

## Society Position Statement

# Standardized Approaches to the Investigation of Syncope: Canadian Cardiovascular Society Position Paper

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### ABSTRACT

Syncope is a very common presentation in the emergency department, and the combination of a wide differential diagnosis, a range of prognoses, and infrequent documentation of the faint leads to a high proportion of patients being admitted. These problems are mirrored in the investigation of inpatients with syncope, for which

### RÉSUMÉ

La syncope est un symptôme très fréquent au service d'urgence, et la combinaison d'un grand éventail de diagnostics différentiels, d'une gamme de pronostics possibles et d'une rare documentation sur la syncope fait en sorte que la proportion de ces patients qui sont admis est élevée. Ces problèmes se reflètent dans l'investigation dont fait l'objet le

Syncope is a common presentation, comprising 1%–1.5% of emergency department (ED) visits.<sup>1</sup> A high proportion of patients—ranging from 13%–83%<sup>2,3</sup>—are admitted, largely because of diagnostic uncertainty and concern that an underlying cause might result in morbidity or mortality. Assessment is often

difficult because diagnostic clues are usually inferential, as syncope events are rarely captured during investigation. Efforts to detect underlying etiologies can employ a large number of modalities and target several organ systems and are usually performed in an unstructured approach.<sup>4</sup> This consumes substantial resources and

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This statement was developed following a thorough consideration of medical literature and the best available evidence and clinical experience. It represents the

consensus of a Canadian panel comprised of multidisciplinary experts on this topic with a mandate to formulate disease-specific recommendations. These recommendations are aimed to provide a reasonable and practical approach to care for specialists and allied health professionals obliged with the duty of bestowing optimal care to patients and families, and can be subject to change as scientific knowledge and technology advance and as practice patterns evolve. The statement is not intended to be a substitute for physicians using their individual judgment in managing clinical care in consultation with the patient, with appropriate regard to all the individual circumstances of the patient, diagnostic and treatment options available and available resources. Adherence to these recommendations will not necessarily produce successful outcomes in every case.

the high proportion of patients with benign outcomes and the profound risk aversion of health care providers make for expensive and inefficient assessment. Difficulties such as this in health services delivery can be improved by standardized approaches, such as guidelines, pathways, and checklists. Accordingly, emergency department decision rules, specialized syncope-monitoring units, and formal diagnostic algorithms have been developed to provide standardized approaches to the investigation of syncope. To provide guidance in the management of syncope, the Canadian Cardiovascular Society commissioned a position paper on standardized approaches to syncope investigation in adults. A primary panel first reviewed the literature systematically, then undertook iterative syntheses of data, and finally took positions with specific recommendations according to the GRADE framework. This paper summarizes the evidence and its quality and makes recommendations on the specific approaches meriting adoption. The position paper was then reviewed by a secondary panel, which provided suggestions for revisions leading to the final document as presented here. Overall, the position group concluded that there is little persuasive evidence that emergency department syncope rules and diagnostic syncope units provide efficient care and improved outcomes but that formal diagnostic algorithms with specialist support show promise.

prolongs patient stay.<sup>1</sup> The high proportion of patients who have benign causes of syncope negatively impacts this approach.<sup>5</sup>

Difficulties such as these in health services delivery can be improved by standardized approaches, including guidelines, pathways, and checklists. Accordingly, ED syncope decision rules, specialized syncope-monitoring units, and formal diagnostic algorithms have all been developed to provide standardized approaches to the investigation of syncope. Recognizing that there were no summary documents on the merits and weaknesses of these approaches, the Canadian Cardiovascular Society (CCS) commissioned a position paper on standardized approaches to syncope investigation in adults. Our goals were to summarize the evidence and its quality and to make recommendations on whether any of the 3 approaches merit adoption at this time. The Writing Panel searched PubMed and found 979 articles of interest and then added articles identified by hand searches of personal files and reference lists. This list was narrowed to 85 based on examination of the title and/or abstract and on discarding letters and duplicates. Other articles from outside the field were added as necessary. The panel reviewed the current status of the field, asked whether the published work posed a significant improvement over current practice, and made observations and recommendations using the GRADE format. Briefly, GRADE uses a structured method to weigh the quality of the evidence and a similarly structured method to describe the strength of the recommendation or observation.<sup>6</sup> The Secondary Panel reviewed the resulting document, and it then was submitted to the CCS Guidelines Committee.

