

# Death After Emergency Department Visits for Syncope: How Common and Can It Be Predicted?

**James Quinn, MD, MS**  
**Daniel McDermott, MD**  
**Nathan Kramer, BS**  
**Clement Yeh, MD**  
**Michael A. Kohn, MD, MPP**  
**Ian Stiell, MD, MSc**  
**George Wells, PhD**

From the Divisions of Emergency Medicine, Stanford University, Palo Alto, CA (Quinn, Yeh); the University of California, San Francisco, San Francisco, CA (McDermott, Kramer, Kohn); and the Department of Emergency Medicine and Epidemiology at the University of Ottawa, Ottawa, Canada (Stiell, Wells).

**Study objective:** Syncope is a common condition that is usually benign but occasionally associated with death. This study evaluates the incidence of death after an emergency department (ED) visit for syncope and whether these deaths can be predicted.

**Methods:** A prospective cohort study was conducted during a 45-month period. All patients were followed up 1-and-a-half years after their initial ED visit to determine whether they had died. Death certificates were independently reviewed by 2 physicians for the cause and date of death to determine whether the death was possibly related to the initial visit for syncope. Sensitivity and specificity of risk factors (defined by the San Francisco Syncope Rule) or age greater than 65 years was calculated for all-cause mortality and mortality thought possibly related to syncope.

**Results:** There were 1418 consecutive patients with syncope during the study period, representing 1.2% of all ED visits. The all-cause death rate was 1.4% at 30 days, 4.3% at 6 months, and 7.6% at 1 year. It was believed that the death rates from causes possibly related to syncope were 2.3% and 3.8% at 6 months and 1 year. Of the 112 deaths at 1 year, 37% were cardiac related. At 6 months, the risk factors had a sensitivity of 89% (95% confidence interval [CI] 79% to 95%) and specificity of 53% (95% CI 52% to 53%) for all-cause mortality and sensitivity of 100% (95% CI 90% to 100%) and specificity 52% (95% CI 52% to 53%) for predicting deaths likely or possibly related to syncope. Age greater than 65 years had similar sensitivity but much worse specificity compared with the set combined risk factors.

**Conclusion:** Deaths related to syncope after an ED visit are low, especially in the first 6 months and can usually be predicted by risk factors. [Ann Emerg Med. 2008;51:585-590.]

0196-0644/\$-see front matter

Copyright © 2008 by the American College of Emergency Physicians.

doi:10.1016/j.annemergmed.2007.08.005

## INTRODUCTION

### Background

Approximately a quarter of the population will experience the symptom of syncope sometime during their lifetime. Frequently, these patients will present to emergency departments (ED), accounting for 1% to 2% of all ED visits and hospital admissions.<sup>1-5</sup> Syncope is not only a common problem but also a challenging one for physicians. It occurs in the old and the young, it can be infrequent or recurrent, and although usually a benign symptom, it may have a fatal prognosis.<sup>3</sup> A population-based cohort from the Framingham

Study determined that patients with vasovagal syncope have a prognosis that is excellent, whereas those with syncope thought to be cardiac related have an increased risk of death, with a mortality rate of 10% at 6 months.<sup>3</sup> Unfortunately, on initial presentation in the ED the exact cause of syncope is unknown for most patients, making it difficult to classify patients into these prognostic categories.

### Importance

Given the high proportion of patients with unclear causes, a large number of patients with unknown causes of syncope are

### Editor's Capsule Summary

#### *What is already known on this topic*

The San Francisco Syncope Rule uses the absence of 5 risk factors to help clinicians identify which patients have a low enough risk of short-term sequelae that hospitalization might be avoided. There is debate about the rule's performance.

#### *What question this study addressed*

This study asks whether the absence of the same 5 high-risk criteria also predicts the longer-term outcome of surviving 1 year after being treated in the emergency department (ED) for syncope.

#### *What this study adds to our knowledge*

In this 1,418-patient prospective single hospital study, the San Francisco Syncope Rule effectively stratified 1-year survival in low- and high-risk patients. None of the deaths in the low-risk group were deemed syncope related.

