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Randomized clinical trial of an emergency department observation syncope protocol versus routine inpatient admission.

Permalink

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Journal

Annals of emergency medicine, 64(2)

ISSN

0196-0644

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Publication Date

2014-08-01

DOI

10.1016/j.annemergmed.2013.10.029

Peer reviewed

Randomized Clinical Trial of an Emergency Department Observation Syncope Protocol Versus Routine Inpatient Admission

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Study objective: Older adults are frequently hospitalized from the emergency department (ED) after an episode of unexplained syncope. Current admission patterns are costly, with little evidence of benefit. We hypothesize that an ED observation syncope protocol will reduce resource use without adversely affecting patient-oriented outcomes.

Methods: This randomized trial at 5 EDs compared an ED observation syncope protocol to inpatient admission for intermediate-risk adults (≥ 50 years) presenting with syncope or near syncope. Primary outcomes included inpatient admission rate and length of stay. Secondary outcomes included 30-day and 6-month serious outcomes after hospital discharge, index and 30-day hospital costs, 30-day quality-of-life scores, and 30-day patient satisfaction.

Results: Study staff randomized 124 patients. Observation resulted in a lower inpatient admission rate (15% versus 92%; 95% confidence interval [CI] difference -88% to -66%) and shorter hospital length of stay (29 versus 47 hours; 95% CI difference -28 to -8). Serious outcome rates after hospital discharge were similar for observation versus admission at 30 days (3% versus 0%; 95% CI difference -1% to 8%) and 6 months (8% versus 10%; 95% CI difference -13% to 9%). Index hospital costs in the observation group were \$629 (95% CI difference $-\$1,376$ to $-\$56$) lower than in the admission group. There were no differences in 30-day quality-of-life scores or in patient satisfaction.

Conclusion: An ED observation syncope protocol reduced the primary outcomes of admission rate and hospital length of stay. Analyses of secondary outcomes suggest reduction in index hospital costs, with no difference in safety events, quality of life, or patient satisfaction. Our findings suggest that an ED observation syncope protocol can be replicated and safely reduce resource use. [Ann Emerg Med. 2014;64:167-175.]

Please see page 168 for the Editor's Capsule Summary of this article.

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0196-0644/\$-see front matter

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<http://dx.doi.org/10.1016/j.annemergmed.2013.10.029>

INTRODUCTION

Background

Syncope represents a common and vexing chief complaint in emergency departments (EDs). In the United States alone, syncope accounts for 740,000 annual ED evaluations¹ and yearly hospital costs of more than \$2.4 billion.² Because patients have recovered by ED presentation, it is often difficult to distinguish among the many potential causes that include benign and life-threatening conditions. Despite international efforts to develop clinical guidelines,³⁻⁷ diagnostic pathways,⁸⁻¹¹ and risk prediction tools,¹²⁻¹⁸ there remains considerable uncertainty about how to optimally manage patients at intermediate risk of adverse outcomes.¹⁹ As a result, providers often hospitalize older adults without a clear cause for syncope for diagnostic evaluation.^{1,20-22} However, current admission practices are characterized by low diagnostic yield and

significant practice variation,²³ do not clearly improve outcomes,²⁴ and are costly.^{2,25} These findings have been reported from multiple countries.²⁶⁻³³ Efforts by the Centers for Medicare & Medicaid Services to deny hospital payments for “unnecessary” inpatient admissions have further intensified the need to develop an alternative diagnostic pathway; syncope was recently identified as the top diagnosis associated with payment denials by Centers for Medicare & Medicaid Services recovery audit contractors.³⁴

Importance

An ED observation syncope protocol may safely reduce hospitalizations by expediting and standardizing the evaluation of syncope. A previous single-center randomized evaluation of an ED-based syncope evaluation unit suggested a 55% reduction in hospital admissions without increase in mortality.³⁵ However,

Editor's Capsule Summary*What is already known on this topic*

Hospitalization for syncope has a low diagnostic yield.

What question this study addressed

Can patients with syncope be more efficiently managed in an emergency department observation unit under protocol?