The paper consists of 3 major sections, dealing with stan-

malade hospitalisé pour une syncope, laquelle ne révèle souvent qu'un trouble bénin. L'aversion du risque, profondément ancrée chez les dispensateurs de soins de santé, les amène donc à effectuer des évaluations coûteuses et inefficaces. Il serait possible de remédier à ce genre de difficultés dans la prestation des services de santé en adoptant des procédures uniformisées, comme des lignes directrices, des cheminements et des listes de vérification. C'est pourquoi on a élaboré des règles relatives aux prises de décision dans les services d'urgence, conçu des algorithmes et formé des unités de surveillance spécialisées pour offrir des méthodes uniformisées en ce qui a trait à l'évaluation de la syncope. Afin d'offrir une orientation pour le traitement de la syncope, la *Société canadienne de cardiologie* a commandé un exposé de position sur les procédures uniformisées d'investigation relative à la syncope chez l'adulte. Un premier comité a étudié la documentation méthodiquement, a effectué des synthèses itératives des données et a finalement pris position en formulant des recommandations précises selon la méthode d'évaluation GRADE. Dans leur document, les membres du comité résumant les données empiriques, font état de leur qualité, puis formulent des recommandations quant aux méthodes à adopter. L'exposé de position a ensuite été révisé par un deuxième comité, lequel a suggéré des révisions. C'est ainsi qu'on a obtenu la version définitive du document tel que présenté ici. Dans l'ensemble, le comité ayant pris position a finalement conclu qu'on ne disposait pas de suffisamment de preuves concluantes selon lesquelles des règles sur la syncope au service d'urgence et des unités diagnostiques contribueraient à offrir des soins plus efficaces et à obtenir de meilleurs résultats. Toutefois, le comité a aussi conclu que les algorithmes diagnostics formels et le soutien des spécialistes étaient prometteurs.

dardized approaches in the emergency room, formal syncope units, and standardized algorithms for inpatient investigation. The report focuses on the structure and flow of the investigations, rather than on the details of the particular investigations, which are beyond the mandate of the paper. Each section summarizes the evidence, assesses its quality, and presents the CCS position on the particular standardized approach.

## **Standardized Approaches in the Emergency Department**

### **Emergency department syncope assessment**

There is considerable variability in the assessment of syncope in the ED, reflecting the lack of an evidence-based consensus on the best approach. Accordingly, we summarized the evidence, compiled a list of risk factors, assessed the impact of syncope risk rules in patient disposition, and state the CCS position on ED syncope assessment rules.

### **Emergency department epidemiology**

There are consistent epidemiologic findings of syncope patients from EDs in Australia, Europe, the United Kingdom, and the United States.<sup>7-14</sup> The typical patient is 61 years old, and 45% are males. The final diagnoses include vasovagal syncope in 43% of patients, cardiac in 14%, and other (including undiagnosed syncope) in 43%. Decision-making in ED syncope assessment is driven by 3 options: should the patient be admitted, referred for urgent specialist assessment, or discharged to the care of the family physician? Given the constant strain on the ED, Canadian emer-

gency physicians must make and act on decisions quickly. Therefore the main consideration is often risk assessment, rather than arriving at a precise diagnosis. Risk assessment decisions appear to be aimed at 2 timelines for outcomes: poor outcomes in the first 7-30 days mandate admission, and poor outcomes beyond 30 days mandate early specialist assessment. The early outcome rate is of particular interest here, given its impact on acute care.

