Risk of Vascular Events in Emergency Department Patients Discharged Home With Diagnosis of Dizziness or Vertigo

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Study objective: Dizziness and vertigo are common reasons for visiting the emergency department (ED), but many patients are discharged home without a specific diagnosis. Given the concern that important diagnoses could be missed, we measure the incidence of subsequent major vascular events in patients after discharge home.

Methods: We identified all adults discharged home from California EDs with a primary diagnosis of dizziness or vertigo from January to June 2005, using comprehensive encounter records. Events were captured with linked statewide hospital discharge and national mortality data. We used Nelson-Aalen survival analysis for the primary outcome, hospitalization or death for cerebrovascular (acute ischemic or hemorrhagic stroke) or cardiovascular events (acute myocardial infarction, unstable angina, and ventricular arrhythmia), and the secondary outcomes, repeat ED visit for dizziness or vertigo, cerebrovascular events, and cardiovascular events.

Results: Among 31,159 patients identified, median age was 56 years and 63.5% were women. During the follow-up period, there were 274 deaths, 231 cerebrovascular events, and 115 cardiovascular events. The 180-day cumulative incidence of vascular event, cerebrovascular event, or cardiovascular event was 0.93% (95% confidence interval [CI] 0.83% to 1.04%), 0.63% (95% CI 0.55% to 0.72%), and 0.32% (0.26% to 0.38%), respectively. The risk of cerebrovascular events was higher in the first month (95% CI 30.2 [24.4 to 37.0] versus 6.5 [5.3 to 7.9] events/10,000 person-months thereafter).

Conclusion: Few patients experience a major vascular event after discharge home with a diagnosis of dizziness or vertigo, with a stroke occurring in less than 1 in 500 patients within the first month. Future studies will be required to accurately stratify the risk for individual patients. [Ann Emerg Med. 2011;57:34-41.]

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INTRODUCTION

Dizziness and vertigo are common reasons for a visit to the emergency department (ED), with more than 2.3 million ED encounters (1.3% of the total)[1] and more than $1.6 billion in health care expenditures for dizziness evaluations in the United States each year.[2] The high prevalence of these symptoms, combined with the potential for serious underlying causes such as posterior circulation stroke,[3-5] transient ischemic attack,[6,7] or cardiac arrhythmia,[8] raises the stakes for making efficient and accurate assessments in the ED.

Unfortunately, widely used diagnostic strategies with categories such as dizziness, vertigo, lightheadedness, and disequilibrium are difficult to apply in the ED setting have may have limited utility for acute clinical decisionmaking.[9] Emerging methods involving the application of new clinical examination techniques have not been widely applied or evaluated in the hands of ED clinicians.[10,11] Furthermore, diagnostic tests such as head computed tomography[12] or ECG can miss important diagnoses such as posterior circulation stroke or transient arrhythmia, whereas more sensitive tests such as brain magnetic resonance imaging[13] or extended cardiac telemetry[14] are not practical to apply without careful targeting to high-risk patients. Therefore, even after lengthy evaluations and extensive use of diagnostic tests, including neuroimaging,[1,2,15] a significant proportion of patients may be discharged without a specific diagnosis after evaluation in the ED.[1]

Given this diagnostic uncertainty, there remains the distinct possibility that some patients who are discharged home after evaluation in the ED for dizziness may develop delayed complications (eg, a stroke after an unrecognized transient

Editor's Capsule Summary

What is already known on this topic

Emergency department (ED) patients with dizziness and vertigo are often discharged home when a serious cause is not identified.

What question this study addressed

How often do such patients have a bad outcome?

What this study adds to our knowledge

Using 6 months of data from a database of all California ED visits, the investigators found that about 2% of the 31,000 patients with an ED discharge diagnosis of dizziness or vertigo died or had a serious vascular event (neurologic or cardiac) in the subsequent 6 months, with the preponderance of events in the first month.