What this study adds to our knowledge

In this randomized controlled trial of 124 intermediate-risk adults with syncope, those treated in the observation unit left the hospital an average of 18 hours earlier than those admitted. They had lower treatment costs and similar outcomes.

How this is relevant to clinical practice

For syncope patients at intermediate risk, an observation unit protocol is more efficient than hospitalization and appears safe.

these results have not been replicated at other sites, and there is no information about how such an approach may affect costs, nonfatal clinical events, and patient-centered outcomes such as quality of life and satisfaction. Evaluating the efficiency and safety of this alternative delivery approach has important health delivery implications; 36% of US EDs operate an observation unit and have the potential ability to implement an ED observation protocol.³⁶

Goals of This Investigation

We compared an ED observation syncope protocol versus routine inpatient admission for intermediate-risk patients after an unrevealing ED evaluation for syncope. We tested the primary hypotheses that an ED observation protocol would reduce hospital admissions and hospital length of stay.

We originally intended to collect planning data for a definitive noninferiority trial of safety, costs, and quality of life. Because of changes in payer audit and payment policies during the study period,³⁴ however, it is unlikely that US hospitals will participate in future randomized studies of ED observation unit care. In exploratory analyses, we assessed the effect of the ED observation protocol on safety, costs, quality of life, and patient satisfaction.

MATERIALS AND METHODS**Study Design and Setting**

We conducted a randomized clinical trial at 5 EDs from March 1, 2010, to October 1, 2011 (ClinicalTrials.gov identifier NCT01003262). Study staff completed participant follow-up on

April 31, 2012. We include the trial protocol and Consolidated Standards of Reporting Trials (CONSORT) checklist as [Appendix E1](#) (available online at <http://www.annemergmed.com>).

The study sites represent a diversity of hospital characteristics, geography, and patient populations (Table E1, available online at <http://www.annemergmed.com>). All ED observation units are located in a distinct physical space adjacent to the main ED, supervised by attending emergency physicians, and staffed by midlevel providers.

The Institutional Review Boards of the coordinating center and all enrolling sites approved this study. An independent safety monitor reviewed all data on clinical events.

Selection of Participants

Patients aged 50 years or older were prospectively screened in the ED for a complaint of syncope or near syncope. Syncope was defined as a sudden, transient loss of consciousness. Near syncope was defined as a sensation of imminent loss of consciousness, without actual syncope.

Using specialty society guidelines, the study team developed risk-stratification guidelines for short-term, dangerous clinical events after syncope ([Figure 1](#)).^{4,6,37} We included additional feedback from enrolling physicians to ensure that the guidelines were feasible and acceptable at the study sites. Treating physicians used these criteria to categorize patients as high, intermediate, or low risk. Patients at intermediate risk were eligible for study enrollment. Although we considered objective risk scores, none have been validated for routine clinical use³⁸ and were not thought to be feasible at our enrolling sites.

We excluded patients with a serious condition identified during the ED visit, including symptomatic arrhythmias,

High Risk Criteria

- Serious condition identified in the ED
- History of ventricular arrhythmia
- Cardiac device with dysfunction
- Exertional syncope
- Presentation concerning for acute coronary syndrome
- Severe cardiac valve disease (eg, aortic stenosis <1 cm2)
- Known cardiac ejection fraction <40%
- Electrocardiogram findings of QTc>500 mS, pre-excitation, non-sustained ventricular tachycardia
- Emergency physician judgment

Intermediate Risk Criteria

- No high risk features **AND**
- No low risk features **AND**
- Clinical judgment by emergency physician that patient requires further diagnostic evaluation

Low Risk

- Symptoms consistent with orthostatic or vasovagal syncope
- Emergency physician judgment that no further diagnostic evaluation is needed

Figure 1. Risk stratification guidelines.

myocardial infarction, pulmonary embolism, acute pulmonary edema, stroke, severe anemia or blood loss requiring blood transfusion, sepsis, and major traumatic injury. Additional exclusion criteria included seizure, head trauma, or intoxication as the reason for loss of consciousness; new or baseline cognitive impairment; do-not-resuscitate or do-not-intubate status; active chemotherapy for cancer; and inability to speak either English or Spanish.

