this issue. These prediction tools usually incorporate significant predictors of outcomes from history, physical examination and basic diagnostic tests [3,7].

A scoping review showed that up to 19 tools have been devised, of which 13 have not been further investigated or validated [7]. The prominent ones which have been further studied include the San Francisco Syncope Rule (SFSR), the Evaluation of Guidelines in Syncope Study Univariate (EGSYS), the Canadian Syncope Risk Score (CSRS), and the Risk Stratification of Syncope in the Emergency Department (ROSE) and Osservatorio Epidemiologico sulla Sincope nel Lazio (OESIL). These scales vary in their inclusion of biomarkers, patient history, clinician judgement, and the time frame of the outcomes they assess [7-11]. However, these tools were developed in the general adult population and none of these scales was explicitly created for the older adult population, although they have greater resource utilization and more serious outcomes following syncope [6].

A comparative study by Kirodah et al. to analyze the efficacy of SFSR, EGYS, CSRS, ROSE in risk stratifying patients over the age of 65 who present to the ED with syncope for short-term adverse events within 48 hours and 30 days demonstrated that the sensitivity and specificity of the four tools in their cohort of older adult patients were average, although the results of these tools in the general adult population was more robust. The study also highlighted that CSRS performed better in older adult population than the others [3].

The FAINT score is specifically derived for risk stratification in the older adult population. The five components of the FAINT score are 1) history of heart failure, 2) history of cardiac arrhythmia, 3) initial abnormal electrocardiogram, 4) elevated pro-B-type natriuretic peptide (>125) (NT-proBNP), and 5) elevated high-sensitivity troponin T (hs-troponin). Based on the derivative study, the FAINT score demonstrated sensitivity of 96.7% and a specificity of 22.2%, respectively. A FAINT score of zero also reasonably excluded 30-day serious cardiac events or death [6]. It has undergone limited external validation, with the only prospective study being an international multicenter study by Du Fay de Lavallaz et al., which demonstrated moderate discriminatory ability, with good sensitivity for identifying low-risk patients, but no clear superiority over the existing OESIL score [12]. In a cohort of older patients, the modified FAINT score developed by Voigt et al. showed higher sensitivity than CSRS and SFSR, but no meaningful differences between the tools were detected [13].

Given the limited external validation of the FAINT score, further evaluation in independent cohorts is essential. Therefore, the primary objective of this study is to externally evaluate the discriminatory performance of an adapted FAINT score in risk-stratifying patients aged 65 and older who present to the ED with syncope for short-term adverse events within 48 hours and 30 days, including the ability of the prespecified low-risk threshold (FAINT=0) to identify patients at low risk of these outcomes. Since biomarker availability differed in our retrospective cohort, we evaluated adapted FAINT score using locally available natriuretic peptide and troponin assays.

Materials And Methods

Study design and setting

This is a single-centre health records review of 350 patients who presented to the ED between 01/01/2018 and 12/31/2019 with a chief complaint of syncope. The Institutional Research Ethics Review Board approved the protocol and exempted it from informed consent as part of the original study [3]. No new data collection was planned for this phase of the study.

Of the 350 patients in the original retrospective cohort, 144 (41.1%) had complete data for all five adapted FAINT components. The remaining 206 patients (58.9%) lacked BNP measurements and were excluded from the present analysis. No missing values were imputed, and the analysis was restricted to complete cases.

Subject selection criteria

Patients were selected from the Clinical and Translational Science Institute (CTSI) research database using the inclusion and exclusion criteria. We identified patients using an inbuilt search function of the CTSI i2b2 Data warehouse system using search terms "syncope," "presyncope," "fall," "near syncope," or "loss of consciousness." Secondary manual screening of the records to identify patients 65 years or older with a primary diagnosis of syncope was performed.

Inclusion criteria were patients age ⩾65 years, those presented to the emergency department within 24 hours of the syncopal episode, and a primary diagnosis of syncope confirmed by manual chart review and had complete data for all five adapted FAINT variables.

Exclusion criteria were age <65, those who presented >24 hours after the episode, the presence of polytrauma requiring hospital admission, confirmed non-syncopal syndromes such as stroke, vertigo, coma, shock, witnessed seizure, sustained unconsciousness >5 minutes, head injury preceding loss of consciousness, pregnancy, alcohol, drug-related loss of consciousness, change in mental status from baseline after syncope, hypoglycemia, severe metabolic acidosis, or sepsis.