### Events following presentation

Syncope patients who present to the ED have significant risk during follow-up, although this risk varies widely depending on the etiology. The composite estimate of outcomes is that about 0.7% of patients die in the next 7-30 days, and about 10% of patients die within 1 year.<sup>2,9,10,12,14-23</sup> Nonfatal severe outcomes generally are defined as a significant new diagnosis, a clinical deterioration, serious injury with recurrence, or a significant therapeutic intervention. An average of 7.5% of syncope ED visits have a nonfatal severe outcome while in the ED, and another 4.5% have a nonfatal severe outcome in the next 7-30 days. Only half of nonfatal severe outcomes have cardiovascular causes. *Therefore, only a small minority of patients will benefit from urgent assessment and treatment outside the ED, and only half of these are for cardiovascular disorders.* The purpose of assessment in the ED is to stabilize the 7.5% of patients with an adverse outcome while there, identify the 4.5% of patients likely to have an early adverse outcome, and arrange urgent assessment and treatment in either ambulatory or acute care settings.

### Risk factors for nonfatal severe outcomes

Unfortunately, there is only limited interstudy agreement on the specific factors. An abnormal electrocardiogram (ECG),<sup>9,14,22</sup> a history of cardiovascular disease,<sup>12,14</sup> and hypotension<sup>12,14</sup> are the most commonly identified factors; others include age >60 years,<sup>22</sup> syncope without prodrome,<sup>9</sup> syncope while supine and while exercising,<sup>16</sup> hypertension,<sup>22</sup> dyspnea,<sup>14</sup> and anemia.<sup>14</sup> We arbitrarily defined major risk factors as those independently identified in more than one publication and minor risk factors as those identified in only one report (Table 1). Patients with major risk factors should have an urgent cardiac specialist assessment within 2 weeks.<sup>24</sup> The specific investigations depend on the circumstances and are beyond the mandate of this position paper.

**Summary.** Overall 7- to 30-day outcome following discharge from the ED after syncope assessment is generally benign. High-risk features that guide physician judgement include hypotension and findings of cardiovascular disease, including an abnormal ECG. There is evidence that other factors might include age >60 years, cerebrovascular disease, hypertension, dyspnea, syncope without prodrome or while supine or during exercise, and anemia (Table 1). Patients with high-risk features should have an urgent cardiac specialist assessment within 2 weeks.

**Table 1. Risk factors for short-term outcomes**

Major risk factors (Should have urgent cardiac assessment)	
Abnormal ECG	Any bradyarrhythmia, tachyarrhythmia, or conduction disease New ischemia or old infarct
History of cardiac disease	Ischemic, arrhythmic, obstructive, valvular
Hypotension	Systolic BP < 90 mm Hg
Heart failure	Either past history or current state
Minor risk factors (Could have urgent cardiac assessment)	
Age > 60 y	
Dyspnea	
Anemia	Hematocrit < 0.30
Hypertension	
Cerebrovascular disease	
Family history of early sudden death	Age < 50 y
Specific situations	Syncope while supine, during exercise, or with no prodromal symptoms

We defined major risk factors as those independently derived in more than one study; minor risk factors were derived in only one study. Syncope patients should have an urgent cardiac assessment in the presence of a single major risk factor, and consideration could be given to obtaining an urgent specialist assessment with one or more minor risk factors. Urgent cardiac assessment should take place within 2 weeks, as either an inpatient or outpatient.<sup>24</sup>

### RECOMMENDATION

Higher-risk patients, who should be considered for further assessment, are those with at least one major risk factor (see Table 1) (Strong Recommendation, Low-Quality Evidence).

### Emergency department risk rules

The data from several groups when calculated (or estimated) suggest that the diagnostic performance in the ED for syncope has a sensitivity of 95% for early adverse outcomes and >99% for mortality.<sup>12,14-17,19</sup> This is accompanied by specificities in the range of 30%-60%. Therefore, any decision rule would need to match this sensitivity but target increased specificity. A common feature of the syncope risk stratification rules based in EDs is that in order to achieve 95% sensitivity for an early adverse event, the presence of any single risk factor is enough to move the patient from the low-risk group. Studies in the effectiveness of syncope assessment are difficult because numerous clinical factors contribute to syncope, overall subsequent outcome rates are low, and a number of different outcomes may occur. Attributing clinical outcomes to the etiology that caused syncope is problematic, as the syncopal event is rarely documented physiologically.