How this is relevant to clinical practice

Although bad outcomes in this group are uncommon, prospectively identifying which patients will experience an event remains a challenge.

ischemic attack [TIA], a ventricular arrhythmia after unrecognized cardiac ischemia). Although previous cross-sectional studies have estimated that 3% to 4% of ED patients who present with a primary complaint of dizziness receive a diagnosis of stroke during the course of the ED and hospital evaluation,[1,15,16] few studies have had the longitudinal follow-up that is necessary to capture missed or delayed outcomes, particularly for those patients who are evaluated and discharged home without a specific diagnosis.[17-19] Therefore, we identified and followed a large cohort of ED patients who were discharged home with a primary diagnosis of dizziness or vertigo to measure the risk of subsequent major vascular outcomes. We hypothesized that measuring the frequency of excess vascular events in the short-term period after ED discharge could inform efforts to optimize the management of these patients in the ED and potentially provide an attractive target for intervention.

MATERIALS AND METHODS

Study Design

We conducted a retrospective cohort study using linked hospital discharge and mortality records for follow-up.

The Office of Statewide Healthcare Planning and Development, a division of the California Department of Health and Human Services, maintains comprehensive data on ED encounters and hospital discharges from all 337 EDs and all 539 licensed nonfederal hospitals within the state. From ED encounter records, we collected the record linkage number, encounter date, patient age, sex, race/ethnicity, county of primary residence, insurance status, disposition, and primary and secondary discharge diagnoses (using *International Classification of Diseases, Ninth Revision (ICD-9), Clinical Modification* codes). From each linked hospital discharge, we collected the record linkage number, admission date, discharge date, disposition, and primary and secondary discharge diagnoses codes. From each linked death record, we collected the record linkage number, date of death, and cause of death.

The Office of Statewide Healthcare Planning and Development assigns a unique record linkage number based on the social security number to each encounter after validating the first 3 digits against Social Security Administration records. This provides a mechanism to link statewide ED encounter, statewide hospitalization discharge, and national mortality records.[20] For linkage to death records, an additional 4-step probabilistic matching algorithm with positive predictive and negative predictive values of 0.994 and 0.998, respectively, was applied.[21] This algorithm sequentially applies combinations of demographic data (sex, birth date, birth year, death date, race/ethnicity, zip code, partial social security number) to identify exact matches and high-probability partial matches that account for transcription and data entry errors.[20,p3]

An active program that incorporates basic data quality checks at electronic submission has been in place, so missing values for the important data elements used for this study were relatively uncommon. Age, insurance status, and at least one discharge diagnoses was listed for all records. Sex was missing in 0.6% and race/ethnicity was missing in 4.6% of records. For records with missing values, a specific code for missing values was used during analysis; no values were imputed.

We identified all California residents age 18 years or older who were discharged home with a primary discharge diagnosis of dizziness or vertigo (*ICD-9* codes 780.4 and 386.x, respectively) from nonfederal California EDs from January 1, 2005, to June 30, 2005. Subjects who were younger than 18 years were not included because the typical mechanisms for cerebrovascular and cardiovascular disease were expected to be different in this group.[22] Because our analysis was focused on subjects who were discharged home without a more specific diagnosis, we excluded those patients who received a diagnosis of stroke or cardiovascular events during the initial ED visit, those who were directly admitted to hospital, or those who were transferred from the ED directly to another facility. Only subjects who listed an in-state residence were included to maximize subsequent follow-up. For subjects with multiple qualifying ED visits during the study period, the first ED encounter was chosen as the index visit.

Outcome Measures

The record linkage number was used to link subjects from the initial ED encounter to any subsequent ED encounter or hospitalizations within the state for a period of 180 days after the initial ED encounter. The primary outcome was time to the first major vascular event within 180 days after the initial ED

Table 1. Characteristics of ED patients discharged home with diagnosis of dizziness of vertigo from January to June 2005.