Initial evaluation and inclusion were performed by one trainee physician, with subsequent review by one of the faculty investigators, who was unaware of the patient's outcome status. Weekly data integrity meetings were held to review cases that were difficult to include or exclude, based on evaluations by a trainee physician and a supervising faculty member. If consensus was not reached about the appropriate inclusion criteria, those cases were excluded from the study. Additionally, patients with missing values for any of the five variables used to calculate the FAINT score were also excluded.

Outcome measures

The outcomes of interest were the occurrence of any predefined adverse event within 48 hours and 30 days of the index ED presentation. The composite outcome included major adverse cardiac events (MACE), major therapeutic interventions, and return ED visits or hospitalizations for any cause. MACE included stroke, myocardial infarction, cardiac death, heart failure exacerbation, and cardiac arrest. Major therapeutic interventions included acute antiarrhythmic therapy, ablation, pacemaker or implantable cardioverter-defibrillator (ICD) placement, cardioversion, defibrillation, percutaneous coronary intervention (PCI), and coronary artery bypass grafting (CABG). Any return ED visit or hospitalization for any cause was also included in the composite outcome. We evaluated the diagnostic performance of the FAINT score for these outcomes. Adverse outcomes were ascertained using a multimethod screening approach incorporating mortality data from the CTSI to determine dates of death. Hospital electronic medical records, including records available through Care Everywhere, were reviewed to identify readmissions, cardiovascular interventions, cardiac events, and mortality occurring both within and outside the study health system during the 48-hour and 30-day follow-up periods.

Statistical analysis

Data on demographics, medications, and clinical characteristics were already collected. Descriptive statistics of demographics, comorbidities, and clinical characteristics were computed, including means and standard deviations (SD) for continuous variables or frequencies and percentages for categorical variables. The FAINT score was calculated from a previously collected dataset (REDCap, Vanderbilt University, Nashville, US), and each patient's syncope risk status (high or low) was determined based on the FAINT score [6]. It is calculated by summing points from the five variables: history of heart failure (+1), history of arrhythmia (+1), abnormal ECG (+1), elevated NT-proBNP (+2), and elevated troponin (+1). Since NT-proBNP measurements were unavailable, BNP >100 pg/mL was used as a substitute, based on the institutional reference cutoff and established guidance regarding natriuretic peptides in heart failure assessment [14,15]. Conventional cardiac troponin I was measured using the Siemens assay employed at the study institution during the study period, with a 99th-percentile upper reference limit of 0.040 ng/mL (40 ng/L), in place of hs-troponin. We therefore regarded this as an adapted external evaluation of the FAINT score rather than a strict replication of the original derivation study. A FAINT score of zero was considered low-risk syncope. Univariable associations between individual factors and clinical outcomes (either 48-hour or 30-day adverse events) were assessed using t-tests for continuous variables and chi-square tests (or Fisher's exact test when warranted by small, expected cell counts) for categorical variables. The FAINT score's ability to predict 48-hour and 30-day adverse events in the sample was assessed using a univariate logistic regression model. Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) were calculated at a FAINT score threshold of ⩾1. Receiver operating characteristic (ROC) curve analysis was performed using the full numerical FAINT score (0-6) to assess its discriminatory performance in predicting 48-hour and 30-day adverse events. The area under the curve (AUC) was calculated, and its statistical significance was assessed using a Z-test. All statistical analyses were performed using IBM SPSS Statistics for Windows, Version 29 (Released 2022; IBM Corp., Armonk, New York, United States).

Patient and public involvement statement

Patients and the public were not involved in the design, conduct, reporting, or dissemination plans of this retrospective health-records study.

Important definitions

Major Adverse Cardiac Events (MACE)

MACE included stroke, myocardial infarction, cardiac death, heart failure exacerbation, and cardiac arrest.

Major Therapeutic Intervention

Major therapeutic interventions included acute antiarrhythmic therapy, ablation, pacemaker or ICD placement, cardioversion, defibrillation, PCI, and CABG.

Abnormal EKG

ECG abnormality was defined as the presence of one or more of the following: bradycardia (<40 beat/minute), ST changes (>1 mm elevation or depression), corrected QT interval >480 ms, QRS>130ms, Abnormal QRS axis <-30 or >100, ventricular tachycardia, atrioventricular block (second or third degree), sick sinus syndrome, ventricular and rapid paroxysmal supraventricular arrhythmias, sinus pauses and other pacing malfunction, Wolff-Parkinson-White Syndrome (WPWS), Wellens sign, arrhythmogenic right ventricular hypertrophy or supraventricular tachycardia (SVT).

