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ORIGINAL CONTRIBUTION

Multivariable risk scores for predicting short-term outcomes for emergency department patients with unexplained syncope: A systematic review

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ABSTRACT

Objectives: Emergency department (ED) patients with unexplained syncope are at risk of experiencing an adverse event within 30 days. Our objective was to systematically review the accuracy of multivariate risk stratification scores for identifying adult syncope patients at high and low risk of an adverse event over the next 30 days.

Methods: We conducted a systematic review of electronic databases (MEDLINE, Cochrane, Embase, and CINAHL) from database creation until May 2020. We sought studies evaluating prediction scores of adults presenting to an ED with syncope. We included studies that followed patients for up to 30 days to identify adverse events such as death, myocardial infarction, stroke, or cardiac surgery. We only included studies with a blinded comparison between baseline clinical features and adverse events. We calculated likelihood ratios and confidence intervals (CIs).

Results: We screened 13,788 abstracts. We included 17 studies evaluating nine risk stratification scores on 24,234 patient visits, where 7.5% (95% CI = 5.3% to 10%) experienced an adverse event. A Canadian Syncope Risk Score (CSRS) of 4 or more was associated with a high likelihood of an adverse event ($LR_{score \geq 4}$ = 11, 95% CI = 8.9 to 14). A CSRS of 0 or less ($LR_{score \leq 0}$ = 0.10, 95% CI = 0.07 to 0.20) was associated with a low likelihood of an adverse event. Other risk scores were not validated on an independent sample, had low positive likelihood ratios for identifying patients at high risk, or had high negative likelihood ratios for identifying patients at low risk.

Conclusion: Many risk stratification scores are not validated or not sufficiently accurate for clinical use. The CSRS is an accurate validated prediction score for ED patients with unexplained syncope. Its impact on clinical decision making, admission rates, cost, or outcomes of care is not known.

KEYWORDS
syncope predictors, syncope risk scores, syncope risk stratification, syncope outcomes, systematic review

INTRODUCTION

Syncope is a transient loss of consciousness with spontaneous recovery due to a global reduction in cerebral perfusion. Syncope can be due to life-threatening cardiac conditions such as arrhythmias or pulmonary embolism, orthostatic hypotension, or reflex ("vasovagal") syncope. The cause of syncope may be unexplained after initial emergency department (ED) assessment. About 7% to 23% of adult ED patients with unexplained syncope experience an adverse event including cardiac arrhythmia, myocardial infarction, bleeding, or death within 30 days of an ED presentation.[1] Syncope accounts for 1% of ED visits, so accurate risk assessment is a common problem.[1,2] Imprecise risk assessment may lead to unnecessary hospital admissions and investigations. A total of 30% to 50% of patients with syncope are admitted to hospital[2–4] and undergo advanced imaging and investigations.[5] One-third of these hospitalizations are nondiagnostic with no discharge diagnosis,[2,5] suggesting that many admissions and investigations may be avoidable.[3,6]

No single clinical or electrocardiographic (ECG) variable has adequate predictive ability, and the predictive ability of cardiac biomarkers is uncertain,[7,8] so over the past 20 years current guidelines do not recommend a specific risk stratification method, perhaps due to many risk assessments available and a lack of recent systematic review of available assessments.[3,6] At least nine multivariable risk scores have been developed, but there are no recent systematic reviews of these scores. Previous systematic reviews focused on older multivariable risk scores or did not assess methodologic quality or risk of bias.[9–12] Many new risk scores have been published since these overviews were completed.

We performed a systematic review to assess the accuracy of multivariate risk scores for adult ED patients with unexplained syncope including assessment of methodologic quality and risk of bias. The outcome of interest was adverse events within 30 days of ED discharge.