Characteristic	Dizziness (N=24,229)	Vertigo (N=6,930)	Total (N=31,159)
Age, y, median (interquartile range)	57 (42–73)	54 (41–69)	56 (42–72)
Women, No. (%)	15,206 (63.1)	4,454 (64.7)	19,660 (63.5)
Race, No. (%)			
White, Non-Hispanic	12,199 (50.4)	3,448 (49.8)	15,647 (50.2)
Black	1,907 (7.9)	404 (5.8)	2,306 (7.4)
Hispanic	5,553 (22.9)	1,713 (24.7)	7,266 (23.3)
Asian	2,342 (9.7)	756 (10.9)	3,098 (9.9)
American Indian	95 (0.4)	49 (0.7)	144 (0.5)
Other	774 (3.2)	237 (3.4)	1,011 (3.2)
Unknown	1,364 (5.6)	323 (4.7)	1,687 (5.4)
Insurance status, No. (%)			
Medicaid	2,592 (10.7)	700 (10.1)	3,292 (10.6)
Medicare	5,740 (23.7)	1,441 (20.8)	7,181 (23.1)
Private	11,954 (49.4)	3,635 (52.5)	15,589 (50.0)
Other	388 (1.6)	104 (1.5)	492 (1.6)
Uninsured	3,547 (14.6)	1,049 (15.1)	4,596 (14.8)
Secondary diagnoses			
No. per patient, mean (SD)	1.24 (1.44)	0.99 (1.30)	1.19 (1.42)
No secondary diagnoses listed, No. (%)	9,158 (37.8)	3,283 (47.4)	12,441 (39.9)
Secondary diagnoses are symptom codes only,* No. (%)	11,985 (49.5)	4,021 (58.0)	16,006 (51.4)

**ICD-9* codes 780 to 799; symptoms, signs, and ill-defined conditions.

visit. A major vascular event was defined as death or hospitalization with a major cerebrovascular or cardiovascular diagnosis. Major cerebrovascular outcomes were determined from hospital discharge records, using a previously validated algorithm with high sensitivity and specificity for identifying stroke.[23] Specifically, we searched hospital discharge codes for hemorrhagic or ischemic stroke diagnosis codes (430, 431, 433.x1, 434.x1, or 436.x) in any position but excluded hospitalizations listing diagnosis codes for rehabilitation (V57) or trauma (800, 801, 802, 803, 804, or 85x). Major cardiovascular outcomes were determined by searching hospital discharge records for a primary diagnosis of acute myocardial infarction (410.x1),[24] unstable angina (411.x),[24] or ventricular arrhythmia (427.1, 427.4, 427.5, or 427.69).[25] Additional patient identifiers for linkage to individuals' charts were not available in this deidentified data set, so additional validation using medical records was not possible. Secondary outcomes were time to first repeated ED visit for dizziness or vertigo, time to first cerebrovascular event, and time to first cardiovascular event with censoring at death or first adverse event.

Primary Data Analysis

We used survival analysis techniques to determine the cumulative incidence of major vascular events. The period at risk began on the date of the ED evaluation for dizziness or vertigo and ended on the date of the first major vascular event (the "failure" event) or censoring. Cases were censored (ie, withdrawn from the survival analysis) at nonvascular death or administratively censored at 180 days after the initial ED visit. We performed analogous survival analyses for the secondary outcomes. We constructed Nelson-Aalen cumulative hazard plots to graphically represent the proportion of subjects who experienced the outcome over time and derived smoothed hazard functions to show changes in the estimated incidence rate over time. We constructed univariable and multivariable Cox models to evaluate the effect of major demographic categories (age, sex, race) or diagnosis type (dizziness or vertigo) on the risk of these adverse outcomes. All variables were included for face validity after formally verifying the proportional hazards assumption for each predictor. We assessed for evidence of effect modification among pairs of predictors, but we found no substantive interactions; we did not include interactions terms in the model. FileMaker Pro (version 10; FileMaker Incorporated, Santa Clara, CA) was used for database programming, and Stata (MP version 11; StataCorp, College Station, TX) was used for all statistical analyses.

Approval for this study was obtained from both the California Health and Human Services Agency's Committee for the Protection of Human Subjects and the local institutional review board.

RESULTS

Characteristics of Study Subjects

A total of 31,159 subjects met the study entry criteria, including 24,229 (77.8%) subjects with a primary diagnosis of dizziness and 6,930 (22.2%) patients with a primary diagnosis of vertigo. The median age was 56 years (interquartile range 42 to 72 years) and 63.5% were women. Age, sex, race-ethnic

Table 2. Adverse outcomes within 180 days among ED patients discharged home with diagnosis of dizziness or vertigo from January to June 2005.