Results

Of 350 patients in the parent cohort, 144 had complete data for all FAINT variables and were included in this complete case analysis. The mean (± SD) age was 78.1 (±8.3) years, with a median age of 77 years and a range of 65-97 years. The majority were females (n=81, 56.3%). The mean (± SD) FAINT score was 1.9 (± 1.2), and the median (interquartile range or IQR) FAINT score was two [1-3]. Based on FAINT score-based risk stratification, 16% (n=23) were classified as low risk (FAINT score=0), and the majority, that is, 84% (n=121), were classified as high risk (FAINT score ⩾1). A history of congestive heart failure was common in 39.6% (n=57), a history of arrhythmia was common in 43.8%(n=63), and an abnormal ECG was present in 79.2% (n=114). BNP was ⩾100 pg/mL in about 63.9% (n=92), and 19.4% (n=28) had elevated troponin levels (Table *1*).

Characteristics		Value (%)
Age, years, mean ± SD		78.1 ± 8.3
Gender	Male	63 (43.7)
	Female	81 (56.3)
Mean FAINT score		1.9 ± 1.2
FAINT risk classification	High risk	121 (84)
	Low risk	23 (16)
FAINT individual parameters	History of congestive heart failure	57 (39.6)
	History of arrhythmia	63 (43.8)
	Abnormal ECG	114 (79.2)
	BNP ≥100 pg/mL	92 (63.9)
	Elevated Troponin	28 (19.4)
Adverse events within 48 hours		17 (11.8)
Adverse events within 30 days		34 (23.6)

TABLE 1: Baseline characteristics of participants (N=144)

BNP: B-type natriuretic peptide.

Overall, about 11.8% (n=17) experienced an adverse event at 48 hours, and about one-quarter, 23.6% (n=34), experienced an adverse event at 30 days.

Distribution of FAINT risk and adverse events

None of the patients classified as FAINT low-risk developed any 48-hr adverse event whereas 14% of high-risk patients (n=17) experienced an adverse event within 48 hours. However, this difference was not statistically significant (p=0.075). At 30 days, 8.7% (n=2) of low-risk patients and 26.4% (n=32) of high-risk FAINT patients had an adverse event. The high-risk category patients had 3.7 times increased odds (95% CI 0.84-17.0) of 30-day adverse events; however, this difference was not statistically significant (p=0.066)

(Table 2).

Adverse events	Low risk (FAINT=0) (N=23), n (%)	High risk (FAINT≥1) (N=121), n (%)	OR (95% CI)	p-value
At 48 hours	0/23 (0)	17/121 (14%)	Not estimatable	0.075
At 30 days	2/23 (8.7%)	32/121 (26.4%)	3.7 (0.84-17.0)	0.066

TABLE 2: Distribution of FAINT risk category and adverse event

Fisher's exact test was used for the 48-hour comparison, and Chi-square test was used for the 30-day comparison.

Predictive performance of the FAINT score

The overall sensitivity is high for FAINT score of ⩾1 in predicting the adverse event at 48 hours and 30 days with a low specificity of 18.1% and 19.1% respectively and the PPV is low with a high NPV (100% and 91%, respectively) (Table 3).

Diagnostic accuracy of FAINT score ≥1	FAINT score and adverse events at 48 hours (95% CI)	FAINT score and adverse events at 30 days (95% CI)
Sensitivity	100% (85.6-100.0)	94.1% (80.9-98.4)
Specificity	18.1% (12.4-25.7)	19.1% (12.8-27.4)
PPV	14.0% (8.9-21.4)	26.4% (19.4-34.9)
NPV	100% (85.7-100.0)	91.3% (73.2-97.6)

TABLE 3: Diagnostic performance of the FAINT score (≥1) for adverse events

PPV: positive predictive value; NPV: negative predictive value.

The ROC analysis using the full numerical FAINT score and demonstrated fair to moderate discrimination of the FAINT score (⩾1) for predicting 48-hour adverse events, with an area under curve (AUC) of 0.691 (Figure 1 and Table 4).

