Interhospital variability in hospital admissions for patients with low-risk syncope presenting to the emergency department

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BACKGROUND Guidelines and risk scores have sought to standardize the management of syncope in the emergency department (ED), but variation in practice remains.

OBJECTIVE The purpose of this study was to explore factors associated with admission for patients presenting to the ED with low-risk syncope.

METHODS Our study population included adult patients in the Nationwide Emergency Department Sample between 2006 and 2019 who presented to an ED with a primary diagnosis of syncope. Multivariable hierarchical logistic regression analyses determined the association of patient or hospital factors with admission. Reference effect measures methodology assessed the relative contributions of patient, hospital, and unmeasured hospital factors.

RESULTS Of the 3,206,739 qualifying encounters during the study period, 804,398 (25.1%) met low-risk criteria. Of these patients, 20,260 were admitted to the hospital (2.5%). Factors associated with increased odds of admission included increasing age and weekend presentation to the hospital, while female sex, lack of medical insurance, hospital region, teaching status, and higher ED volume decile were associated with lower odds of admission. Reference effect measures methodology demonstrated that unmeasured site variability contributed the widest range of odds for admission (odds ratio [OR] 5th percentile vs 95th percentile 0.23–4.38) compared with the composite patient (OR 0.33–3.68) or hospital (OR 0.65–1.30) factors.

CONCLUSION Admission patterns for low-risk syncope varies widely across institutions. Unmeasured site variation contributes significantly to the variability in admission rates, suggesting which hospital a patient presents to plays a disproportionate role in admission decisions. Further guidance to reduce practice variation in syncope care in the ED is needed.

KEYWORDS Syncope; Emergency department; Health care utilization; Hospital admissions; Reference effect measures methodology

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Introduction

Syncope accounts for more than 1 million emergency department (ED) visits per year in the United States, accounting for approximately 1% of annual ED visits.[1] Syncope workup in the ED presents a challenge for physicians, as causes range from largely benign (eg, vasovagal syncope) to life-threatening (eg, serious arrythmias) conditions. There have been several attempts to standardize the management of syncope in the ED, but there remains no widely adopted protocol, and significant variation remains in care of patients with syncope in the ED.[2] While approximately one-third of patients presenting with syncope are admitted, admission to the hospital has been found to offer limited diagnostic yield, is associated with an estimated $2.4 billion in costs annually, and can be potentially harmful for low-risk patients.[1,3,4] Studies have also demonstrated the low value of several diagnostic tests used for many patients with syncope, including neuroimaging and carotid duplex ultrasound, leading to calls to limit their use from national organizations such as the Choosing Wisely campaign.[2,5] In an effort to reduce variation in practice patterns, several professional societies have provided clearer guidance for syncope management in recent years.[6,7] These guidelines include standardization of workup and criteria for more selective use of advanced diagnostic imaging and admissions, though the impact of these efforts on reducing variation in care remains unclear.

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KEY FINDINGS

- Barriers to implementation at the individual and system level have led to continued variability in practice patterns, including unnecessary hospitalizations and tests that can pose an unneeded risk for patients presenting to the emergency department for low-risk syncope.
- Unmeasured site variation contributed more to the overall variability in admission rates in low-risk patients than did measured patient or hospital factors, suggesting presenting hospital plays a disproportionate role in determining admission decisions for patients with syncope.
- These findings emphasize the heterogeneity of low-risk syncope evaluation in the United States and support the need for more standardized practice guidelines to consolidate variation in practice patterns.

To examine temporal trends and variation in admission patterns performed in the ED for patients with syncope, we leveraged data from the Healthcare Cost and Utilization Project Nationwide Emergency Department Sample (NEDS) database. Specifically, we sought to examine key drivers that influence the disposition of low-risk patients with syncope in the ED at the patient and hospital levels.