#### *How this might change clinical practice*

Although these data document the performance of the rule, it remains to be seen whether the rule augments clinical judgment or performs equally in a broader sample of EDs.

admitted from EDs, contributing significantly to the \$2 billion cost of syncope admissions each year.<sup>6</sup> Taking a risk-stratification approach seems to be practical and may lead to the more efficient disposition of patients treated in the ED.<sup>7-9</sup> A multiphase prospective study, the San Francisco Syncope Rule, was designed to risk-stratify patients and augment physician decisionmaking in the acute setting by helping to predict patients at risk for short-term serious outcomes in need of emergency admission.<sup>4,10</sup>

### Goals of This Investigation

We examine the incidence of death from a large cohort of consecutive ED patients with syncope and to determine whether the risk factors from the San Francisco Syncope Rule can also predict death up to a year after the initial ED visit.

### MATERIALS AND METHODS

This prospective cohort study of consecutive ED patients was conducted at a large university teaching hospital and received initial approval from the institution's committee on human research under a waiver of informed consent for the derivation and validation studies. A further waiver of consent was granted to complete the follow-up and collection of data in this study. The collection of the cohort and study methods has previously been published.<sup>4,10</sup> In summary, patients presenting with acute

syncope or near syncope as a symptom for their ED visit were considered for the study. To identify patients, we used physician awareness, student volunteers, and a real-time continuous electronic tracking system to identify all possible patients with a symptom of syncope. All student volunteers, physicians, and house staff were made aware of the study. The electronic tracking system works by screening the hospital registration system in real time. According to the patients' presenting complaints (syncope, syncopal, faint, passed out, fall, collapse, light headed, dizzy), study personnel would be alerted by text messaging of all potential study patients.<sup>11</sup> Potential patients identified were brought to the attention of the attending physician while they were treating the patient. That physician then made the final decision to enroll the patient, depending on whether in their opinion syncope was a symptom that had occurred in that patient, according to our definition. As an operational definition for the study, we defined syncope to all providers as a transient loss of consciousness, with return to baseline neurologic function.

We specifically excluded patients with trauma-associated LOC, alcohol- or drug-related loss of consciousness, and patients with a definite seizure. Patients with loss of consciousness associated with an altered level of consciousness or persistent new neurologic deficits did not meet our operational definition of syncope and were also excluded.

### Outcome Measures

We used the online Social Security Death Index to identify whether a patient had died.<sup>12</sup> When a person dies, his or her social security number is retired by the federal government. Each patient in the cohort had his or her name and social security number checked in the online index at least 1-and-a-half years after the original ED visit to ensure that we would have accurate 1-year death data. The online index is updated frequently and reported to be accurate to within 6 months of the death of the patient and comparable in accuracy to the National Death Index.<sup>13</sup> Furthermore, to ensure the validity of the Social Security Death Index in this cohort we undertook a study to determine the accuracy of the Social Security Death Index for determining death at 6 months and using direct follow-up as the criterion standard and found it to be 100% sensitive and specific for this population.<sup>14</sup>

If a patient was verified to be dead with our death index search, we then acquired the death certificate to ascertain the official cause of death and tried to verify this when possible with the inpatient record and primary physician. Two physicians then independently reviewed the deaths and broke them into categories, and based on cause, date of death, and date of initial visit, they determined whether the death was possibly related to the ED visit for syncope. In general, they were instructed to be conservative, and all cardiac causes were considered possibly related to syncope, as were patients whose cause of death was unknown. If either physician thought the case was possibly related to the initial visit for syncope, then the case was considered to be so. Both physicians were blinded to the

**Table 1.** Characteristics of consecutive ED visits for syncope.

Characteristic	All Patients, N=1474	High Risk, N=718 (49%)	Low Risk, N=756 (51%)
Age, mean, y (95% CI)	62 (61–63)	69 (67–70)	56 (54–58)
Female (%)	830 (56)	339 (47)	481 (64)
Admitted from ED (%)	840 (57)	639 (76)	201 (24)
<b>Cause of syncope at follow up (%)</b>			
Cardiac	166 (11)	164 (23)	2 (0.3)
Neurologic	41 (3)	38 (5)	3 (0.4)
Orthostasis	180 (12)	79 (11)	101 (13)
Vasovagal	304 (21)	79 (11)	225 (30)
Medications	72 (5)	52 (7)	20 (3)
Psychiatric	17 (1)	2 (0.3)	15 (2)
Unclear	694 (47)	304 (42)	390 (53)

patient's initial presentation and clinical characteristics, including whether the patient was high or low risk, as determined by the clinical decision rule.