After providing informed consent, patients were block randomized ($n=4$) by site in a 1:1 ratio to either the observation protocol or routine inpatient admission. A computer generated the study arm assignment at randomization, and no research personnel had advance knowledge of study arm assignment. We could not blind this health service intervention to patients, providers, or research personnel. All study patients received an initial ED evaluation consisting of a directed history, physical examination, standardized laboratory tests, and a 12-lead ECG.

Interventions

We used professional society guidelines^{4,6,37} to design the ED observation protocol intervention. All observation protocol patients received continuous cardiac monitoring for at least 12 hours. The ED treating team ordered at least 2 serial cardiac troponin tests approximately 6 hours apart to exclude acute myocardial infarction. The study sites used different troponin assays; we defined a normal troponin threshold as the 99th percentile value for a reference population for each site's assay. The ED treating team ordered a rest echocardiogram for patients with a cardiac murmur on chest auscultation, if an echocardiogram had not been performed in the previous 6 months. The ED treating teams could perform additional testing at their discretion.

The maximum stay in the ED observation unit could not exceed 24 hours. Observation protocol patients who received a diagnosis of a serious condition, had persistent symptoms of syncope or near syncope, were thought by the treating physician to be unable to be safely discharged home because of functional reasons (eg, inability to ambulate), or had pending tests at 24 hours were admitted to the hospital. All other patients were eligible for discharge. The treating ED team made the final decision to admit or discharge observation patients.

An inpatient medicine service managed patients randomized to routine inpatient admission. The study protocol did not guide the care of patients randomized to this arm. Contamination between the study arms was minimized because both groups were managed in distinct physical spaces by different clinical services. Although it is possible that some patients in the routine inpatient admission arm were classified as "observation status" for billing purposes, the physical setting, providers, and processes were indistinguishable from "inpatient" care.

Outcome Measures

Primary outcomes included inpatient admission rates (percentage) and hospital length of stay (hours) at the index ED

visit. Previous studies of health service interventions for syncope have used admission rate as a primary outcome.^{8-11,35} Because hospital services may be similar in inpatient, observation, and ED settings, we also assessed hospital length of stay as a primary outcome.

Secondary outcomes included 30-day and 6-month serious clinical events, index and 30-day hospital costs, 30-day changes in quality of life after study enrollment, and 30-day patient satisfaction.

We defined potential safety events as serious clinical events that occurred after discharge from the index hospital visit. Clinical events that occurred during the hospitalization were not considered safety events because these were thought to represent appropriate recognition of serious illness during the diagnostic evaluation. A multispecialty panel of emergency physicians, internists, geriatricians, and cardiologists previously defined syncope-related, serious clinical events.²⁰ These include death, ventricular arrhythmias, Mobitz II or complete heart block, sick sinus syndrome, sinus pause greater than 3 seconds, symptomatic supraventricular tachycardia (pulse rate >100 beats/min), symptomatic bradycardia (pulse rate <60 beats/min), major cardiac intervention such as permanent pacemaker placement, myocardial infarction, stroke, pulmonary embolism, aortic dissection, nontraumatic intracranial hemorrhage, internal hemorrhage or anemia requiring blood transfusion, and major traumatic injury (intracranial bleeding, bone fracture, or thoracoabdominal visceral injury) associated with syncope, near syncope, or a fall occurring after the index visit. We also measured recurrent episodes of syncope or near syncope resulting in an ED visit.

We modeled hospital costs for all 30-day acute care services in the ED, observation unit, and inpatient settings by imputing 2011 Medicare national mean payments for procedures and observation facility fees. The methods and Table E2 (both available online at <http://www.annemergmed.com>) describe the cost model in detail.

We administered the Quality of Well-being Scale³⁹ to measure general health utility and the Syncope Functional Status Questionnaire^{40,41} to measure symptom-specific quality of life. The Quality of Well-being Scale ranges from 0 to 1, with 0 indicating worst possible health and 1 indicating optimum health. The Syncope Functional Status Questionnaire ranges from 0 to 100, with 0 indicating no syncope-related impairment and 100 indicating maximum impairment.