Standardized scores have been developed in Europe, the United Kingdom, and the United States.<sup>9,12,14-17,20,22,25-27</sup> Risk factors are elicited at the bedside and/or are the results of readily obtainable tests. Some groups have simply compiled a list of plausible variables and tested their accuracy and efficiency once, while others have performed extensive multivariable analyses resulting in regression scores and subsequent risk score, followed by validation studies with independent samples. Although the scores predict outcome, they do not necessarily identify a treatable cause. The 2 studies with the best methodology and external validation are the

San Francisco Syncope Rule (SFSR)<sup>14,18,19,28-30</sup> and the OESIL (Osservatorio Epidemiologico della Sincope nel Lazio) score.<sup>15,31</sup> Both the SFSR and the OESIL score were developed thoroughly, starting with epidemiologic risk factors and proceeding through validation studies.

The OESIL group<sup>15,31</sup> identified 4 equally weighted risk factors for 1-year mortality: age >65 years, cardiovascular disease in clinical history, syncope without prodrome, and an abnormal ECG. The risk score resulted in 0-4 points, with 1-year mortalities ranging from 0.8%-57%. This was partly validated in a small study by UK investigators, who found 3-month serious outcomes to range from 0%-37%, with deaths contributing half the outcomes. Martin et al<sup>17</sup> identified 4 similarly weighted independent risk factors (age >45 years, history of heart failure, history of ventricular arrhythmias, and an abnormal ECG) that predicted 1-year death rates ranging from 2%-30%. Therefore, the factors most commonly identified to predict 1-year mortality are advancing age, a history of cardiovascular disorders, and an abnormal ECG.

The SFSR used similar methodology to identify independent predictors of serious morbidity and mortality within 7 days of presentation to the ED.<sup>14</sup> High-risk patients could be identified by the presence of any 1 of 5 factors: dyspnea, hypotension, congestive heart failure, abnormal ECG, or anemia. Although the SFSR was reported to have 96% sensitivity and 62% specificity, subsequent validation studies produced heterogeneous results, with generally reduced sensitivity and specificity.<sup>2,10,18,20,21,23</sup> Several reports have modeled the application of the rules on admission rates. On the whole, admission rates would be increased with no gain in sensitivity, compared to the actual decision made by the emergency physician. A substudy found that the SFSR is no better than physician judgement in predicting 7-day adverse major nonfatal outcome.<sup>19</sup>

### Impact of application of guidelines in the emergency department

Once expert guidelines for syncope assessment are published, do they have a significantly beneficial effect on patient flow and outcome? The impact of guidelines on syncope assessment in the ED has been reported by 2 groups. The American College of Emergency Physicians (ACEP) issued guidelines for management of ED syncope patients in 2001<sup>32</sup> and 2007.<sup>33</sup> The 2001 guidelines, based more on consensus opinion, identified 4 high-risk features—history of congestive heart failure or ventricular arrhythmias, presence of chest pain or Acute Coronary Syndrome picture, signs of heart failure or valvular heart disease, and ECG signs of ischemia, arrhythmia, prolonged QT interval, or bundle branch block—and 4 medium-risk features: age >60 years, coronary or congenital heart disease, family history of sudden death, and young patients with unexplained exertional syncope. In one study the high-risk features had very high sensitivity and specificity for identifying cardiogenic syncope and if implemented would have reduced admissions by 29%,<sup>34</sup> while application of medium-risk features decreased specificity and increased admissions.<sup>34</sup> The ACEP guidelines have not been tested directly after their publication.

The European Society of Cardiology (ESC) published guidelines, again based more on expert opinion than on evi-

dence, in 2001 and updated them in 2004 and 2009.<sup>1,35,36</sup> The guidelines recommended admission for significant heart disease, abnormal ECG, syncope during exercise or while supine, associated severe injury, family history of sudden death, preceding palpitations, and frequent recurrent episodes or high suspicion of cardiac syncope, and also recommended admission for treatment of arrhythmias, cardiopulmonary or neurologic disorders, or pacer insertion. [(The 2009 guidelines added severe anemia and electrolyte disturbance as admission criteria<sup>1</sup>). But do the ESC guidelines improve care?