Methods

Data sources, study cohort, and predictor variables

The NEDS is the largest all-payer ED database in the United States. Beginning in 2006, the NEDS includes data from more than 33 million annual ED visits, accounting for 83.9% of all US ED visits. The NEDS comprises discharge information from ED visits across 993 hospitals situated in 39 states and the District of Columbia. These data represent an estimated 20% stratified sample of EDs owned by US hospitals. Participation in this data collection is on a voluntary basis.[8] Encounters with a primary diagnosis of syncope between 2006 and 2019 were identified using *International Classification of Diseases, Ninth Revision, Clinical Modification* and *International Classification of Diseases, Tenth Revision, Clinical Modification* codes, as were the medical comorbidities. Patient demographic characteristics included in the study included age, sex, insurance status, and income quartile that is determined in the NEDS by the zip code. Relevant *International Classification of Diseases* codes are outlined in Online Supplemental Table 1. Patients were required to be at least 18 years old at the time of an ED encounter. The total ED encounter volume was calculated by compiling all available NEDS data for each hospital in a calendar year and then calculating deciles relative to all participating EDs. Lastly, the year of an ED encounter, ED region (Northeast, South, East, or West), teaching status of the ED, and weekend vs weekday presentation to the ED were extracted from the database.

Outcomes

The primary outcome of interest was admission to the hospital. For the primary analysis, patients were required to be "low risk," which we defined as age below 50 years as used in previous studies,[9] as well as requiring (1) the absence of comorbidities identified in the 2017 American College of Cardiology/American Heart Association/Heart Rhythm Society (ACC/AHA/HRS) syncope guidelines that might "warrant consideration of further evaluation and therapy in a hospital setting" including ventricular tachycardia, Mobitz II or third-degree heart block, symptomatic bradycardia, supraventricular tachycardia, cardiac implanted electronic device malfunction, inheritable cardiovascular conditions, cardiac ischemia, aortic stenosis, cardiac tamponade, hypertrophic cardiomyopathy, severe prosthetic valve dysfunction, pulmonary embolism, aortic dissection, acute heart failure, and moderate-to-severe left ventricular dysfunction[7]; (2) the absence of comorbidities identified by Probst et al[9] used to identify low-risk patients with syncope, which were reviewed by the American College of Emergency Physicians Quality and Patient Safety Committee in 2021[9]; and (3) the absence of a list of medical comorbidities selected a priori, which were not included in the previous 2 diagnostic exclusion lists, including end-stage renal disease, chronic kidney disease, peripheral arterial disease, dementia, history of cerebrovascular attack, diabetes mellitus, atrial fibrillation, hypertension, sleep apnea, obesity, native valvular heart disease, anxiety, or depression. To provide context for the relative magnitude of unmeasured site variation, we investigated admission to the hospital in "high-risk" patients, defined as those with at least 1 high-risk syncope–affiliated diagnosis from the 2017 guidelines[7] without an age cutoff of 50 years.

Analysis

Descriptive statistics were used to summarize patient and hospital characteristics, and bivariable comparisons were made using analysis of variance, Kruskal-Wallis test, χ^2 test, or Fisher exact test, where appropriate. Trends in admission rates over years were performed using linear regression. To examine covariates independently associated with admission from the ED, multivariable hierarchical logistic regression analyses were performed using all aforementioned patient and hospital factors. Hierarchical modeling with a random effect for the ED site was used to account for encounter clustering by the ED.

The primary analysis sought to measure patient and hospital factors associated with admission, to quantify otherwise unexplained variation by hospital, and to determine the relative influence of each of these sets of factors on rates of admission to the ED. A reference effect measures (REM) methodology was used to examine the contribution of measured patient factors and hospital factors (measured and unmeasured) to admission.[10] We calculated empirical distributions of risk for the set of all measured patient

characteristics and of all measured hospital characteristics, in each case holding all other factors constant, and compared these risk distributions with the estimated random effect distribution describing unmeasured hospital variation. These distributions are summarized using odds ratios (ORs) for admission for patients at lower (5th percentile) and higher (95th percentile) percentiles of these distributions when compared with the 50th percentile. Wider ranges of ORs indicated larger contributions to admission. To provide context to these distributions in ORs, we repeated the analysis on the aforementioned high-risk cohort.

Since all data were abstracted retrospectively and anonymously without unique patient identifiers, institutional review boards waive the need for patient informed consent. The research in this article adhered to Helsinki Declaration guidelines. Statistical analyses were performed using R version 4.2.1 (2022, R Core Team, Vienna, Austria).