Event	Dizziness (N=24,229)	Vertigo (N=6,930)	Total (N=31,159)
All-cause mortality	247	27	274
Cerebrovascular hospitalization	184	47	231
Intracerebral hemorrhage	24	4	28
Subarachnoid hemorrhage	10	3	13
Ischemic stroke	150	40	190
Cardiovascular hospitalization	96	19	115
Acute myocardial infarction	61	16	77
Unstable angina	16	2	18
Cardiac arrhythmia	19	1	20

makeup, and insurance status were similar in patients with dizziness and vertigo. There were fewer Hispanics and more white, non-Hispanic subjects than would be expected according to statewide demographics.[21]

A substantial proportion of subjects had no secondary diagnoses listed (39.9%), especially when the primary diagnosis was vertigo (47.4% versus 37.8%; difference 9.6% [95% confidence interval {CI} 8.2% to 10.9%]; Table 1). Patients with vertigo were more likely to have secondary diagnoses codes that were only for other symptoms (*ICD-9* codes 780 to 799) rather than specific causal diagnosis (58.0% versus 49.5%; difference 8.6% [95% CI 9.9% to 7.2%]).

During the 180-day period after the initial ED visit for dizziness or vertigo, 274 patients died and 332 patients were hospitalized with a major vascular event (which includes 14 who had separate hospitalizations for both a cerebrovascular and a cardiovascular outcome) (Table 2). Most cerebrovascular events were ischemic strokes and most cardiovascular events were acute myocardial infarctions. For patients who were hospitalized for stroke, 90 (35.0%) were discharged to home, 55 (21.4%) were discharged to skilled nursing/intermediate care, and 35 (13.6%) were discharged with home health services. During the follow-up period, 1,257 patients returned and received a diagnosis of dizziness or vertigo at another ED visit at a median of 31 days after their initial ED visit.

The 180-day cumulative incidence of a major vascular event or death was 0.93% (95% CI 0.83% to 1.04%). The corresponding cumulative incidence of cardiovascular events was 0.32% (95% CI 0.26% to 0.38%). For cerebrovascular events, the cumulative incidence was 0.63% (95% CI 0.55% to 0.72%) (Figure 1). However, the incidence rate for adverse events was not constant during the follow-up period. For cerebrovascular events, the incidence rate was highest in the first month (30.2 [24.4 to 37.0] per 10,000 person-months) and then decreased during the study period to 6.5 (5.3 to 8.0) events per 10,000 person-months) thereafter (Figure 2). In contrast, the incidence rate of cardiovascular events was relatively stable throughout the follow-up period (9.0 [6.0 to 13.0] versus 10.6 [8.2 to 13.3] per 10,000 person-months).

In the univariable Cox model, advancing age and male sex were associated with a higher risk of adverse vascular outcomes, although the effect of male sex on adverse outcomes was largely driven by a higher risk of cardiovascular outcomes but not cerebrovascular outcomes. These associations persisted when evaluated in the multivariable model. Patients who received a discharge diagnosis of dizziness were also at significantly higher risk of adverse outcomes compared with those who received a discharge diagnosis of vertigo in the univariate model, but not in the multivariable model (Table 3). According to this model, 85-year-old white men discharged with the diagnosis of dizziness or vertigo would be predicted to have a 180-day risk of stroke of 3.1%, whereas the corresponding risk for 35-year-old white women would be 0.22%.