Patients were determined to be high risk if any one of the criteria of the San Francisco Syncope Rule was positive. The rule was derived and validated in a multiphase study. Our original study identified many risk factors associated with serious short-term outcomes and syncope but determined that most serious outcomes could be predicted by one of 5 risk factors: an abnormal ECG result, a history of congestive heart failure, a complaint of shortness of breath, persistent low blood pressure less than 90 mm Hg in the ED, and a hematocrit level less than 30%. An abnormal ECG result was the best predictor in our study. In our study, an ECG was considered to be abnormal if the rhythm was nonsinus or if there were any abnormalities (including any minimal changes such as first-degree block, conduction delays, or any morphologic changes to the QRS complex or ST segments) observed on the tracing. The ECG could be deemed normal only if there was a previous ECG for comparison and we believed these changes to be old. The final determination of an "abnormal ECG result" in our studies was determined by the attending physician caring for the patient.

### Primary Data Analysis

Physician agreement about whether the patient's death was possibly related to syncope was calculated with the  $\kappa$  statistic.<sup>15,16</sup> Sensitivity and specificity of the San Francisco Syncope Rule were calculated for all-cause and syncope-related mortality. We also performed a Kaplan-Meier survival analysis, comparing high- and low-risk patients.

## RESULTS

One thousand four hundred eighteen patients had 1,474 visits for syncope, representing 1.2% of the 124,801 ED visits during the 45-month study period (from July 1, 2000, to February 28, 2002; and July 15, 2002, to August 31, 2004). Fifty-seven percent of all patient visits were admitted, 56% were women, and the average age was 62 years (Table 1).

The death rate from all-cause mortality was 1.4% at 30 days, 2.9% at 90 days, 4.3% at 6 months, and 7.6% at 1 year. For deaths possibly related to syncope, the rate was 1.3% at 30 days, 1.8% at 90 days, 2.3% at 6 months, and 3.8% at 1 year (Figure 1). Deaths at 1 year were classified as cardiac 37%, chronic disease (including cancer) 36%, neurologic 9%, pulmonary embolism 2%, accidental 1%, and other 15% (includes infection, pneumonia) (Table 2).

At 6 months, the San Francisco Syncope Rule had a sensitivity of 100% (95% confidence interval [CI] 90% to 100%) and specificity 52% (95% CI 52% to 53%) for deaths possibly related to syncope and sensitivity of 89% (95% CI 79% to 95%) and specificity of 53% (95% CI 52% to 53%) for predicting all-cause mortality. At 1 year, the San Francisco Syncope Rule had a sensitivity of 93% (95% CI 83% to 97%) and specificity 53% (95% CI 52% to 53%) for predicting deaths likely or possibly related to syncope and sensitivity of 83% (95% CI 75% to 89%) and specificity 54% (95% CI 53% to 55%) for all-cause mortality (Table 3) Survival analysis shows those at low risk had a significantly lower risk of death (Figure 2).

Table 4 compares the sensitivity and specificity of the San Francisco Syncope Rule versus age greater than 65 years as a lone risk factor for death after an ED visit at 30, 90, and 180 days for all-cause mortality.