Results

Of the 3,206,739 ED encounters for a primary diagnosis of syncope from 2006 to 2019, 804,398 (25.1%) met criteria for a low-risk encounter. Of these patients, 20,260 were admitted to the hospital (2.5%) for a median of 1 day (interquartile range ±1 day). The baseline characteristics of patients and hospitals in the low-risk cohort are outlined in Table 1. Patients admitted to the hospital were older (35.1 ± 9.5 years vs 30.5 ± 9.4 years; $P < .001$), more likely to be male (47.7% vs 36.4%; $P < .001$), more likely to be insured (83.1% vs 79.9%; $P < .001$), and more likely to live in higher-income quartiles based on the zip code ($P < .001$). Of the 3476 hospitals included in the NEDS treating low-risk patients with syncope, factors associated with higher rates of hospital admission included region of the country ($P < .001$), nonteaching status (54.5% vs 49.9%; $P < .001$), and lower ED total encounter volume decile ($P < .001$). Admission rates for low-risk patients declined from 4.5% in 2006 to 1.2% in 2019 (0.3% per year; P for trend $< .001$) (Figure 1).

Adjusted analyses of factors associated with hospital admission of patients with low-risk syncope are shown in Table 2 and Figure 2. Factors associated with increased odds of hospital admission included increasing age (OR 1.60 per 10 years; 95% confidence interval [CI] 1.57–1.62) and weekend presentation to the hospital (OR 1.07; 95% CI 1.03–1.11). Patient characteristics associated with lower odds of admission included female sex (OR 0.65; 95% CI 0.63–0.67) and lack of medical insurance (OR 0.74; 95% CI 0.71–0.77). Hospital factors associated with lower odds of admission included hospital region (lower for all non-Northeast regions), teaching status (OR 0.84; 95% CI 0.79–0.90 for teaching vs nonteaching), and higher ED volume (OR 0.96; 95% CI 0.95–0.98 for admission per decile of syncope ED encounters at a given hospital).

Table 1 Patient and hospital demographic characteristics

Characteristic	Not admitted (n = 784,138)	Admitted (n = 20,260)	Total (N = 804,398)	*P*
Patient factors				
Age (y)	30.541 ± 9.356	35.114 ± 9.470	30.656 ± 9.386	<.001
Female sex	498,872 (63.6)	10,585 (52.3)	50,9457 (63.3)	<.001
Presentation timing				<.001
Weekday	588,221 (75.0)	14,900 (73.5)	60,3121 (75.0)	
Weekend	195,917 (25.0)	5,360 (26.5)	201,277 (25.0)	
Income quartile				<.001
Missing	15,026 (1.9)	641 (3.2)	15,667 (1.9)	
1 (lowest income)	214,950 (27.9)	5,364 (27.3)	220,314 (27.9)	
2	198,129 (25.8)	4,906 (25.0)	203,035 (25.7)	
3	184,444 (24.0)	4,600 (23.4)	189,044 (24.0)	
4 (highest income)	171,589 (22.3)	4,749 (24.2)	176,338 (22.4)	
Primary insurance				<.001
Missing	2,700 (0.3)	67 (0.3)	2,767 (0.3)	
Medicare	24,268 (3.1)	1,047 (5.2)	25,315 (3.2)	
Medicaid	161,194 (20.6)	4,027 (19.9)	165,221 (20.6)	
Private	389,449 (49.8)	10,049 (49.8)	399,498 (49.8)	
Self-pay	157,412 (20.1)	3,422 (16.9)	160,834 (20.1)	
No charge	5,808 (0.7)	364 (1.8)	6,172 (0.8)	
Other	43,307 (5.5)	1,284 (6.4)	44,591 (5.6)	
Hospital factors				
Region				<.001
Northeast	179,012 (22.8)	5,696 (28.1)	184,708 (23.0)	
Midwest	170,569 (21.8)	4,434 (21.9)	175,003 (21.8)	
South	291,628 (37.2)	7,408 (36.6)	299,036 (37.2)	
West	142,929 (18.2)	2,722 (13.4)	145,651 (18.1)	
Teaching hospital				<.001
No	391,219 (49.9)	11,051 (54.5)	402,270 (50.0)	
Yes	392,919 (50.1)	9,209 (45.5)	402,128 (50.0)	

Values are presented as mean ± SD or n (%).