Finally, we measured patient satisfaction, using the Consumer Assessment of Healthcare Providers and Systems–Hospital overall rating of care,⁴² which ranges from 0 (worst) to 10 (best).

At baseline, all patients received 12-lead ECG, cardiac troponin, basic metabolic panel, and hematocrit testing during the index ED evaluation. Research staff extracted laboratory and vital sign data from the ED chart. Research assistants obtained demographic data, including race/ethnicity, directly from patients and administered baseline quality-of-life instruments. Treating physicians completed a survey about patient history of presentation, preexisting comorbidities, physical examination, and ECG interpretation. We used clinical data to estimate a

Syncope Risk Score, which is a case mix measure derived from a population of older adults with syncope.⁴³ Research staff extracted information on inpatient admission and length of stay from administrative data.

Outcomes ascertainment after patient enrollment included direct patient telephone interviews by research assistants and medical chart abstraction by physician-reviewers. Research staff called patients at 30 days to determine vital status, identify subsequent hospital visits occurring at nonenrolling site facilities, and administer follow-up quality-of-life instruments. Physician reviewers abstracted records from all ED visits and hospitalizations within 30 days, including those that occurred outside of the enrolling sites, to identify serious clinical events and to quantify hospital-based health service use. Research staff recorded disposition (discharge from ED, observation, inpatient admission) and major diagnostic and therapeutic procedures. We repeated direct patient telephone interviews and chart reviews at 6 months to identify additional serious clinical events and episodes of recurrent syncope. Finally, we verified the vital status of all patients at 6 months after enrollment with the Social Security Death Masterfile.⁴⁴

A second physician-reviewer who was blinded to the original reviews reabstracted charts for the 40 enrolled patients (first 10 enrollments at each of the 4 sites). There was 100% agreement on the occurrence of serious clinical events and good agreement on whether patients received any of 25 diagnostic or therapeutic procedures ($K=0.63$ to 1).

Primary Data Analysis

We created intent-to-treat regression models with study sites as fixed effects to analyze all outcomes. The predictor variable was randomization assignment. We analyzed binary outcomes with logistic regressions. To correct for skewness, we applied a log transformation to cost outcomes. The difference in cost outcomes between observation and routine care was estimated according to a log-scale analysis and then transformed back to the original scale, and the corresponding 95% confidence interval (CI) was calculated by using bootstrapping with 1,000 iterations. Finally, we used the log-rank test to analyze survival without a safety event during the first 6 months after initial hospital discharge, and Kaplan-Meier curves for safety events were plotted.

The sample size was designed to achieve a power of 80% to detect a 22% reduction in inpatient admission rate in the observation group (2-sided $\alpha=.05$), assuming an inpatient admission rate of 85% in the standard care group. A safety monitor performed an interim analysis at 6 months, with a predefined stopping threshold for an absolute difference of 8% or greater in serious outcomes between the 2 study arms.

We performed a post hoc noninferiority analysis of 1-month serious outcomes after index hospital discharge. We defined a prespecified noninferiority threshold of 4% absolute difference in 30-day safety event rates, using an economic justification (see trial protocol). If the observation protocol resulted in a 4% worse safety event rate than routine care, then previous cost data² suggest that it would cost \$135,000 to potentially avoid 1 safety

event by admitting all patients rather than observing them. This threshold assumes that inpatient admission reduces downstream morbidity and mortality related to syncope safety events, which has never been proven,²⁴ and this margin is more expensive than commonly suggested criteria for cost-effective care (eg, \$100,000/quality-adjusted life-year).⁴⁵

In contrast to frequentist procedures, which seek to disprove the null hypothesis, a Bayesian approach estimates the likelihood that a study hypothesis is true. Bayesian analyses may be particularly helpful for small studies, in which there may be insufficient data to exclude the null hypothesis.⁴⁶ We used Bayesian logistic regression models to estimate the posterior probability that the absolute difference in 1-month safety events was within the prespecified 4% noninferiority margin. We used noninformative previous distributions for the models. Bayesian parameter estimates were generated with Markov chain Monte Carlo methods, and Bayesian model inferences were summarized as a point estimate and an interval containing the true parameter with some probability (ie, the 95% credible interval). As recommended by CONSORT guidelines for noninferiority analyses,⁴⁷ we analyzed all enrolled patients (intent-to-treat approach) and all patients who received the assigned treatment (per-protocol approach). The Bayesian modeling was implemented with the WinBUGS software (available at: <http://www.mrc-bsu.cam.ac.uk/bugs/winbugs/contents.shtml>; version 1.4.3).⁴⁸