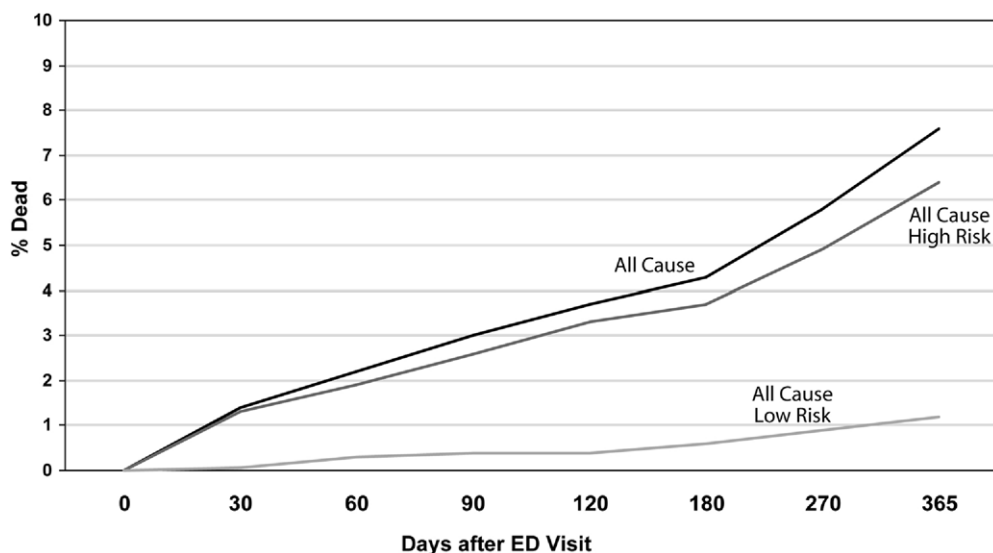
Physicians had good agreement when determining which patients' deaths were possibly related to syncope:  $\kappa$  0.71 (95% CI 0.58 to 0.84).

## LIMITATIONS

Our study has a few limitations. Even though our cohort is the largest of consecutive ED patients with syncope to date, we still had modest CIs around the sensitivity of the prediction rule, given the low incidence of death. It is also possible that because all patients in the cohort came from a single tertiary-care center that the results may not be generalizable. However, in this case the bias would be that the death rates are overestimated because the cohort was from a medical center with one of country's highest acuity rates.

## DISCUSSION

In this large prospective cohort of consecutive ED patients with syncope, we have demonstrated that the 30-day incidence of death from all causes is low and that the 1-year rate remains low when the death could have been related to syncope. Furthermore, we have shown that these deaths can be risk stratified with established risk factors, with death among low-risk patients being rare even up to a year and regardless of cause of death (Figure 1). The San Francisco Syncope Rule is a risk-stratification tool derived and validated to predict short-term outcomes. This study demonstrates that the risk factors in the rule can also help predict death up to 1 year. A risk-stratification approach that can predict short-term adverse outcomes and death throughout the next year likely provides a better rationale of who should receive a more aggressive evaluation either as an inpatient or through referral as an outpatient.



**Figure 1.** All-cause death rates for ED patients with syncope. Days after ED visit. \* $P < .005$  comparing high- and low-risk patients.

**Table 2.** Characteristics of all patients dead at 1 year.

Mortality from all causes	N=112
Age, mean, y	79
Range	13–103
Female	46 (41%)
High risk per San Francisco Syncope Rule	93 (83%)
Admitted from ED	88 (78%)
<b>Primary cause of death (%)</b>	
Cardiac	42 (38)
Cancer	28 (25)
Other*	21 (19)
Chronic disease†	10 (9)
Neurologic	7 (6)
Pulmonary embolism	3 (2)
Accidental	1 (1)

\*Other: sepsis, renal, gastrointestinal, and pulmonary cause.  
 †Chronic: Alzheimer's, failure to thrive.