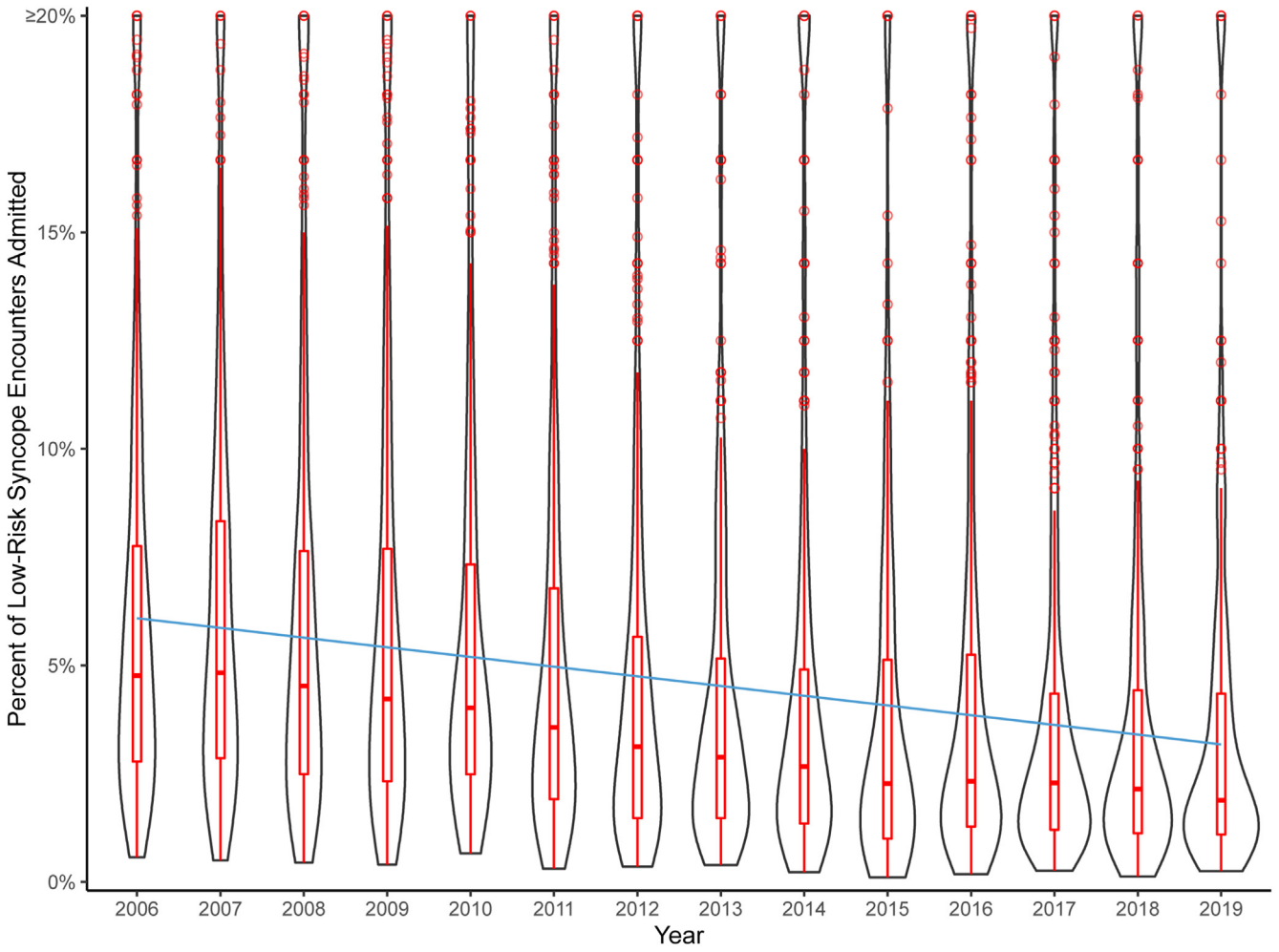

Figure 1 Trends in admission rates for low-risk syncope, 2006–2019. Violin plot demonstrating the relative density of patients admitted for low-risk syncope from years 2006 to 2019. Linear regression (*blue line*) demonstrates a downward trend from 5.1% in 2006 to 2.0% in 2019 (0.3% per year; *P* for trend < .001).