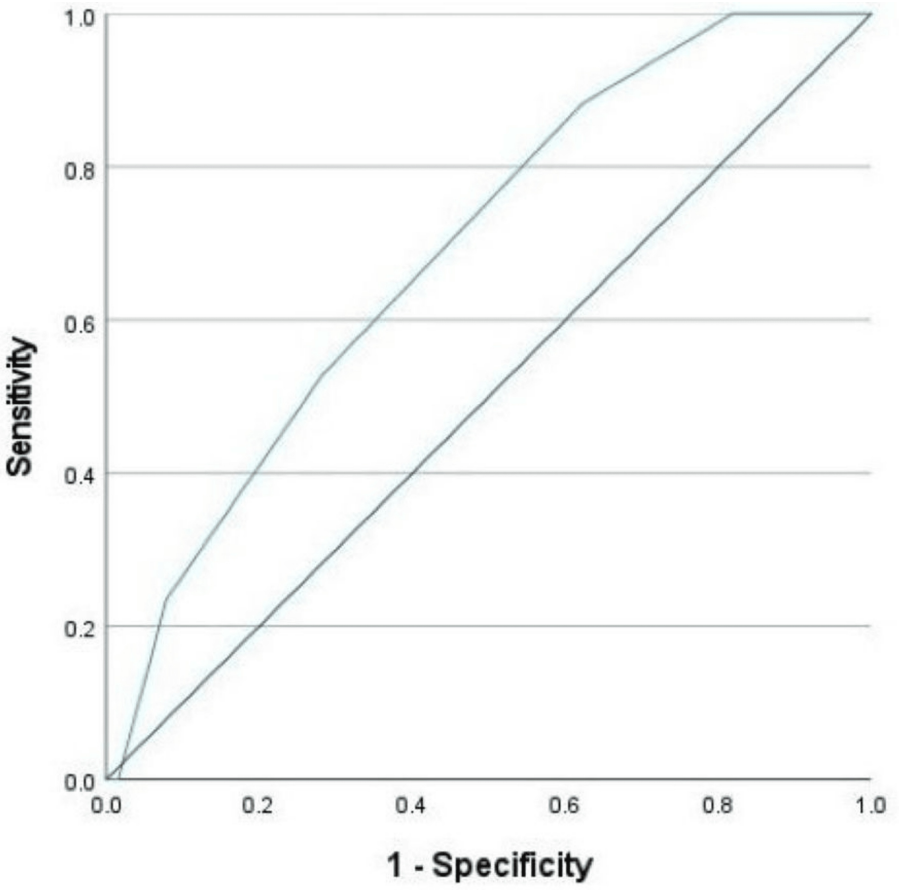


FIGURE 1: ROC curve using the full numerical FAINT score to predict 48-hour adverse events

ROC: receiver operating characteristic; AUC: area under curve; AUC=0.691.

ROC analysis	AUC	Std. Error	95% Confidence Interval		p value	Z* value
			Lower	Upper		
FAINT score and 48- hours Adverse events	0.691	0.062	0.570	0.812	0.011	3.08
FAINT score and 30 days adverse events	0.693	0.051	0.594	0.793	0.001	3.78

TABLE 4: ROC curve analysis using the full numerical FAINT score for predicting adverse events

*Z test; ROC: receiver operating characteristic; AUC: area under curve.

The ROC analysis demonstrated fair to moderate discrimination of the FAINT score (⩾1) for predicting 30-day adverse events, with an AUC of 0.693 (Figure *2* and Table *4*).