This study differs from the original trial registration and protocol in the following aspects: (1) We decreased the age criterion from the original trial proposal (≥ 60 years) after 4 months of enrollment to improve patient recruitment; the study sponsor and study site Institutional Review Boards approved this change. (2) The original trial protocol proposed collection of 6-month quality-of-life data; however, this was dropped because of participant complaints about survey length and burden. (3) We proposed a formal cost-effectiveness analysis (ie, comparison of the ratio of cost to quality-adjusted life-year). We dropped this analysis because of lack of observed differences in the denominator (see “Results”). A formal cost-effectiveness analysis would yield no additional information compared with an assessment of cost difference only. (4) We added satisfaction as a secondary outcome because of its importance to patient-centered care. (5) Finally, the Bayesian noninferiority assessment of safety events was an exploratory analysis and not proposed in the original protocol.

RESULTS

Characteristics of Study Subjects

Figure 2 describes screening, eligibility, and randomization. Of 2,724 ED patients screened for syncope or near syncope, there were 1,235 who were potentially eligible before risk stratification. Treating physicians excluded an additional 315 patients for low risk and 633 patients for high risk. Compared with intermediate-risk patients, high-risk patients were older (70 versus 66 years; 95% CI difference 2.4 to 5.7 years); there were no differences by sex (67% versus 70% female; $\chi^2 P=.26$).

Figure 2. Screening and enrollment flowchart. DNR, do not resuscitate; DNI, do not intubate.

Table E3 (available online at <http://www.annemergmed.com>) lists specific reasons for high-risk exclusions.

Of 287 eligible patients after risk stratification, study staff randomized 124. Table E4 (available online at <http://www.annemergmed.com>) describes reasons eligible patients were not randomized. In the final study cohort, there was a higher proportion of patients with abnormal ECG results in the control group; there were otherwise no major imbalances in demographic and clinical features between the groups (Table 1). Protocol violations included 4 patients who left against medical advice after randomization and 2 patients discharged by the treating physician despite randomization to the admission arm.

We describe study outcomes in Table 2 and missing outcome data in Table E5 (available online at <http://www.annemergmed.com>). In the routine admission arm, protocol violations accounted for the 8% of patients who were not hospitalized. Compared with routine admission, observation was associated with absolute reductions of 77% in inpatient admission rate (relative risk ratio 0.16; 95% CI 0.09 to 0.29; $P<.001$) and 18 hours in hospital length of stay ($P<.001$).

Table E6 (available online at <http://www.annemergmed.com>) describes all patients with potential safety events. There were no significant differences in the proportion of patients who received a diagnosis of a serious clinical condition after the initial ED evaluation at 30 days or 6 months. Figure 3 displays the Kaplan-Meier curve for safety events at 6 months ($P=.80$).

The ED observation syncope protocol was associated with an absolute cost reduction of \$629 for hospital services

Table 1. Characteristics of study cohort.