Using REM methodology, we found that all 3 sources of variation (measured patient factors, measured hospital factors, and unmeasured hospital factors) contributed substantially to the association with admission rates of patients with low-risk syncope. However, extensive unmeasured hospital variation was observed when comparing the odds of similar patients presenting to hospitals less likely (5th percentile) or more likely (95th percentile) to admit for low-risk syncope (95% OR range 0.23–4.38) (Table 2). This unmeasured hospital variation was greater than the impact of measured hospital factors (95% OR range 0.65–1.30) as well as measured patient factors (95% OR range 0.33–3.68) (Figure 2). From 2006 to 2019, the magnitude of unmeasured variation in the low-risk cohort did not change significantly (Online Supplemental Figure 1).

To provide context for the OR ranges determined using REM methodology, an additional analysis of higher-risk patients presenting to the ED with syncope was performed. These patients have clear indications for admission as recommended by the 2017 ACC/AHA/HRS guidelines. Patient demographic characteristics and diagnoses for this high-risk cohort are presented in Online Supplemental Table 2, including 552,833 ED visits, of which 181,259 (32.8%) resulted in hospital admissions. Multivariable hierarchical logistic regression results are presented in Online Supplemental Table 3. Using REM methodology, significant unmeasured hospital variation was demonstrated in the high-risk cohort (95% OR range 0.22–4.60). This unmeasured hospital variation was greater than the impact of measured hospital factors (95% OR range 0.76–2.13) but less than the contributions from measured patient factors (95% OR range 0.19–5.31). Compared with the low-risk cohort, the high-risk cohort showed greater contributions from patient factors (95% OR range 0.19–5.31 vs 95% OR range 0.31–4.17) and measured hospital factors (95% OR range 0.76–2.13 vs 95% OR range 0.66–1.31) but similar findings for unmeasured hospital factors (95% OR range 0.22–4.60 vs 95% OR range 0.23–4.30), as shown in Online Supplemental Figure 2.

Discussion

In this study of more than 3.2 million ED encounters for syncope from 2006 to 2019, the overall admission rate in

Table 2 Multivariable model for odds of hospital admission of low-risk syncope

Variable	OR (95% CI)	*P*
Patient factors		
Age (per 10 y)	1.60 (1.57–1.62)	<.001
Female sex	0.65 (0.63–0.67)	<.001
No insurance	0.74 (0.71–0.77)	<.001
Income quartile	0.99 (0.98–1.01)	.328
Year	0.88 (0.88–0.89)	<.001
Weekend presentation	1.07 (1.03–1.11)	<.001
Hospital factors		
Midwest (vs Northeast)	0.80 (0.70–0.91)	<.001
South (vs Northeast)	0.82 (0.72–0.92)	<.001
West (vs Northeast)	0.62 (0.54–0.71)	<.001
Teaching hospital	0.84 (0.79–0.90)	<.001
Total ED syncope volume (per decile)	0.96 (0.95–0.98)	<.001
Composite patient factors		
5th percentile	0.33 (0.31–0.35)	
10th percentile	0.40 (0.39–0.42)	
25th percentile	0.60 (0.59–0.61)	
50th percentile	1 (1–1)	
75th percentile	1.69 (1.66–1.73)	
90th percentile	2.79 (2.68–2.90)	
95th percentile	3.68 (3.50–3.87)	
Composite hospital factors		
5th percentile	0.65 (0.57–0.77)	
10th percentile	0.77 (0.68–0.86)	
25th percentile	0.83 (0.77–0.93)	
50th percentile	1 (1–1)	
75th percentile	1.09 (1.05–1.25)	
90th percentile	1.23 (1.14–1.39)	
95th percentile	1.30 (1.25–1.52)	
Unmeasured site variation		
5th percentile	0.23 (0.21–0.25)	
10th percentile	0.32 (0.30–0.34)	
25th percentile	0.55 (0.53–0.56)	
50th percentile	1 (1–1)	
75th percentile	1.83 (1.77–1.89)	
90th percentile	3.16 (2.97–3.35)	
95th percentile	4.38 (4.05–4.72)	