METHODS

Search strategy and study selection

We recruited a medical librarian to search MEDLINE, Embase, CINAHL, and Cochrane databases from their earliest possible date until May 14, 2020, for relevant studies of adults presenting to an ED with syncope or presyncope. The librarian used the following Medical Subject Headings (MeSH) terms and search strategy: "physical examination OR medical history taking OR professional competence OR sensitivity AND specificity OR reproducibility of results or observer variation or decision support techniques OR Bayes theorem" and "syncope OR consciousness OR unconsciousness OR seizures." The librarian limited searches to articles published in English. We retrieved additional articles from searching the bibliographies of relevant articles.

We adhered to the PRISMA checklist[13] (see Data Supplement S1, Table S1, available as supporting information in the online version of this paper, which is available at http://onlinelibrary.wiley.com/doi/10.1111/acem.14203/full) and were exempt from review from our local Institutional Review Board given the study did not involve human subjects. Two coauthors (R.A.L.S., O.T.A., R.J.R., S.S., or E.E.E.) independently reviewed all abstracts. We obtained the full-text article of any potentially relevant abstract identified by any reviewer. Two of us independently reviewed the full-text articles. We included English language studies that (i) enrolled at least 10 human participants who were 12 years or older (but not if all participants were less than 18 years old) with transient loss of consciousness, syncope, or presyncope; (ii) identified patients in EDs; (iii) performed clinical tests (including history, physical examination, ECG, and cardiac biomarkers); (iv) created a multivariate risk prediction score; and (v) had systematic follow-up within 30 days for serious outcomes.

Assessment of methodologic quality

Two coauthors (R.A.L.S., O.T.A., R.J.R., S.S., or E.E.E.) independently performed a qualitative methodologic review. We chose the 14 item Quality Assessment of Diagnostic Accuracy Studies (QUADAS-2) tool[14] to assess the risk of bias. The QUADAS contains similar elements as the Quality in Prognosis Studies (QUIPS)[15] checklist. The QUADAS addresses risks of bias not addressed by QUIPS, such as blinding and handling of indeterminate results. Neither QUADAS nor QUIPS includes detailed questions about development and validation of multivariable prediction rues. We added the Transparent Reporting of a multivariable prediction model for Individual Prognosis Or Diagnosis (TRIPOD) criteria,[16] questions 10, 12, 14 and 16 that specifically address development and validation of multivariable clinical rules (Data Supplement S1, Table S2). We resolved disagreements through discussion and consensus. A third coauthor independently performed these assessments if a consensus could not be reached. We excluded studies if those assigning the risk score were not blinded to a patient's outcome. We contacted authors for clarification if their methods were unclear from the published full text.

Data abstraction and analysis

Two coauthors (R.A.L.S., O.T.A., R.J.R., S.S., or E.E.E.) independently abstracted data from the eligible studies. We used Microsoft Excel to organize abstracted data and for calculating likelihood ratios with CIs.[17] We resolved disagreements through discussion and consensus. A third coauthor independently abstracted data if a consensus could not be reached. We contacted authors for methodologic information or additional data if it was not readily available in the published full-text article. We used the extracted data to derive likelihood ratios and CIs wherever

possible for each individual study. For risk scores with more than two possible results, we calculated interval likelihood ratios and also collapsed the results into intervals with nonoverlapping CIs to make a parsimonious and more clinically useful result without sacrificing accuracy by simply dichotomizing the result.[17,18] We reported likelihood ratios because they are single variables that allow clinicians a quick way to estimate posttest likelihood of disease. In general, a positive likelihood ratio of 4 or more provides a clinically useful increase in the likelihood of outcome, while a negative likelihood ratio of 0.25 or less provides a clinically useful reduction in the likelihood of an outcome. A dichotomous test result with a sensitivity of 80% and specificity of 80% would have a positive likelihood ratio of 4 and a negative likelihood ratio of 0.25.