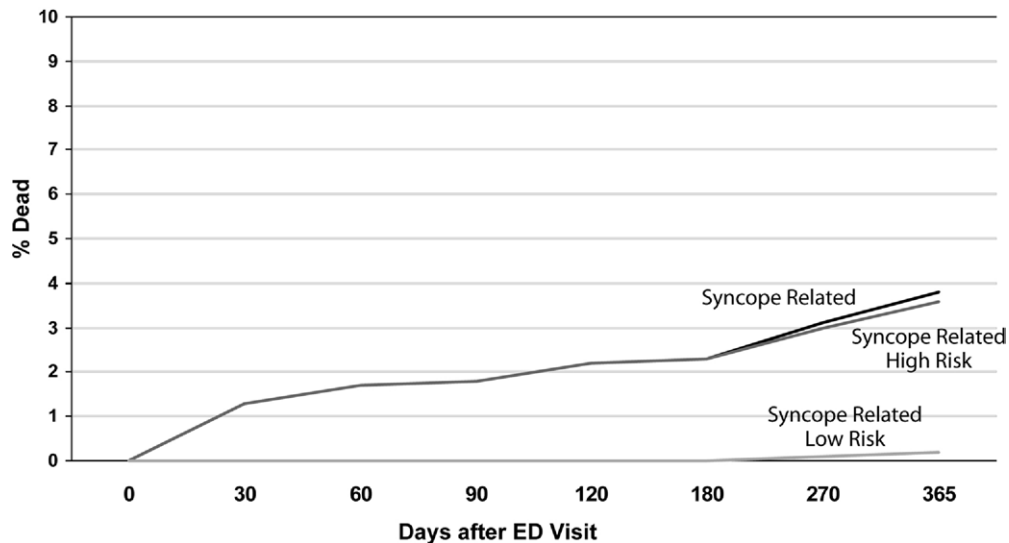
According to prognostic classification, patients eventually diagnosed with cardiac and neurologic disease after having syncope are at an increased risk of death, as demonstrated by the Framingham Study.<sup>3</sup> Those with a documented cardiac cause and syncope had 2 times the rate of death of patients without syncope, and those with syncope related to a neurologic cause were 50% more likely to die. People with an unknown cause also had a significantly increased risk of death of 30%, whereas those with neurally mediated (vasovagal) syncope had a lower risk of death. The group with unknown cause represented the largest group in this cohort, at approximately 40%. Determining which patients with an unknown cause of syncope are at risk is the challenge facing physicians. This problem of “unknown” syncope is further magnified for physicians assessing patients with syncope in the ED, where the rate of patients with

**Table 3.** Sensitivity and specificity of the San Francisco Syncope Rule for predicting death.

Syncope or all cause	Sensitivity, % (95% CI)	Specificity, % (95% CI)
6-mo syncope related	100 (90–100)	52 (52–53)
1-y syncope related	93 (83–97)	53 (52–53)
6-mo all cause	89 (79–95)	53 (52–53)
1-y all cause	83 (75–89)	54 (53–55)

an unclear cause for their syncope may be as high as 60%.<sup>9</sup> In this cohort, after 30 days the proportion of patients with syncope and unclear cause was 47%, and it is this large heterogeneous group of patients who, for the most part, are “low risk” but because of the “high stakes” (small risk of increase morbidity and mortality) are often admitted. It has been reported that physicians admit 30% of syncope patients that they believe have less than a 2% risk of a serious outcome. This inefficient use of hospitalization accounts for a large portion of the estimated \$2 billion spent annually on syncope admissions alone.<sup>6</sup> It is this “unknown” group of patients in which the efficiency of admission can be improved through risk stratification by providing a prospective prognosis for risk of short-term outcomes and long-term death.<sup>7</sup>

In 2000, we started a multiphase study to address this important problem. To risk-stratify ED patients with syncope, we used strict methodologic criteria for decision rule development.<sup>17,18</sup> We derived the San Francisco Syncope Rule on 684 patient visits by assessing the accuracy and reliability of 50 predictor variables used in the evaluation of patients with syncope and developed a highly sensitive clinical decision rule that we believed would augment physician judgment and allow physicians to rationally decide which patients with syncope need



**Figure 2.** Syncope-related death rates of ED patients presenting with syncope.

**Table 4.** Comparison of San Francisco Syncope Rule versus age greater than or equal to 65 years as high risk for all-cause mortality.