LIMITATIONS

Our results should be interpreted in the context of important limitations. First, although capture of all mortality events should be complete, we were unable to capture the few hospitalizations that may have occurred out of state. We attempted to mitigate this problem by including only patients with a primary residence within the state. Second, because we used deidentified encounter data, a direct validation of outcomes and an assessment of the extent to which specific causes were evaluated and excluded were not possible with chart review. However, we used previously validated algorithms with high sensitivity and specificity to identify outcomes from discharge diagnosis codes. Next, our analysis of predictors for adverse outcomes was limited to the demographic variables that were reliably available in the source data set, but because we did not have access to individual medical charts, we were not able to include relevant predictors from chart review. Our hope is that this analysis provides an estimate of the baseline risk that can be used as a basis for follow-up studies that capture these clinical details for additional risk stratification. Next, because we examined ED visits during the first half of the calendar year, we are unable to assess the possible effect of seasonal variation on our findings. Also, we did not account for potential clustering by facility, which could affect the width of our reported CIs, but not our point estimates. Finally, because we focused only on patients who were deemed safe enough to be discharged home, we are unable to generalize to patients who may have initially presented with dizziness symptoms but were found to have a more specific diagnosis in the course of the ED evaluation.

DISCUSSION

Our primary finding is that major vascular outcomes such as stroke, myocardial infarction, or arrhythmia are uncommon in ED patients who are evaluated and discharged home with a diagnosis of dizziness or vertigo. We estimate that in the 180

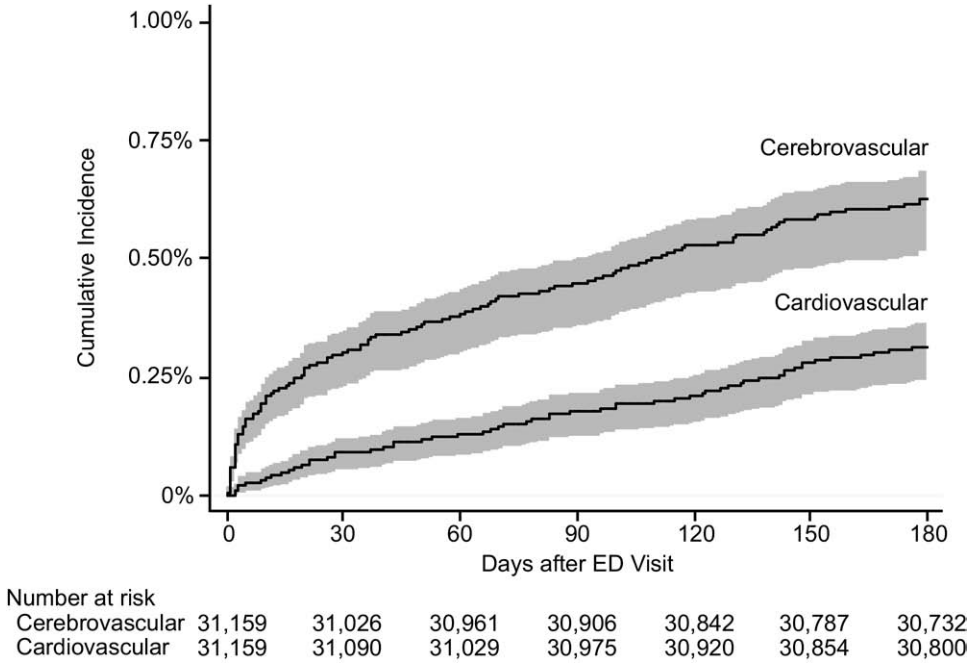

Figure 1. Cumulative incidence of major vascular events among patients after discharge home from ED with diagnosis of dizziness or vertigo from California EDs from January to June 2005. Grey area represents the 95% CI.

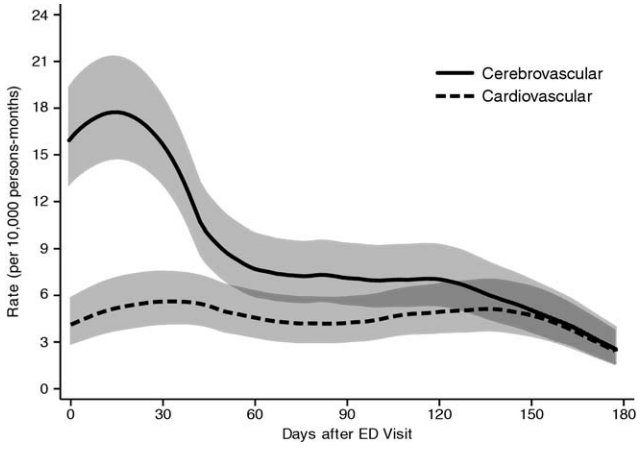

Figure 2. Rate of adverse vascular events among patients discharged from California EDs with diagnosis of dizziness or vertigo from January to June 2005. Grey area represents the 95% CI.