McCarthy et al<sup>37</sup> retrospectively assessed a pathway developed based on these guidelines and found that 9.6% of the admissions could have been avoided if the pathway was used, but there was unclear follow-up for adverse events. Del Greco et al<sup>38</sup> examined the investigation of syncope before and after the publication of the 2001 ESC guidelines in 258 patients who were hospitalized after an episode of syncope. The guidelines had no apparent effect on length of stay, extent of testing, or cost of hospitalization.

**Summary.** Although emergency department syncope decision rules may have prognostic value, there is no compelling evidence that they improve diagnostic accuracy or reduce costs, and they may increase costs substantially.

### RECOMMENDATION

Existing syncope decision rules do not increase diagnostic specificity or sensitivity, or reduce costs (Weak Recommendation, Very Low-Quality Evidence).

**Methodologic limitations.** The studies on which our positions are based have numerous limiting features. None included a control population, and the outcomes and their timing vary considerably. The scores were derived mainly to predict patient outcome both in the ED and in the next 7-30 days, yet most outcomes occurred in the ED. Whether the scores are valid for patient outcome after discharge from the ED is unknown. As well, many studies included presyncope as an inclusion criterion, yet it is a nonspecific symptom and should not be used as a surrogate of syncope. Finally, there is little evidence that the specific etiology of syncope accounts for the majority of adverse outcomes over time. Indeed, Quinn et al<sup>14</sup> concluded that deaths related to syncope at any time during the first year of follow-up comprised at most 50% of all deaths.

### Syncope Units

The term “syncope unit” has been used to mean any organized approach to investigation or, more narrowly, here as a geographically contained unit for assessing syncope. The ESC 2009 guidelines<sup>1</sup> recommend the establishment of formal syncope units, either virtual or geographically contained, staffed by a coterie of syncope experts and having easy access to all referring physicians. The ESC recommended that units have *preferential* access to all contemporary cardiac investigations.

The generally benign short-term outcome of patients with syncope raises the possibility of an entirely outpatient

assessment of patients who do not have a declared outcome in the ED. Whether the Canadian public or physicians would accept this approach is unknown, but it has been attempted successfully in older patients in a UK centre.<sup>39-41</sup> The estimated death rate for outpatient syncope management ( $0.67\% \pm 0.60\%$ ) approximates death rates among outpatients waiting for coronary artery bypass graft surgery, which are 0.25%-0.5% in the first month.<sup>42-45</sup> Similarly, mortality rates for patients awaiting cardiac catheterization are 0.4%-1.1%, and 57% of deaths occurred during the recommended maximum wait time in one study.<sup>46,47</sup>

The concept of a dedicated syncope clinic or unit arose in a study of 65 consecutive elderly patients who were referred to a dedicated syncope clinic over a 6-month period.<sup>48</sup> A causal diagnosis was reached in 92% of patients. The most frequent cause of syncope in this cohort was carotid sinus syndrome (CSS) in 45%, orthostatic hypotension (OH) in 32%, arrhythmia in 21%, and vasovagal syncope (VVS) in 11%. The high prevalence of CSS may be due to a site-specific inclusion process. Subsequently, 3 small observational studies showed that in elderly patients, dedicated units achieved a diagnosis in almost all patients.<sup>40,41</sup> However, none of these studies was controlled, and many diagnoses were simply best clinical judgement. In one study, a syncope-and-falls day clinic for elderly patients achieved a dramatic estimated reduction in bed occupancy (35% vs 97% of expected) and length of stay (2.7 vs 10.9 days expected).