CI = confidence interval; ED = emergency department; OR = odds ratio.

low-risk patients was 2.5%, decreasing by 0.3% per year. While patient and hospital factors were found to influence the odds of hospital admission, unmeasured site variability was the largest contributing factor and persisted despite a reduction in overall admission rate over time. These findings suggest that presenting to one ED vs another can be equally, if not more, influential in the decision for admission than individual patient or hospital factors. These findings suggest that further guidance to reduce practice variation in syncope care in the ED is needed, potentially in the form of further clarification from the guidelines or improved utilization of previously published risk scores. This is further supported by the persistent magnitude of unmeasured site variation from 2006 to 2019.

Previous studies have documented widespread variability in admission patterns for many of the most common ED presentations,[11,12] with a myriad of contributing factors implicated including variation in clinical judgment, variation in risk tolerance, and variation in regional factors.[11,13–15] Syncope admissions may be particularly subject to significant variation given the wide range of possible etiologies. A single-system study by Khojah et al[11] found that syncope was among the top diagnoses with highest variation in hospital-level admission rate and among the most common conditions driving ED admission along with asthma/chronic obstructive pulmonary disease and injuries. While there is evidence that patients with syncope in the ED may benefit from outpatient follow-up with a syncope specialist rather than admission,[16] the existence of such clinics varies widely between health systems, which may contribute further to unmeasured variation as has been demonstrated with encounters for chest pain[15] and atrial fibrillation.[17]

A recent study by Probst et al[9] sought to examine hospital-level variation in low-risk patients with syncope, defining low-risk patients as those younger than 50 years who had no cardiac conditions on the basis of analysis of a data set used to develop the Canadian Syncope Risk Score. Using logistic regression clustered at the hospital-based ED level, they found substantial variation in hospitalization rates for the very low risk cohort (median 1.7%; interquartile range 0%–3.9%). While their analyses found that hospital characteristics accounted only for a small proportion of the observed variation in syncope admission rates, they did note that higher annual ED volume and metropolitan teaching status were associated with higher odds of hospitalization. Our study similarly found that teaching status and ED volume, as well as regional location in the Northeast, were associated with higher admission rates. In addition to the hierarchical logistic regression analysis, we sought to further characterize and quantify heterogeneity in admission decisions using REM methods, which allows one to quantify unmeasured site variation. Our analysis using the REM methods suggests that the hospital a patient presents to is a more important factor in the decision for admission than all other individual patient or hospital factors. After adjusting for measured factors, we can compare the risk of admission for a patient at a site more likely for admission (95th percentile of unmeasured site distribution) to a patient at a median risk site. This odds of admission related to site variation exceeds the odds of all measured patient factors (95th percentile of empirical distributions) relative to a median risk patient. Similarly, it exceeds the risk of comparing a high-risk patient (95th percentile of empirical distributions) relative to a median risk patients on the basis of measured hospital factors. Therefore, the impact of a patient presenting to one ED vs another has more influence on the odds of admission than does the composite of patient factors or composite of hospital factors. Possible sources for this site variation include inter-hospital and provider practice patterns, access to inpatient specialist care, utilization of syncope protocols both within the ED and after admission, access to specialist consultation in the ED, as well access to early outpatient follow-up in the primary care or specialty care clinic.