days after a patient is evaluated and discharged home with a diagnosis of dizziness or vertigo, a major vascular event occurs in 1 of 108 patients; 1 in 159 patients are hospitalized for stroke, and 1 of 313 patients are hospitalized for major cardiovascular outcomes. Although the acuity of patients who present to the ED is likely to be higher than that of the general population, to provide some frame of reference, the estimated 6-month incidence of stroke for the general US population is approximately 0.13%, or 1 in 772,[26] and the 30-day risk of patients who received a diagnosis of transient ischemic attack in the ED is 7.5%.

Instead, the adverse events that may be most relevant for ED management are those that occur in the immediate period of days to weeks after the ED visit. A high incidence of early events could justify pursuing more intensive diagnostic evaluations to identify and treat serious causes than is pursued in current practice, whereas a low incidence of early events would focus additional attention on the preceding ED evaluation that identified patients who could safely be discharged home or whether the underlying risks of these symptoms are very low regardless of ED evaluation.

The shape of the cumulative risk curve in Figure 1 and the hazard function in Figure 2 during the first month provides some insight into the early excess risk of cerebrovascular events. We infer that these early cerebrovascular events may be more directly attributable to the ED visit because of the temporal association with the ED visit. In contrast, the flatter part of the curve at the later time points may reflect a background constant incidence of vascular events over time according to population risk factors. Therefore, the actual number of cerebrovascular events and opportunities for preventive interventions attributable to the ED visit is likely to be much smaller than the 180-day rates described above, with a stroke occurring in only about 1 in 555 patients within the first month, compared with a monthly risk of 1 in 4,600 in the general population.[26]

Previous estimates of the short-term prognosis for patients presenting with dizziness have varied widely. One study following 100 patients with dizziness in the outpatient primary care setting for 1 year found that one patient had died from congestive heart failure and none had experienced

Table 3. Predictors of adverse outcomes among ED patients discharged home with diagnosis of dizziness or vertigo from January to June 2005.

	Hazard Ratio (95% CI)		
Variable	**All Vascular Outcomes**	**Cerebrovascular Outcomes**	**Cardiovascular Outcomes**
Univariate model			
Age, y (per decade)	1.54 (1.43, 1.65)	1.52 (1.40, 1.66)	1.53 (1.36, 1.73)
Male sex	1.50 (1.19, 1.90)	1.23 (0.93, 1.64)	2.11 (1.41, 3.15)
Race			
White, Non-Hispanic	Reference	Reference	Reference
Black	0.63 (0.38, 1.06)	0.97 (0.56, 1.66)	0.21 (0.05, 0.84)
Hispanic	0.67 (0.49, 0.91)	0.86 (0.60, 1.23)	0.46 (0.26, 0.81)
Asian	0.91 (0.62, 1.34)	1.01 (0.63, 1.61)	0.76 (0.39, 1.48)
American Indian	1.92 (0.61, 6.00)	1.03 (0.14, 7.40)	3.32 (0.81, 13.5)
Other	0.54 (0.24, 1.22)	0.59 (0.22, 1.60)	0.47 (0.11, 1.91)
Dizziness (vertigo as reference)	1.41 (1.03, 1.91)	1.46 (1.00, 2.13)	1.28 (0.76, 2.13)
Multivariable model			
Age, y (per decade)	1.55 (1.43, 1.67)	1.56 (1.42, 1.71)	1.52 (1.33, 1.73)
Male sex	1.53 (1.21, 1.94)	1.28 (0.96, 1.72)	2.06 (1.37, 3.09)
Race			
White, Non-Hispanic	Reference	Reference	Reference
Black	0.92 (0.55, 1.54)	1.39 (0.81, 2.40)	0.15 (0.02, 1.08)
Hispanic	0.91 (0.66, 1.26)	1.21 (0.84, 1.75)	0.56 (0.30, 1.05)
Asian	1.02 (0.70, 1.50)	1.12 (0.70, 1.80)	0.86 (0.44, 1.67)
American Indian	2.87 (0.92, 9.01)	1.55 (0.22, 11.1)	4.88 (1.19, 20.0)
Other	0.76 (0.34, 1.73)	0.83 (0.31, 2.26)	0.65 (0.16, 2.65)
Dizziness (vertigo as reference)	1.25 (0.91, 1.72)	1.28 (0.86, 1.89)	1.16 (0.68, 1.97)