Brignole et al<sup>49</sup> compared 6 Italian hospitals that had an organized syncope unit with 6 matched hospitals not offering this service. Whether these were geographically contained units is unclear. There was a weak trend to fewer admissions and tests performed in the syncope unit hospitals. Importantly, only 11% of eligible syncope patients were referred to the unit. Ammirati et al<sup>50</sup> reviewed 102 consecutive patients referred to their syncope unit as either outpatients or during hospitalization in a retrospective observational study. The syncope unit appeared to increase the diagnostic yield from 75% to 82% and reduced hospital costs by 85% in a subsequent follow-up period.

The only randomized study evaluating the efficiency and accuracy of the investigation of syncope with a dedicated syncope clinic/unit is the SEEDS trial.<sup>51</sup> This study allocated 103 intermediate-risk syncope patients presenting to a single centre to a standard care approach compared to a syncope unit evaluation associated with the ED. The unit provided 6 hours of ECG monitoring, echocardiography, an urgent tilt test, and an arrhythmia consult. Diagnostic yield was significantly higher in those patients randomized to the syncope unit arm (67% vs 10%), mostly due to increased detection of vasovagal syncope. Hospital admission rates were lower in the syncope unit group (43% compared to 98% in the standard of care group). There were no differences in total mortality or syncope recurrence.

**Summary.** There is weak evidence that formal syncope units increase diagnostic yield and prevent unnecessary admissions and testing. This may be explained by advanced access to specialist assessment and related testing.

**Table 2. General concepts on the assessment of syncope**

Perform a comprehensive history and physical examination using evidence-based tools
Routinely obtain an ECG
Utilize electroencephalography and brain CT or magnetic resonance imaging only with clinical suspicion of focal neurologic deficit or seizure disorder
Utilize cardiac imaging only with clinical suspicion of structural or valvular heart disease
Perform invasive electrophysiologic stimulation only with clinical suspicion of a tachyarrhythmia
Obtain a tilt test only for diagnostic dilemmas, and if it will affect treatment and/or outcome
Consider Holter monitoring, event recorders, or implantable loop recorders if an arrhythmia is suspected, depending on the frequency of the events

Details of each test were reviewed in the ESC 2009 guidelines on syncope.<sup>1</sup>

## RECOMMENDATION

Formal syncope units might increase diagnostic specificity or sensitivity, and reduce costs (Weak Recommendation, Low-Quality Evidence).

## Standardized Syncope Investigations

### Specific investigations

There are several general principles with good evidence to support them (Table 2). These are reviewed in detail in the recent ESC guidelines.<sup>1</sup> The history and physical examination (including orthostatic blood pressure measurement where appropriate) remain the cornerstone of the diagnosis of syncope.<sup>1</sup> An accurate and quantitative history provides a diagnosis in most cases, a prognosis for vasovagal syncope, a sense of patient needs and preferences, and an economic basis for further investigation.<sup>52-57</sup> The efficient use of investigations, as appropriate, should follow the flow charts suggested in the ESC document.

Testing in syncope patients is in 3 broad categories. The first involves screening for a substrate for syncope, including careful clinical assessment, a resting ECG, and, where appropriate, short-term ECG monitoring, echocardiography, and blood work. This will provide a presumptive diagnosis in most patients. This is also useful for estimating prognosis, particularly because syncope with underlying heart disease is an important risk for sudden death. The yield of blood tests in detecting the cause of syncope is only 2%-3% in patients, detecting mostly electrolyte or metabolic abnormalities causing seizure.<sup>58,59</sup> A hematocrit  $<0.3$  is useful for detection of gastrointestinal bleeding.<sup>14,58,59</sup> Blood tests (hemoglobin, electrolytes, cardiac biomarkers) should be undertaken only if there is a clinical suspicion of occult hemorrhage, arrhythmias/seizures due to electrolyte or metabolic abnormalities, or myocardial infarction.

Tests such as echocardiography, coronary angiography, and radionuclide scintigraphy are of little value in unselected populations and should only be used when indicated by clinical assessment.<sup>1</sup> Computed tomography (CT) scan of the head is performed in 24%-47% of all syncope patients, with only 0.8%-5% of scans detecting a cause.<sup>3</sup> CT head scanning should be done only in patients with focal neurologic signs and symptoms or seizure activity or to rule out hemorrhage in trauma

patients. Similarly, conventional electroencephalography is rarely useful in the investigation of unselected syncope patients.