There have been several attempts to standardize evaluation of syncope, including the 2017 ACC/AHA/HRS

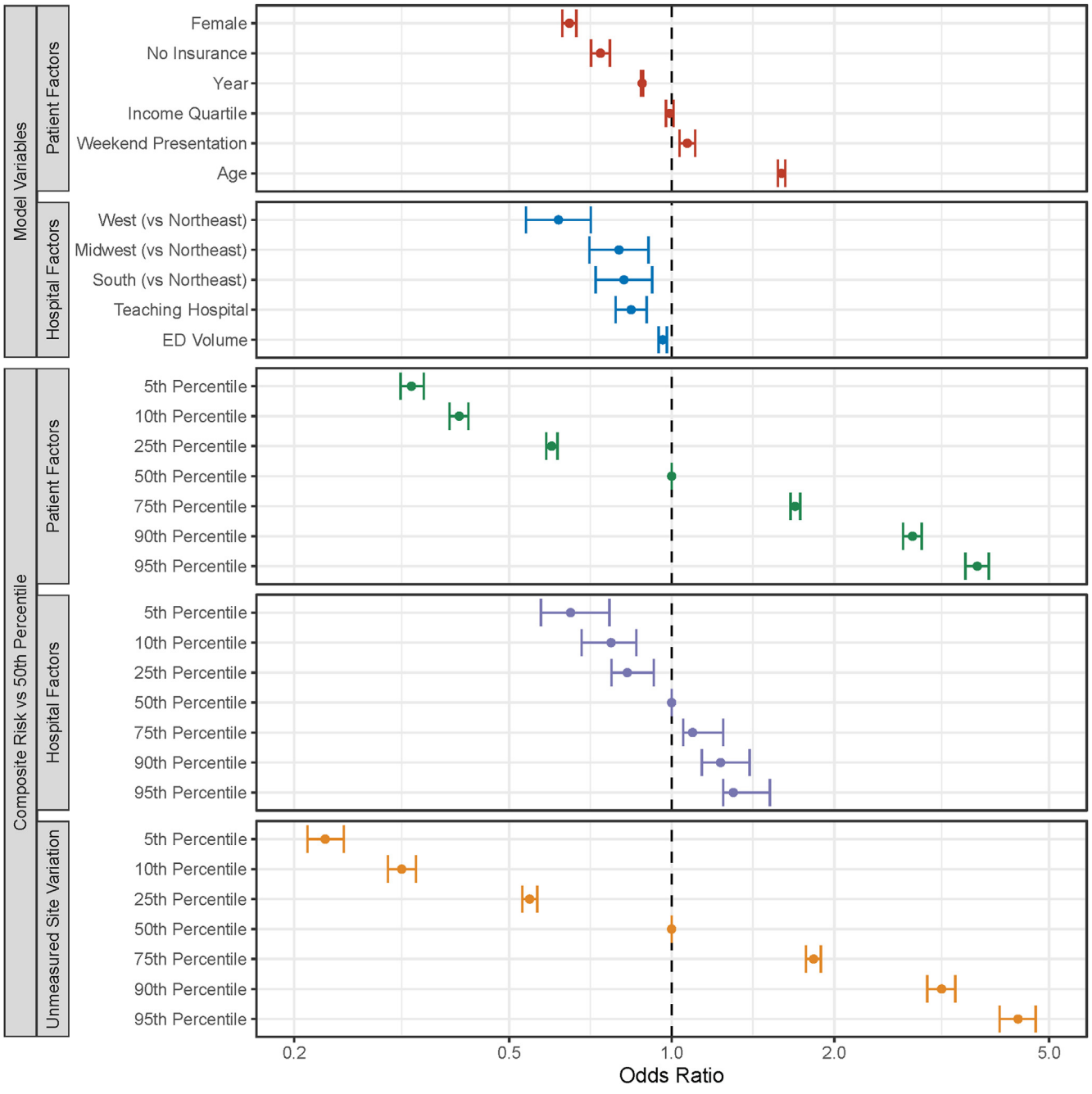

Figure 2 Multivariable model for odds of low-risk syncope admission. Faceted forest plot demonstrates point estimates and 95% confidence intervals of factors associated with higher or lower odds of admission after presenting to the emergency department (ED) for low-risk syncope. The top 2 facets are individual patient- or hospital-level characteristics included in the model. The bottom 3 facets summarize measured patient variation, measured site variation, and unmeasured site variation using reference effect measures methodology so that their relative magnitudes may be compared.