a cerebrovascular event.[17] However, this study was enriched for patients with more benign chronic dizziness rather than the patients who present to the ED with acute dizziness. Another study of 121 patients presenting to the ED with dizziness found that 5% of patients had major morbidity such as stroke within 6 months, even though an 18% loss to follow-up may have led to an underestimation of these risks.[19] However, this study included patients who received a diagnosis of serious causes of dizziness in the ED or who were admitted for additional evaluation; only 1 of the 49 patients who were discharged home from the ED was subsequently rehospitalized.

The observation that dizziness is more common in women and the elderly creates an additional challenge because these are precisely the demographic groups in which the evaluation of dizziness may be more difficult. For instance, women are more likely to have atypical and underrecognized symptoms of myocardial infarction or stroke that could present with dizziness.[27] Elderly patients who are at higher overall risk for cerebrovascular or cardiovascular disease are also more likely to have multiple causes for dizziness,[28] which can complicate management when alternative diagnoses are tentative.[29,30] We did find a strong association between advancing age and adverse events and with male sex and cardiovascular outcomes in particular. To provide some context for these rates, the 180-day risk of stroke for 85-year-old men is 1.67% and for 35-year-old women is 0.02%,[26] which are lower than our observed event rates, although the subpopulation of patients who present to the ED is likely to be different from the general population in important ways. However, we did not have the additional clinical detail necessary to provide additional risk-stratification for these patients. The high prevalence of these presentations and the incentives to pursue costly evaluations to best exclude these infrequent complications continues to highlight the utility of developing reliable methods to stratify risk through the development of clinical prediction rules[31] and more reliable and highly accurate bedside examination techniques.[10,11]

Our study has certain important strengths. We include a large sample size drawn from an ethnically diverse population and from more than 300 EDs. Our study design includes longitudinal follow-up with precautions to minimize loss to follow-up and validated algorithms with high sensitivity and specificity for ascertaining outcomes. Finally, we were able to capture not only the absolute frequency but also the timing of adverse events in relation to the initial ED visit that enhances causal inference through temporality.

In summary, major vascular events appear to be uncommon among ED patients who are discharged home with a diagnosis of dizziness or vertigo overall. However, our study has limited ability to identify specific subpopulations that may be at significantly higher or lower risk for these adverse outcomes. The increased incidence rate of cerebrovascular outcomes but not cardiovascular outcomes in the early period after the ED visit suggests that there may be additional opportunities to identify and prevent adverse outcomes, but future studies will be required to develop

efficient and effective methods to risk stratify these patients at initial presentation.[25]