Characteristic	Observation (n=62)	Routine Admission (n=62)
Age, mean (SD), y	65 (11)	64 (11)
Chief complaint of syncope, No. (%) [*]	46 (74)	38 (61)
Male, No. (%)	29 (47)	32 (52)
White/non-Hispanic, No. (%)	27 (44)	24 (39)
Medical history, No. (%)		
Congestive heart failure	1 (2)	2 (3)
Coronary artery disease	8 (13)	5 (8)
Arrhythmia	5 (8)	4 (6)
Syncope in previous year	10 (16)	13 (21)
Index syncope history, No. (%)		
Occurred while supine	8 (13)	8 (13)
Associated with chest pain	8 (13)	7 (11)
Associated with shortness of breath	11 (18)	4 (6)
Associated with palpitations	6 (10)	4 (6)
No warning signs	18 (29)	13 (21)
Baseline quality-of-life scores		
Quality of Well-being Scale, mean (SD)	0.55 (0.15)	0.55 (0.14)
Quality of Well-being Scale, median (IQR)	0.55 (0.45, 0.65)	0.55 (0.47, 0.66)
Syncope Functional Status Questionnaire, mean (SD)	29 (25)	25 (26)
Syncope Functional Status Questionnaire, median (IQR)	26 (7.1, 41)	17 (4.8, 39)
Triage systolic blood pressure, mean (SD)	140 (24)	141 (24)
Hematocrit <30%	5 (8)	3 (5)
Troponin >99% normal reference, No. (%) [†]	5 (8)	5 (8)
Abnormal initial ECG result, No. (%) [‡]	11 (18)	23 (37)
Syncope Risk Score, mean (SD) [§]	0.76 (0.84)	0.76 (0.67)

SD, Standard deviation; IQR, Interquartile range.

*Versus near syncope.

[†]>99% Normal reference range for site-specific troponin assay.

[‡]Presence of nonsinus rhythm, multiple premature ventricular contractions (>1 on standard 12-lead tracing), sinus bradycardia <40, left or right ventricular hypertrophy, left or right axis deviation, complete left or right bundle-branch block, first-degree block (>20 mS), short PR interval (<10 mS), prolonged QRS (>10 mS), prolonged QTc (>450 mS), and Q/ST/T changes consistent with acute or chronic ischemia.

[§]Risk prediction score developed for older adults with syncope.⁴³

associated with the index visit, and a nonsignificant trend toward decreased 30-day hospital costs. We found no differences in diagnostic testing rates between the groups (Table E7, available online at <http://www.annemergmed.com>); therefore, the cost differences were attributable to differences in hospital length of stay. There were no significant differences in general health utility, syncope-specific quality of life, or patient satisfaction.

Table 2. Outcomes by study group.*

Outcomes	Observation (n=62)	Routine Admission (n=62)	Difference (95% CI)
Primary outcomes			
Inpatient admission, No. (%)	9 (15)	57 (92)	−77 (−88 to −66)
Length of stay, mean (SD), h	29 (15)	47 (34)	−18 (−28 to −8)
Secondary outcomes			
Costs, \$US†			
Hospital costs, at index visit, mean (SD)	1,400 (1,220)	2,420 (3,930)	−629 (−1,376 to −56)
Hospital costs, at index visit, median (IQR)	1,190 (870, 1,550)	1,570 (870, 2,370)	
Hospital costs, within 30 days, mean (SD)	1,800 (2,150)	2,520 (3,980)	−479 (−1,230 to 198)
Hospital costs, within 30 days, median (IQR)	1,210 (948, 1,660)	1,580 (870, 2,390)	
Serious clinical outcomes during hospital visit, No. (%)	5 (8)	3 (5)‡	3 (−6 to 12)
Death	0	0	
Arrhythmia	2 (3)	2 (3)	
Pacemaker insertion	1 (2)	1 (2)	
Syncope/fall with bone fracture	2 (3)	1 (2)	
30-day recurrent syncope, No. (%)	1 (2)	1 (2)	0 (−4 to 4)
30-day serious outcomes after hospital discharge, No. (%)	2 (3)	0	3 (−1 to 8)
6-mo serious outcomes after hospital discharge, No. (%)	4 (8)	5 (10)	−2 (−13 to 9)
Quality of life			
Change in Quality of Well-being Scale score, mean (SD)	0 (0.20)	0.03 (0.18)	−0.02 (−0.10 to 0.06)
Change in Syncope Functional Status Questionnaire score, mean (SD)	−7.6 (20.1)	−2.4 (26.3)	−5.2 (−15.2 to 4.8)
Patient satisfaction, mean (SD)	8.9 (1.4)	9.3 (0.9)	−0.46 (−0.95 to 0.026)

*% Denominator based on complete outcomes data; see Table E3 (available online at <http://www.annemergmed.com>) for missing outcomes data. All site fixed effects were nonsignificant ($P>.05$).