Time, Days	Sensitivity, SFSR (95% CI)	Specificity, SFSR (95% CI)	Sensitivity, Age >65 y (95% CI)	Specificity, Age >65 y (95% CI)
30	100 (84–100)	51.9 (51.8–52)	90 (70–97)	45.8 (45.6–45.9)
90	86 (74–94)	52.4 (52.1–52.7)	88 (76–95)	46.4 (46.0–46.6)
180	89 (79–95)	53.1 (52.7–53.4)	89 (79–94)	46.9 (46.4–47.1)

SFSR, San Francisco Syncope Rule.

admission, according to their short-term risk.<sup>4</sup> In a separate validation study, we assessed the rule’s performance on 791 visits to predict only outcomes that had not occurred during the initial ED assessment.<sup>10</sup> The rule has high sensitivity and acceptable specificity, with the potential to augment physician judgment and improve the efficiency of admission. The rule is not complex and is easily remembered by a simple mnemonic, “CHESS” (history of Congestive heart failure, Hematocrit <30, abnormal ECG result, a patient complaint of Shortness of breath, and a triage Systolic blood pressure <90 mm Hg).

Others examining risk factors for 1-year death and syncope found that components of our rule were also important risk factors on their smaller cohorts. In a retrospective study, Kapoor and Hanusa<sup>19</sup> showed that patients with cardiac disease or risk factors and ECG abnormalities were at greater risk of death or arrhythmia, regardless of whether they had syncope. Furthermore, both Martin et al<sup>20</sup> and Colivicchi et al<sup>21</sup> found that an abnormal ECG result and history of congestive heart failure were predictors of 1-year death with syncope. These investigators also found age to be an important risk factor and came up with different cut points for age. However, age alone is a marker for increased mortality, regardless of the patient’s presenting problem, and to use any specific cut point makes little sense because there is no single age cutoff, but rather a continuum of gradually increasing risk with age.

There has been a call for us to reconsider age in our rule.<sup>22</sup> However, closer evaluation will allow people to realize that age was considered in the derivation.<sup>4</sup> In our derivation set, we too found age an important variable in our univariate analysis, and during the derivation we tried numerous cut points but found age was too nonspecific (even at age >75 years) to include in a decision rule for short-term risk, and we determined that there were more efficient predictors.<sup>4</sup> It should also be apparent that high-risk San Francisco Syncope Rule patients are significantly older than the low-risk group, as demonstrated in Table 1, making the incorporation of age into the rule less valuable or important. Furthermore, Table 4 demonstrates—although age is sensitive—just how particularly nonspecific age is when used alone as a risk factor. This analysis shows that the San Francisco Syncope Rule can risk-stratify patients better than age alone when predicting death after an ED visit for syncope and should discourage those who use age as the sole or most important determinant for risk and ED disposition.

Our work suggests that short- and long-term outcomes can be predicted in patients presenting to EDs with syncope. We believe that risk factors can define patients into high- and low-risk groups that can augment physician judgment and lead to the safe disposition and appropriate evaluation of the majority

of these patients as inpatients or outpatients, according to their risk.

*Supervising editors:* Robert Silbergleit, MD; William G. Barsan, MD

*Author contributions:* JQ and DM conceived the study, designed the trial, and obtained research funding. JQ, DM, NK, and CY undertook recruitment and follow-up of patients. JQ and MAK managed the data, including quality control. IG and GW provided statistical advice on study design and the data. JQ drafted the article, and all authors contributed substantially to its revision. JQ takes responsibility for the paper as a whole.

*Funding and support:* By Annals policy, all authors are required to disclose any and all commercial, financial, and other relationships in any way related to the subject of this article, that might create any potential conflict of interest. See the Manuscript Submission Agreement in this issue for examples of specific conflicts covered by this statement. Funded in part through a grant from the Office of Technology and Licensing at Stanford University and an intramural REAC grant from the University of California, San Francisco.

*Publication dates:* Received for publication February 14, 2007. Revisions received June 19, 2007, and June 27, 2007. Accepted for publication August 1, 2007. Available online September 24, 2007.

*Address for reprints:* James Quinn, MD, MS, Division of Emergency Medicine, Stanford University, 701 Welch Rd, Suite C103, Palo Alto, CA 94304; 650-736-4391, fax 650-723-0121; E-mail [quinnj@stanford.edu](mailto:quinnj@stanford.edu).