RESULTS

We screened 13,788 abstracts and reviewed 543 full-text articles. We excluded 526 full-text articles because they did not meet inclusion criteria after full-text review (*n* = 507), did not blind the multivariate risk score to the outcome (*n* = 8), were overviews (*n* = 4), or were duplicate publications (*n* = 7; Data Supplement S1, Table S3). We included 17 studies evaluating nine risk stratification scores (Data Supplement S1, Table S4) on 24,234 patient visits, where a median of 7.5% (95% CI = 5.7% to 11%) experienced an adverse event after presenting to an ED. Ten studies were restricted to patients with syncope while seven included patients with syncope or near syncope. Five studies assessed outcomes within 7 days and 12 within 30 days (Data Supplement S1, Table S5).

All risk stratification scores incorporated a patient's ECG. Five risk scores included known cardiac disease, two included the presence of shortness of breath, and three included a patient's troponin (Data Supplement S1, Table S6). Depending on a patient's score they may be classified as high or low risk (Data Supplement S1, Table S4) for an adverse event. The definitions of high and low risk varied by study (Data Supplement S1, Table S7). Some scores had multiple results that could confer high, low, or indeterminate risk.

Study quality

All 17 studies enrolled consecutive eligible participants and collected multivariable risk score data blinded to the outcome. In some studies,[19–21] data collection on eligible patients was completed only when ED staff and research personnel were available. Fifteen studies were prospective and two were retrospective. Sixteen studies interpreted outcomes without knowledge of the results of the risk score. Nine studies used uniform surveillance all patients, in that all patients regardless of their risk score were followed up with equal intensity, four studies were unclear regarding uniform surveillance, and four did not use uniform surveillance (Data Supplement S1, Tables S8 and S9).

Accuracy of multivariate risk scores (Tables 1–3)

San Francisco Syncope Rule (Table 1)

The San Francisco Syncope Rule (SFSR) assesses five variables to create a score from 0 to 5. A patient with a score of one or more is considered high risk. We identified nine studies (*n* = 6,311 patient visits, 1.4%–11% event rate)[19,22–29] of the SFSR, including nine validation studies. Five studies[19,22,25,27,28] followed patients for 7 days and four studies[23,24,26,29] followed patients for 30 days. A SFSR score of one or more had a likelihood ratio ranging from 1.1 to 2.2 and a score of 0 had negative likelihood ratio ranging from 0.03 to 0.63 (Tables 1-3).

Osservatorio Epidemiologico sulla Sincope nel Lazio Rule (Table 1)

The Osservatorio Epidemiologico sulla Sincope nel Lazio (OESIL) rule assesses four variables to create a score from 0 to 4. A patient with a score of 2 or more is considered high risk. We identified one validation study (*n* = 187 patient visits, 6.4% event rate)[19] of the OESIL score which followed patients for 7 days.

A positive OESIL score had a likelihood ratio of 1.0 (95% CI = 0.68 to 1.6) and a score of 0 had a negative likelihood ratio of 0.94 (95% CI = 0.41 to 2.1) for identifying patients at risk for myocardial infarction. Results were similar for predicting death and stroke (data not shown).

Boston Syncope Criteria (Table 1)

The Boston Syncope Criteria assesses eight variables to create a score of 0 to 8. A patient with a score of one or more is considered high risk. We identified three studies (*n* = 757 patient visits, 6.4%–25% event rate)[19,30,31] of the Boston Syncope Criteria, including two validation studies. Two studies[30,31] followed patients for 30 days, and one study followed patients for 7 days.[19] A Boston Syncope Criteria score of one or more had a likelihood ratio ranging from 1.3 to 2.6 and a score of 0 had a negative likelihood ratio ranging from 0.01 to 0.48.

Risk Stratification of Syncope in the Emergency Department Rule (Table 1)

The Risk Stratification of Syncope in the Emergency Department (ROSE) rule assesses seven variables to create a score from 0 to 8. A patient with a score of 1 or more is considered high risk. We identified two studies (*n* = 1,254 patient visits, 6.4%–7.6% event rate)[19,26] of the ROSE rule, including one validation study. One study[26] followed patients for 30 days and one study[19] followed patients for 7 days. A ROSE rule score of one or more had a likelihood ratio ranging from 1.2 to 3.5 and a score of 0 had a negative likelihood ratio ranging from 0.1 to 0.2.