†95% CI for differences based on back-transformation of log-transformed analysis; see text.

‡One patient experienced symptomatic arrhythmia, cardiac ablation, and pacemaker placement.

Figures E1 and E2 (available online at <http://www.annemergmed.com>) illustrate the posterior distributions of rate differences. For the intent-to-treat analysis, the posterior estimate of difference in safety event rates at 1 month between observation and admission was 3.1% (95% CI 0.3% to 9.0%). With a 4% noninferiority margin, the posterior probability of the

observation protocol's being noninferior to routine care was 0.72, given the observed data.

For the per-protocol analysis, the posterior estimate of difference in safety event rates at 1 month between the 2 arms was 3.3% (95% CI 0.3% to 9.4%). The posterior probability of the observation protocol's being noninferior to routine admission was 0.70.

LIMITATIONS

Strengths of our study include patient-level randomization and replication of the protocol at EDs with a diversity of structural and patient characteristics. However, we acknowledge potential limitations. First, this study was not a priori powered to assess noninferiority of secondary outcomes. Given external payer pressures to reduce inpatient syncope admissions,³⁴ additional efforts to randomize patients are unlikely to succeed in US settings. However, our Bayesian analyses suggest that the observation protocol is likely to be noninferior to routine inpatient admission for safety events.

Second, there is no existing consensus for an acceptable noninferiority margin for safety events. We used an economic approach with a conventional cost/quality life-year threshold and highly conservative assumptions about the potential benefit of hospitalization over observation. However, the clinical acceptability of our proposed safety margin is unknown and requires investigation.

Third, we found that almost half of potentially eligible patients were excluded as “high risk”; half of those exclusions were based on the clinical judgment of treating physicians.

Note: Circles are censored observations and they are marked at their censored times.

Figure 3. Kaplan-Meier curves for safety events.

Because published risk scores have not been validated for routine clinical use,³⁸ we developed risk-stratification guidelines that were acceptable to enrolling site physicians and consistent with those of previous research.³⁵ However, conservative risk stratification and physician discomfort with the observation protocol may have limited potential enrollment.⁴⁹ Validated risk-prediction instruments may broaden the safe application of the observation protocol.⁴³ Although there is the potential for selection bias toward less severely ill patients, the overall 30-day event rate (6%) observed in our trial is almost identical to the reported event rate in a community cohort of intermediate-risk, older adults presenting to an ED with syncope.⁴³

Fourth, our cost analysis did not include outpatient facility or patients' costs. We were unable to collect reliable data on outpatient visits, and it is possible that there were differences in outpatient health service use between the treatment arms. In addition, there is increasing concern about large and unanticipated patient copayments associated with observation care.⁵⁰ Although we did not have data on patient copayments, it is likely that Medicare-covered patients in our trial would have paid less under observation status than as an inpatient admission. The 2011 Medicare inpatient deductible⁵¹ for hospital services was \$1,132; at the outpatient Medicare copay rate of 20%, Medicare covered patients in our observation arm on average would have paid less than \$300 for hospital services.

Fifth, the original protocol proposed to study patients aged 60 years and older because of higher incidence of adverse events and health service use.^{52,53} The age criterion was decreased because of enrollment challenges, and it is possible that observation has a differential effect on patients older and younger than 60 years. In post hoc analysis, we assessed whether there was any interaction effect between treatment assignment and age (dichotomized as <60 and ≥ 60 years). We found no significant interaction effects ($P>.30$) for any of the primary or secondary outcomes.

Sixth, there was an imbalance in patients with abnormal ECG results between the 2 treatment arms, likely because of the small sample size. Similar Syncope Risk Stratification Scores (which incorporate ECG abnormalities) suggest that overall risks in the groups were comparable before randomization. In post hoc analysis that included abnormal ECG results, the difference in index hospital costs became insignificant ($P=.07$); there were no qualitative changes in analyses of any other primary or secondary outcome.