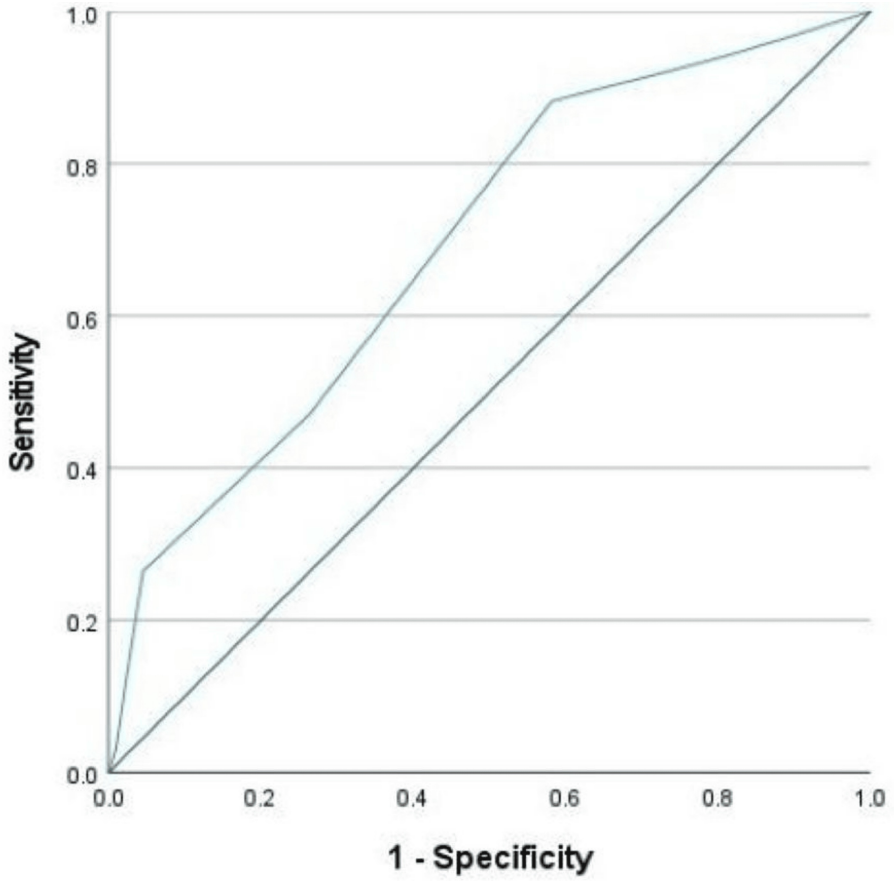


FIGURE 2: ROC curve using the full numerical FAINT score to predict 30-day adverse events

ROC: receiver operating characteristic; AUC: area under curve; AUC=0.693.

Discussion

In this retrospective cohort of elderly patients, we externally evaluated the adapted FAINT score for predicting both early (48-hour) and short-term (30-day) adverse events. Our findings show high sensitivity for excluding 30-day adverse events among low-risk patients (FAINT=0), serving as a rule-out tool, while overall discrimination remained modest (AUC=0.693). We also observed no adverse events in the low-risk cases over 48 hours, yielding an AUC of 0.691, supporting its role as a rule-out tool for early deterioration. These findings are directionally concordant with the FAINT derivation study, in which low risk (FAINT score=0) had a high sensitivity for excluding short-term adverse outcomes [6]. These findings suggest that the adapted FAINT score may serve as a rule-out aid for early disposition decisions, but not as a standalone risk-stratification tool.

Although the 48-hour outcome was not evaluated in the original FAINT study, we included this endpoint to assess very early adverse events that may be relevant to ED disposition decisions. A meta-analysis showed that most adverse events identified during follow-up after syncope, particularly bradycardia and supraventricular arrhythmia, occurred within three days [16]. Hence, evaluating the performance of a risk-stratification tool within this time frame may help inform early disposition decisions and potentially reduce unnecessary hospitalizations.

External validation of the FAINT score remains limited. A large prospective multicenter validation (n=1885) showed that FAINT score=0 had a sensitivity of 97% for 30-day serious cardiac events or mortality, with an AUC of 0.75. The analysis also suggested that the FAINT score's discriminatory performance was comparable to NT-proBNP or hs-troponin and did not outperform OESIL. It also showed high calibration in the low-risk group. The study's findings, along with the high sensitivity and low specificity also observed in our study, underscore the score's limited role as a rule-in tool [12].

As in our study, the availability of NT-proBNP and hs-troponin may limit the completion of the FAINT score, as mentioned in the derivative study. In FAINT's derivation, Probst et al. used Roche Elecsys assays with fixed thresholds (NT-proBNP >125 pg/mL; high-sensitivity cardiac troponin T (hs-cTnT) >19 ng/L), while

they acknowledged the limitations of availability of hs-troponin and added that the conventional BNP assay can be used instead of NT-proBNP [6]. A study by Voight et al. had to use a modified FAINT score without NT-proBNP due to this issue [13]. This introduces a relevant selection bias in retrospective cases such as ours because only complete cases would be considered, which might already represent a higher-risk subgroup. Our findings therefore provide real-world evidence regarding the performance of an adapted FAINT approach in settings where the original assays are not routinely available. However, because BNP and conventional troponin are not interchangeable with the biomarkers and thresholds specified in the original FAINT score, our results should not be assumed to represent the performance of the original FAINT score.