TABLE 1 Accuracy of studies with dichotomous outcomes for predicting short term serious outcomes (SFSR, OESIL, Boston Syncope Criteria, ROSE score, and Ottawa ECG criteria)

Study	Sample Size	LR+ (95% CI)	LR– (95% CI)
SFSR			
Quinn (2004)[25]–derivation study	684	2.5 (2.3–2.8)	0.06 (0.02–0.19)
Quinn (2006)[24]	713	2.2 (2.0–2.5)	0.03 (0.01–0.24)
Quinn (2008)[23]	1474	2.0 (1.9–2.2)	0.04 (0.003–0.68)
Tan (2013)[28]	1194	1.9 (1.8–2.1)	0.11 (0.06–0.22)
Birnbaum (2008)–any SFSR predictor[22]	738	1.8 (1.5–2.1)	0.45 (0.30–0.69)
Safari (2016)[19]	187	1.7 (1.3–2.2)	0.33 (0.09–1.2)
Sun (2007)[27]	351	1.5 (1.3–1.8)	0.26 (0.12–0.55)
Thiruganasambandamoorthy (2010)[29]	457	1.3 (1.2–1.5)	0.30 (0.13–0.72)
Reed (2010)[26]	538	1.1 (1.0–1.3)	0.63 (0.30–1.3)
OESIL			
Safari (2016)[19]	187	1.0 (0.68–1.6)	0.94 (0.41–2.1)
Boston Syncope Criteria			
Grossman (2007)[31]–derivation study	293	2.6 (2.2–3.1)	0.05 (0.01–0.19)
Grossman (2012)[30]	277	2.5 (2.1–2.9)	0.01 (0.001–0.19)
Safari (2016)[19]	187	1.3 (1.0–1.7)	0.48 (0.13–1.7)
ROSE rule			
Reed (2010)[26]–derivation study	529	3.5 (3.0–4.2)	0.10 (0.03–0.30)
Reed (2010)[26]	538	2.5 (2.1–3.0)	0.20 (0.09–0.45)
Safari (2016)[19]	187	1.2 (0.80–1.8)	0.75 (0.33–1.7)
Ottawa ECG Criteria			
Thiruganasambandamoorthy (2012)[32]–derivation study	470	4.0 (3.4–4.8)	0.05 (0.007–0.34)

Abbreviations: LR+, positive likelihood ratio; LR–, negative likelihood ratio; OESIL, Osservatorio Epidemiologico sulla Sincope nel Lazio; ROSE, Risk Stratification of Syncope in the Emergency Department; SFSR, San Francisco Syncope Rule.

Ottawa ECG Criteria (Table 1)

The Ottawa ECG Criteria assesses seven variables to create a score from 0 to 7. A patient with a score of one or more is considered high risk. We identified one derivation study (n = 470 patient visits, 5.7% event rate)[32] of the Ottawa ECG Criteria, which followed patients for 30 days. An Ottawa ECG Criteria score of one or more had a likelihood ratio of 4.0 (95% CI = 3.4 to 4.8) and a score of 0 had negative likelihood ratio of 0.05 (95% CI = 0.007 to 0.4).

Canadian Syncope Risk Score (Table 2 and Table 3)

The Canadian Syncope Risk Score (CSRS) assesses eight variables to create a score from −2 to 8. A score of 0 or less is low risk, a score of 4 or more is high risk, and scores of 1 to 3 are indeterminate. We identified two studies[20,21] (n = 7,849 patient visits, 3.6%–3.7% event rate) of the CSRS, all of which followed patients for 30 days, including one validation study.[21]

Overall, 76% of patients had a score of 0 or less, 6% had a score of 4 or higher, and 18% had indeterminate results. A score of 0 or less ($LR_{score\leq 0}$ = 0.10, 95% CI = 0.06 to 0.20]) was associated with a low likelihood of an adverse event. A score of 4 or more was associated with a higher likelihood of an adverse event ($LR_{score\geq 4}$ = 11, 95% CI = 8.9 to 14).