guidelines.[7] These guidelines emphasized the need for a thorough history and physical examination for all patients with syncope, while encouraging judicious decision making for admission and diagnostic testing in the ED. Importantly, the guidelines clearly defined "high-risk" medical conditions that might necessitate further inpatient and diagnostic testing. Our results demonstrate a gradual decline in admissions for both high- and low-risk patients with syncope throughout our study period but with no change in admission rates after the guidelines were released in 2017, a finding in line with previous research showing downward trends in syncope admission patterns that seemed unaffected by the publication of American College of Emergency Physicians syncope guidelines in 2007.[18] Indeed, admission rates from the ED broadly declined in the period of study, which has been attributed to changes in reimbursement for short-stay hospitalizations and increased access to follow-up care linked to higher rates of insured individuals after the Affordable Care Act of 2010.[19] The implementation of guidelines into clinical practice is a complex process that involves dissemination,

adoption, and adherence by physicians.[20] Thus, the full effect of the 2017 ACC/AHA syncope guidelines may not be reflected in our analyses, which include data from ~18 months after their publication. Further research is needed to assess uptake of the 2017 guidelines and their successful implementation.[21]

In addition to guidelines, several clinical decision rules[22,23] have been developed to provide recommendations on risk stratification based on history, physical examination, and basic diagnostic testing, including the San Francisco Syncope Rule,[24] OESIL risk score,[25] and the Canadian Syncope Risk Score.[26] A recent systematic review found that many of these scores are not validated or sufficiently accurate for clinical use,[15] and the 2017 AHA/ACC/HRS guidelines ranked the use of existing risk stratification tools as only a class IIb recommendation.[7] While there has not been widespread adoption of these scores in clinical practice, efforts to establish a standard risk stratification tool holds potential for expediting clinician decision making while further limiting potentially harmful variation in practice. The development of evaluation and management protocols aimed toward very low risk patients presenting with syncope may help decrease the observed large unmeasured hospital variation demonstrated by decreasing practice pattern variation.

Limitations

This study has several limitations that must be considered while interpreting its results. First, this study is observational and retrospective, so no causality should be inferred. Reference effect measures methodology does attempt to quantify unknown confounding variables, but these effects cannot be entirely accounted for. Second, this study relies heavily on the use of *International Classification of Diseases* codes to identify medical comorbidities and procedural interventions, which transitioned in the year 2015 from *International Classification of Diseases, Ninth Revision* to *International Classification of Diseases, Tenth Revision* codes. As a result, unknown or unmeasured confounding variables may influence the results. Third, data in the NEDS are represented on the encounter level rather than the patient level, so repeat visit or patient-level analyses are not possible. Further, as the unweighted NEDS does not reflect a complete enumeration of all EDs in the United States, sampling bias is possible. Fourth, objective data such as vital signs and physical examination findings are not present in the NEDS and cannot be accounted for, nor can findings and/or procedures performed by first responders be accounted for. Fifth, significant variability in procedure reporting from the NEDS limits the analysis of procedures performed in the ED or while admitted to the hospital.[27] Similarly, adjustment for urban-rural status could not be made because of a change in the coding process midway through the study cohort. Sixth, patient frailty was not specifically quantified because of limitations of the NEDS and reliance on diagnosis codes that focus on medical comorbidities only. Finally, we theorize that a significant portion of the unmeasured site variation found in this study is due to variation in provider and hospital practice patterns and access to inpatient and/or outpatient follow-up and specialty care, which are not present within the NEDS.

Conclusion

In this analysis of a large nationwide database, admission rates for low-risk syncope varied widely. Patient factors and hospital factors played important roles, but these are overshadowed by significant unmeasured hospital variation. Such unmeasured site variation may be due to differences in practice patterns, use of site-level protocols, or access to inpatient consultation and/or outpatient follow-up and specialty care. These findings emphasize the heterogeneity of low-risk syncope evaluation in the United States and support the need for more standardized practice guidelines to consolidate variation in practice patterns.

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Authorship: All authors attest they meet the current ICMJE criteria for authorship.

Patient Consent: Since all data were abstracted retrospectively and anonymously without unique patient identifiers, institutional review boards waive the need for patient informed consent.

Ethics Statement: The research in this article adhered to Helsinki Declaration guidelines.

Appendix

Supplementary data

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.hroo.2024.06.006.

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