One difference between the original FAINT derivation study and our study is the inclusion of patients aged ⩾65 years, whereas the derivation study included patients aged ⩾60 years. In addition, our analysis included our composite outcome was broader than that of the original FAINT study and included non-cardiac adverse events, need for procedural intervention and return ED visits or hospitalization, whereas the derivation study included only cardiac outcomes [6]. The increased age of our cohort may affect the predictive value by altering baseline event rates. As FAINT is a cardiac outcome-weighted score, using broader outcomes may reduce direct comparability with the original study and may have influenced the discriminatory performance observed in our cohort.

Head-to-head geriatric evidence from previous studies provides additional context. Kiradoh et al. compared CSRS, EGSYS, SFSR, and ROSE in patients ⩾65 years using the same 48-hour and 30-day time frames and a broad composite outcome similar to our study. They showed that CSRS had the best AUC overall, but none of the scales were as robust at identifying high-risk geriatric patients and showed lower sensitivities than in their original derivation studies, probably because they were not conducted solely in general populations [3]. Mu et al. analysed five clinical decision rules (ROSE, SFSR, CSRS, BSC, FAINT) and found that FAINT and BSC had the highest sensitivities/NPV, while ROSE and SFSR had higher specificity. They underscored that the utility of the tool lies in the intended use, whether to rule out or rule in patients [17].

A study showed that the newer tool, CSRS, has improved discrimination for 30-day serious adverse events, with an AUC of 0.7 to 0.8, and has been externally validated in a large, multicenter cohort of patients aged 45 or older. However, CSRS was derived from a broad adult population. It incorporates a wider range of clinical variables, and requires expert physician judgement, which may not be available in every ED, thereby limiting its utility [8,18-20].

In conclusion, the FAINT score was specifically developed for older patients and relies on readily available ED evaluation, with its intended role as a supporting tool in decision-making rather than a standalone diagnostic instrument [6]. This aligns with the 2018 European Society of Cardiology (ESC) recommendations, which state that no clinical decision rules for syncope have outperformed clinical judgement and hence should not be used as a standalone tool for risk stratification [21]. Our external evaluation of the adapted FAINT score retains its assessment at the original low-risk threshold (FAINT score= 0), while underscoring its limitations (low specificity, assay requirement, vulnerability to data selection). Furthermore, it extends its applicability to early adverse outcomes, supporting its use in guiding safe disposition decisions in older adults presenting with syncope.

Limitations

First, this was a single-center retrospective study restricted to 144 of the original 350 patients because BNP measurements were unavailable for the remaining 206 patients. This complete-case approach may introduce selection bias, as patients who underwent BNP testing may differ systematically from those who did not, limiting the generalizability of our findings. Additionally, although Care Everywhere records were reviewed to identify events occurring outside our health system, adverse events not documented in accessible records may have been missed. Second, BNP and conventional troponin were used as proxies for NT-proBNP and hs-troponin, so this analysis didn't not reproduce the original FAINT biomarker definitions exactly. Third, the adverse event composite was broader than that used in the original derivation study and included non-cardiac events and return ED visits, which limits direct comparability. Finally, the lower number of adverse events, particularly at 48 hours, resulted in wide confidence intervals around the performance estimates.

Conclusions

In this single-center retrospective cohort of older adults presenting to the ED with syncope, the adapted FAINT score demonstrated modest discrimination and high sensitivity for predicting short-term adverse events at a threshold of FAINT ⩾1, although these findings should be interpreted cautiously given the small sample size. Although no adverse events occurred within 48 hours among patients with a zero FAINT score, the small low-risk subgroup and the occurrence of few adverse events at 30 days warrant cautious interpretation. These findings suggest its potential utility as an adjunct to clinical judgment rather than an independent tool for determining safe ED discharge. Given the complete-case selection, biomarker substitutions, and broader composite outcome definition from the original study, these findings require confirmation in larger prospective multicenter studies.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Neha Haris, Suma Menon, Luqman ATK

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Drafting of the manuscript: Neha Haris, Suma Menon, Luqman ATK

Critical review of the manuscript for important intellectual content: Neha Haris, Suma Menon, Luqman ATK

Supervision: Suma Menon, Luqman ATK

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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