Syncope Risk Score (Tables 2 and 3)

The Syncope Risk Score assesses five variables to create a score from 0 to 8. A score of 0 is low risk, a score of 4 or more is high risk, and scores of 1 to 3 are indeterminate. We identified one derivation study (n = 505 patient visits, 9.7% event rate)[33] of the Syncope Risk Score, which followed patients for 30 days.

Overall, 47% of patients had a score of 0, 10% had a scores of 4 or more, and 43% had indeterminate results from 1 to 3. A score of 0 was associated with a low likelihood of an adverse event ($LR_{score=0}$ = 0.02, 95% CI = 0.001 to 0.30). A score of 4 or more ($Re_{scored>=}$ = 9.3, 95% CI = 5.9 to 15) was associated with a higher likelihood of an adverse event.

Canadian Syncope Arrhythmia Score (Tables 2 and 3)

The Canadian Syncope Arrhythmia Score assesses seven variables to create a score from −2 to 8. A score of 1 or less is low risk, a score

TABLE 2 Interval likelihood ratio for scores with outcomes at multiple test threshold for predicting short-term serious outcomes (CSRS, Syncope Risk Score, Canadian Arrhythmia Risk Score, and FAINT Score)

Study	Number with this score	Score	LR_{score} (95% CI)
CSRS			
Thiruganasambandamoorthy (2020)[21] (*n* = 3,817)	1,049	−3	0.03 (0.004–0.20)
	582	−2	0.09 (0.02–0.40)
	514	−1	0.16 (0.05–0.50)
	740	0	0.22 (0.10–0.50)
	271	1	1.7 (1.0–2.7)
	259	2	2.1 (1.4–3.2)
	157	3	3.9 (2.5–6.0)
	93	4	6.4 (3.9–10)
	74	5	6.2 (3.5–11)
	78	6 or more	28 (18–42)
Syncope Risk Score			
Thiruganasambandamoorthy (2014)[33]–derivation study (*n* = 505)	236	0	0.02 (0.001–0.30)
	81	1	0.36 (0.12–1.1)
	80	2	1.03 (0.53–2.0)
	56	3	2.5 (1.4–4.5)
	52	4 or more	9.3 (5.9–15)
Canadian Arrhythmia Risk Score			
Thiruganasambandamoorthy (2017)[34]–derivation study (*n* = 4,673)	1,181	−2	0.01 (0.001–0.30)
	1,264	−1	0.10 (0.03–0.29)
	1,146	0	0.11 (0.04–0.34)
	468	1	1.5 (0.90–2.4)
	260	2	2.6 (1.6–4.2)
	173	3	4.0 (2.4–6.6)
	106	4	11 (7.2–17)
	46	5	15 (7.9–28)
	29	6 or more	22 (11–47)
FAINT Score			
Probst (2020)[35]–derivation study (*n* = 3,177)	672	0	0.15 (0.07–0.33)
	447	1	0.54 (0.32–0.90)
	499	2	0.62 (0.40–1.0)
	684	3	1.2 (0.90–1.5)
	561	4	2.0 (1.6–2.4)
	235	5	1.5 (0.94–2.3)
	79	6	5.3 (3.2–8.6)

Abbreviations: CSRS, Canadian Syncope Risk Score; LR, likelihood ratio.

of 4 or more is high risk, and scores of 2 and 3 are indeterminate. We identified one derivation study (*n* = 4,673 patient visits, 2.12% event rate)[34] of the Canadian Syncope Arrhythmia Score, which followed patients for 30 days. This study focused on serious arrhythmic events only.

Overall, 87% of patients had a score of 1 or less, 4% had a score of 4 or more, and 9% had an intermediate score. A score of 0 or less ($LR_{score\leq 0}$ = 0.30, 95% CI = 0.20 to 0.40) were associated with a low likelihood of an adverse event. Scores of 4 to 6 were associated with a higher likelihood of an adverse event ($LR_{score\geq 4}$ = 15, 95% CI = 12 to 20).