In contrast, the yield of an ECG is <5% in unselected patients, although it is noninvasive and inexpensive and can detect life-threatening abnormalities. Accordingly, it is recommended in all patients with no cause after clinical examination.<sup>58,59</sup> Provocative testing attempts to reproduce a syncopal episode or detect an abnormal physiologic response that can be inferred to explain the clinical syncopal episode. This includes tests such as tilt table testing and electrophysiologic studies. These tests require considerable judgement to interpret, since they induce a physiologic response and not the event itself, and are troubled by a lack of sensitivity and/or specificity. Finally, long-term ECG monitoring with Holter monitoring and external and implantable loop recorders is used to document the physiology associated with a spontaneous episode of syncope. This strategy is limited by the reliance on a recurrence of syncope, which might be associated with a morbidity and mortality.

### Putting guidelines into practice

Noting the limited impact of published guidelines, Brignole et al<sup>60</sup> developed guideline application software with specific prompting tools based on the ESC 2001 guidelines and compared its effectiveness in 18 hospitals to usual care in 28 other hospitals. In total, 745 syncope patients were assessed in the Evaluation of Guidelines in Syncope Study 2 (EGSYS-2). This was a direct but nonrandomized comparison that improved diagnostic yield (95% vs 80%), reduced admission rate (39% vs 47%), and reduced costs. This algorithm was validated when it was implemented in 11 large hospitals. The strategy led to adherence to a guideline approach in 86% of 541 patients, and yielded a diagnosis in 98% of cases. Half of the diagnoses were obtained initially after clinical assessment and ECG, with targeted testing (1.9 tests per patient) yielding the remainder of the diagnoses. Two important limitations are that the algorithm by design should have provided 100% diagnostic yield (whether or not correct), and a “syncope expert” was available by telephone to provide advice.

Farwell and Sulke utilized a syncope diagnostic protocol at a single large hospital and compared outcomes in 421 patients to those of 660 historic controls.<sup>11</sup> Diagnostic yield increased from 71% to 78%, along with increased use of appropriate testing such as tilt testing and prolonged monitoring. Unfortunately, high noncompliance with the protocol led to hospital admission in a much larger proportion of patients than recommended, and irrelevant testing such as brain imaging persisted, so that costs and bed occupancy went up dramatically.

Sarasin et al<sup>27</sup> deployed a systematic investigation strategy that involved baseline assessment with ECG and limited laboratory testing in 611 patients. They truncated further testing and arrive at a diagnosis in 69% of patients during this phase, with targeted testing in an additional 7%. They restricted extensive testing to the remaining 155 patients. Of interest, all patients with a final diagnosis of arrhythmia had an abnormal baseline ECG, in keeping with observations from the SFSR and OESIL score.

**Summary.** Algorithmic testing coupled with implementation tools improves diagnostic yield and may reduce costs. Key tactics to consider in implementation include access to specialist assessment and provision of an on-line prompting tool.

### RECOMMENDATION

Standardized diagnostic testing pathways may improve efficiency and reduce unnecessary testing, if associated with formal implement [Table 1](#) and Recommendations. Expert backup (Strong Recommendation, Low-Quality Evidence).

### CCS Positions

The CCS positions are presented in [Tables 1](#) and [2](#). While there is considerable heterogeneity in the methodology, data, and conclusions of the studies, it is clear that the overall short-term outcome is quite good, with an estimated early mortality of only 0.7%. Four risk factors for poor outcomes have been detected more than once and include a history or presence of congestive heart failure, an abnormal ECG, structural heart disease, and hypotension <90 mm Hg systolic ([Table 1](#)). Formal syncope investigation units have not been demonstrated to improve care and outcomes, but outpatient syncope units with advanced access might provide early comprehensive assessment and relieve strain on EDs. Standardized syncope assessment may improve care, but only if driven by easily available care pathways and subspecialist backup.

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