## REFERENCES

- Wayne NN. Syncope: physiological considerations and an analysis of the clinical characteristics in 510 patients. *Am J Med.* 1961; 30:418-438.
- Kapoor WN, Karpf M, Wieand S, et al. A prospective evaluation and follow-up of patients with syncope. *N Engl J Med.* 1983;309: 197-204.
- Soteriades ES, Evans JC, Larson MG, et al. Incidence and prognosis of syncope. *N Engl J Med.* 2002;347:878-885.
- Quinn JV, Stiell IG, McDermott DA, et al. Derivation of the San Francisco Syncope Rule to predict patients with short-term serious outcomes. *Ann Emerg Med.* 2004;43:224-232.
- Maisel WH, Stevenson WG. Syncope—getting to the heart of the matter. *N Engl J Med.* 2002;347:931-933.
- Sun BC, Emond JA, Camargo CA Jr. Direct medical costs of syncope-related hospitalizations in the United States. *Am J Cardiol.* 2005;95:668-671.
- Quinn JV, Stiell IG, McDermott DA, et al. San Francisco Syncope Rule vs. physician judgment and decision making. *Am J Emerg Med.* 2005;23:782-786.
- Morag RM, Murdock LF, Khan ZA, et al. Do patients with a negative emergency department evaluation for syncope require hospital admission? *J Emerg Med.* 2004;27:339-343.
- Crane SD. Risk stratification of patients with syncope in an accident and emergency department. *Emerg Med J.* 2002;19: 23-27.
- Quinn J, McDermott D, Stiell I, et al. Prospective validation of the San Francisco Syncope Rule to predict patients with serious outcomes. *Ann Emerg Med.* 2006;47:448-454.
- Quinn J, Durski K. A real-time tracking, notification, and web-based enrollment system for emergency department research. *Acad Emerg Med.* 2004;11:1245-1248.
- Social Security Death Index [Web page]. Available at: <http://www.death-records.net/ssdi.htm>. Accessed September 12, 2007.
- Su D, Fairbanks R, Shah M. Accuracy of the Social Security Death Index and the National Death Index as sources of mortality information for outcomes research. *Acad Emerg Med.* 2006; 13(5 suppl 1):S147.
- Kramer N, Quinn JV, McDermott DA. Who is really dead: how accurate is the Social Security Death Index? *Acad Emerg Med.* 2006;13:S146.
- Landis JR, Koch GG. The measurement of observer agreement for categorical data. *Biometrics.* 1977;33:111-123.
- Mozes B, Confino-Cohen R, Halkin H. Cost-effectiveness of in-hospital evaluation of patients with syncope. *Isr J Med Sci.* 1988;24:302-306.
- Stiell IG, Wells GA. Methodologic standards for the development of clinical decision rules in emergency medicine. *Ann Emerg Med.* 1999;33:437-447.
- Laupacis A, Sekar N, Stiell I. Clinical prediction rules. A review and suggested modifications of methodological standards. *JAMA.* 1997;277:488-494.
- Kapoor WN, Hanusa BH. Is syncope a risk factor for poor outcomes? Comparison of patients with and without syncope. *Am J Med.* 1996;100:646-655.
- Martin TP, Hanusa BH, Kapoor WN. Risk stratification of patients with syncope. *Ann Emerg Med.* 1997;29:459-466.
- Colivicchi F, Ammirati F, Melina D, et al. Development and prospective validation of a risk stratification system for patients with syncope in the emergency department: the OESIL risk score. *Eur Heart J.* 2003;24:811-819.
- Sun BC, Mangione CM, Merchant G, et al. External validation of the San Francisco Syncope Rule. *Ann Emerg Med.* 2007;49:420-427, 427.e1-4.

### Did you know?

You can track the impact of your article with citation alerts that let you know when your article (or any article you'd like to track) has been cited by another Elsevier-published journal.

**Visit [www.annemergmed.com](http://www.annemergmed.com) today to see what else is new online!**