FAINT score (Table 2 and Table 3)

The FAINT score assesses seven variables to create a score from 0 to 6. A score of 0 is low risk and a score of 1 or more is not low

TABLE 3 Simplified Interval likelihood ratios for studies with multiple strata at predicting serious outcomes (CSRS, Syncope Risk Score, Canadian Arrhythmia Risk Score, and FAINT Score

Study	Number with this score	Score	LR_{score} (95% CI)
CSRS			
Thiruganasambandamoorthy (2020)[21] (*n* = 3,817)	2,885	Less than 1 (low risk)	0.10 (0.06–0.20)
	687	1–3 (medium risk)	2.3 (1.8–2.9)
	245	4 or more (high risk)	11 (8.9–14)
Syncope Risk Score			
Thiruganasambandamoorthy (2014)[33] (*n* = 505)	236	0 (low risk)	0.02 (0.001–0.30)
	81	1 (medium risk)	0.40 (0.10–1.1)
	188	2 or more (high risk)	3.0 (2.6–3.5)
Canadian Arrhythmia Risk Score			
Thiruganasambandamoorthy (2017)[34] (*n* = 4,673)	4,059	1 or less (low risk)	0.30 (0.20–0.40)
	433	2–3 (medium risk)	3.5 (2.6–4.8)
	181	4 or more (high risk)	15 (12–20)
FAINT Score			
Probst (2020)[35] (*n* = 3,177)	672	0 (low risk)	0.15 (0.07–0.33)
	1,630	1–3	0.83 (0.70–1.0)
	875	4 or more	2.1 (1.8–2.4)

Note: See Table 2 for results at each individual score.

Abbreviations: CSRS, Canadian Syncope Risk Score; LR, likelihood ratio.

risk. We identified one derivation study (*n* = 3,177 patient visits, 5.7% event rate)[35] of the FAINT score which followed patients for 30 days.

Overall, 21% of patients had a score of less than 1, 28% of patients had a score of 4 or more, and 51% of patients had an intermediate score. A FAINT score of less than 1 was associated with a low likelihood of an adverse event ($LR_{score=0}$ = 0.15, 95% CI = 0.07 to 0.33). Scores of 4 to 6 were associated with a higher likelihood of an adverse event ($LR_{score\geq4}$ = 2.1, 95% CI = 1.8 to 2.4).

DISCUSSION

We identified 17 studies of nine multivariate risk stratification scores for adult patients presenting to an ED with unexplained syncope. We found that some rules (OESIL) lack accuracy, some rules (SFSR, Boston Syncope Criteria, and Rose Criteria) cannot accurately identify high-risk patients, and many rules (Ottawa ECG, SRS, CSAS, and FAINT) have not been validated on an independent sample. We found that the CSRS accurately identified low- and high-risk patients and has been independently validated.[26,28]

Prior systematic reviews of the SFSR and OESIL demonstrate they are not sufficiently accurate.[9–11] We extend these prior reviews with additional validation studies of the SFSR and the OESIL rules and by including a methodologic quality assessment and by including seven additional multivariate risk stratification scores. As a secondary objective, du Fay de Lavallaz et al.[36] assessed the accuracy (measured by area under the receiver operating characteristic curve) of the CSRS in comparison to the ROSE rule, the SFSR, and the OESIL risk score in eight countries. They found that the CSRS was the most accurate based on area under the receiver operating curve, but interval likelihood ratios were not published and were not available for our review.

Multivariable risk scores may be superior to unstructured clinical judgment. Two studies compared the performance of a multivariate risk scores, the FAINT score and the SFSR, to a physician's unstructured clinical judgment.[35,37] These studies demonstrated that a physician's judgment overestimates risks, leading to higher likelihood of unnecessary admission. The seven additional multivariate risk scores included in their review have not been compared to unstructured clinical judgment.