Seventh, we had incomplete data for quality-of-life and satisfaction ratings (Table E3, available online at <http://www.annemergmed.com>) because of participant refusal, which is likely related to length of the survey instruments. There is the potential for response bias, although we did not find evidence of differential response rates by study arm.

DISCUSSION

We found that an ED observation protocol substantially reduced hospital inpatient admissions, length of stay, and index hospital costs in older patients with intermediate-risk syncope. We observed similar rates of potential safety events, changes in

quality-of-life scores, and ratings of overall care between the study arms. We did note that the cost advantage of an ED observation protocol was attenuated at 30 days, and this finding may be related to subsequent hospital visits that were unrelated to the index visit for syncope. Our findings suggest that a structured observation protocol, based in the ED, is a safe and cost-saving alternative to hospital inpatient admission for the evaluation of intermediate-risk syncope.

Several European studies suggest that structured decision pathways and specialized diagnostic units may safely reduce resource use in the evaluation of syncope.^{8,9} However, these studies were not randomized and the findings of benefit have not been uniform.^{10,11} There previously has been a single randomized trial ($n=103$) of an ED-based syncope unit, performed at an academic center serving a predominantly white population.³⁵ The trial reported a 55% absolute reduction in hospital admissions and a 54% relative reduction in hospital bed-days. There were no significant differences in death or recurrent syncope at 2-year follow-up. Our study confirms and generalizes these previous findings to sites with diverse hospital and patient characteristics. We also assessed costs, nonfatal safety events, quality of life, and patient satisfaction, which to our knowledge have not been previously studied. Our trial suggests that an ED observation protocol can be successfully implemented in a variety of practice settings with an existing ED observation unit.

Several mechanisms may explain our findings. The immediate availability of testing services and attending providers at all times of the day may have facilitated rapid decisionmaking in the observation group compared with the patients admitted to the inpatient setting. The study protocol is a structured pathway and may reduce variance in the diagnostic evaluation. Similar postdischarge event rates for both groups suggest that 12 to 24 hours of cardiac monitoring in an observation unit is safe; there may be diminishing diagnostic value in extending monitoring beyond 24 hours.⁵⁴

In summary, we found that an ED-based observation protocol substantially reduced resource use at the index visit for intermediate-risk patients with syncope, without evidence of worse clinical, quality-of-life, or satisfaction outcomes. This protocol can easily be adapted for EDs with existing observation units and represents a cost-effective and safe alternative to routine inpatient admission. Future research should confirm our preliminary findings of safety in external cohorts and develop objective risk prediction instruments to identify a broader set of patients who may be eligible for observation unit care.

Supervising editor: Steven M. Green, MD

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Author contributions: BCS and CMM designed the study. BCS obtained funding for the study and drafted the article. BCS, HM, SB, CB, LR, SOH, CC, and AB were responsible for data collection, and BCS supervised the overall data collection process. HM was responsible for data management and cleaning. L-JL performed the data analysis. EK and RA developed and implemented the cost-model methodology. All authors contributed substantially to article revisions and approved the final article for submission. BCS, HM, and L-JL had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. BCS 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 as per ICMJE conflict of interest guidelines (see www.icmje.org). The authors have stated that no such relationships exist. This study was supported by National Institutes of Health (NIH) grant RC1 AG035664 (Dr. Sun). During the study, Dr. Sun was supported by NIH/National Institute of Aging grant K12 AG001004, the UCLA Older Americans Independence Center grant P30-AGO28748, and an American Geriatrics Society Dennis Jahnigen Career Development Award. Dr. Mangione is supported in part by the UCLA Robert Wood Johnson Clinical Scholars Program, the US Department of Veterans Affairs (grant 67799), the University of California, Los Angeles, Resource Centers for Minority Aging Research Center for Health Improvement of Minority Elderly under NIH/NIA grant P30-AGO21684, and NIH/NCATS UCLA Clinical and Translational Science Institute grant UL1TR000124.

The funding organizations had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; and preparation, review, or approval of the article. The contents do not necessarily represent the official views of the National Institutes of Health.

Publication dates: Received for publication July 19, 2013. Revisions received September 11, 2013, and October 16, 2013. Accepted for publication October 24, 2013. Available online November 13, 2013.

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