The use of the CSRS can provide physicians with a structured approach to estimate risk of a short-term adverse event. In the CSRS validation study, the risk of an adverse event was 3.6%, equivalent to odds of an adverse event of about 1:27. Likelihood ratios allow clinicians a quick way to estimate posttest odds, because post test odds = (pre test odds) × (likelihood ratio). Consider a patient with a CSRS score of 0 or less. This result has a likelihood ratio of 0.10, conferring posttest odds of an adverse event of 1:270 (or about 0.36%). Consider another patient with a CSRS result of 4 or more (likelihood ratio 11). This CSRS result confers posttest odds of 11:27 (or a posttest probability of 11/(11 + 27) = 29%). This patient's significant risk could lead to immediate consultation and timely cardiac evaluation. Of note, the impact of these risk scores on actual clinical decision making, decisions to admit, subsequent testing, safety, or costs of care is unknown.

LIMITATIONS

This review has several limitations. First, we did not quantitatively compare the accuracy of the prediction scores due to significant heterogeneity between the studies. These differences included the definition of a syncopal event, interpretation of the clinical variables, whether the scores were applied by untrained clinicians or research staff, duration of follow-up, and the definitions of adverse events. We also did not attempt to combine results for specific prediction rules. For example, we did not combine SFSR studies because of different eligibility criteria, different surveillance for outcomes, and different outcomes. Therefore, our conclusion that the CSRS is the most accurate is based on qualitative ranking of methodologic strengths and predictive accuracy, rather than statistical comparison. Second, we excluded non-English papers and we did not search the gray literature, so there may be additional studies that were not selected. Third, we included some studies that enrolled patients with presyncope. Presyncope is a less specific clinical syndrome, so studies that include patients with presyncope may have reduced predictive accuracy. Fourth, none of the studies evaluate pediatric patients.

Most studies in this overview were large, prospective studies of consecutively enrolled patients with blinding of the risk assessment to clinical outcomes and high follow-up rates. Some studies did not use uniform management or surveillance to follow up enrolled patients. This would tend to bias toward a more accurate result, because higher-risk patients are more likely to have tests looking for serious events, whereas less sick patients are more likely to be discharged and get less workup. This workup bias will tend to increase the apparent accuracy of the prediction rules.[38] In future studies this bias could be minimized by standardizing the management of patients based on their initial risk assessment and by conducting low-risk noninvasive cardiac testing on a random subset of low-risk patients.

The CSRS has some additional potential limitations. First, the study physicians were trained on distinguishing vasovagal from cardiac syncope. Such training would be needed prior to implementing the score in other settings. Second, many low-risk patients did not have a troponin level measured, so the troponin results were assumed to be normal in the validation study. Clinicians should be cautioned not to order a troponin value simply to calculate a CSRS.

FUTURE DIRECTIONS

The studies in our review did not evaluate the use of clinical prediction rules on clinical decision making. Future studies could evaluate the effect of validated multivariable risk scores on health care utilization and patient outcomes compared to clinical judgment and further refine the assessment of patients with intermediate risk in addition to the separation of syncope and presyncope. Prior to the adaptation of a specific stratification score into guidelines, there is a need for updated head-to-head studies with a focus on the decision to admit, the choice of subsequent diagnostic tests, patient safety, and cost-effectiveness. There is question on whether a syncopal presentation to an ED warrants motor vehicle license restriction.[39] The studies in this review did not include motor vehicle accidents as an adverse event and thus decisions on license suspension cannot be extrapolated from these results. Future longitudinal studies could include vehicle safety outcomes.

CONCLUSIONS

Syncope is a common presentation to an ED; without a standardized risk stratification system of patients there will be health care disparities and inconsistent patient care, which may lead to poor outcomes. Overall, this systematic review provides an updated qualitative overview of the accuracy of nine risk stratification scores among adult patients following a syncopal event.

While more longitudinal studies are required prior to changing guidelines, the Canadian Syncope Risk Score was the most accurate at classifying patients at low and high risk for adverse events. This provides a promising ability to assist physicians in determining whether patients warrant additional workup or admission to hospital.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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