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REFERENCES

1. Newman-Toker DE, Hsieh Y-H, Camargo CA, et al. Spectrum of dizziness visits to US emergency departments: cross-sectional analysis from a nationally representative sample. *Mayo Clin Proc.* 2008;83:765-775.
2. Dallara J, Lee C, McIntosh L, et al. ED length-of-stay and illness severity in dizzy and chest-pain patients. *Am J Emerg Med*. 1994; 12:421-424.
3. Savitz SI, Caplan LR, Edlow JA. Pitfalls in the diagnosis of cerebellar infarction. *Acad Emerg Med*. 2007;14:63-68.
4. Grad A, Baloh RW. Vertigo of vascular origin. Clinical and electronystagmographic features in 84 cases. *Arch Neurol*. 1989; 46:281-284.
5. Gomez CR, Cruz-Flores S, Malkoff MD, et al. Isolated vertigo as a manifestation of vertebrobasilar ischemia. *Neurology*. 1996;47: 94-97.
6. Johnston SC, Gress DR, Browner WS, et al. Short-term prognosis after emergency department diagnosis of TIA. *JAMA*. 2000;284: 2901-2906.
7. Bos MJ, van Rijn MJE, Witteman JCM, et al. Incidence and prognosis of transient neurological attacks. *JAMA*. 2007;298: 2877-2885.
8. Newman-Toker DE, Camargo CA. "Cardiogenic vertigo"—true vertigo as the presenting manifestation of primary cardiac disease. *Nat Clin Pract Neurol*. 2006;2:167-172; quiz 73.
9. Stanton VA, Hsieh Y-H, Camargo CA, et al. Overreliance on symptom quality in diagnosing dizziness: results of a multicenter survey of emergency physicians. *Mayo Clin Proc*. 2007;82:1319-1328.
10. Kattah JC, Talkad AV, Wang DZ, et al. HINTS to diagnose stroke in the acute vestibular syndrome: three-step bedside oculomotor examination more sensitive than early MRI diffusion-weighted imaging. *Stroke*. 2009;40:3504-3510.
11. Newman-Toker DE, Kattah JC, Alvernia JE, et al. Normal head impulse test differentiates acute cerebellar strokes from vestibular neuritis. *Neurology*. 2008;70(24 pt 2):2378-2385.
12. Chalela JA, Kidwell CS, Nentwich LM, et al. Magnetic resonance imaging and computed tomography in emergency assessment of patients with suspected acute stroke: a prospective comparison. *Lancet*. 2007;369:293-298.
13. Colledge N, Lewis S, Mead G, et al. Magnetic resonance brain imaging in people with dizziness: a comparison with non-dizzy people. *J Neurol Neurosurg Psychiatry*. 2002;72:587-589.
14. Zimetbaum PJ, Josephson ME. The evolving role of ambulatory arrhythmia monitoring in general clinical practice. *Ann Intern Med*. 1999;130:848-856.
15. Kerber KA, Meurer WJ, West BT, et al. Dizziness presentations in US emergency departments, 1995-2004. *Acad Emerg Med*. 2008;15:744-750.
16. Kerber KA, Brown DL, Lisabeth LD, et al. Stroke among patients with dizziness, vertigo, and imbalance in the emergency department: a population-based study. *Stroke*. 2006;37:2484-2487.
17. Kroenke K, Lucas C, Rosenberg ML, et al. One-year outcome for patients with a chief complaint of dizziness. *J Gen Intern Med*. 1994;9:684-689.
18. Kroenke K, Lucas CA, Rosenberg ML, et al. Causes of persistent dizziness. A prospective study of 100 patients in ambulatory care. *Ann Intern Med*. 1992;117:898-904.
19. Madlon-Kay DJ. Evaluation and outcome of the dizzy patient. *J Fam Pract*. 1985;21:109-113.
20. Healthcare Quality and Analysis Division. *Report on Heart Attack Outcomes in California 1996-1998: Volume 2: Technical Guide*. Sacramento, CA: California Office of Statewide Healthcare Planning and Development; 2002.
21. Zingmond DS, Ye Z, Ettner SL, et al. Linking hospital discharge and death records—accuracy and sources of bias. *J Clin Epidemiol*. 2004;57:21-29.
22. Roach ES. Etiology of stroke in children. *Semin Pediatr Neurol.* 2000;7:244-260.
23. Tirschwell DL, Longstreth WT Jr. Validating administrative data in stroke research. *Stroke*. 2002;33:2465-2470.
24. Petersen LA, Wright S, Normand SL, et al. Positive predictive value of the diagnosis of acute myocardial infarction in an administrative database. *J Gen Intern Med*. 1999;14:555-558.
25. De Bruin ML, van Hemel NM, Leufkens HG, et al. Hospital discharge diagnoses of ventricular arrhythmias and cardiac arrest were useful for epidemiologic research. *J Clin Epidemiol*. 2005; 58:1325-1329.
26. Williams GR. Incidence and characteristics of total stroke in the United States. *BMC Neurol*. 2001;1:2.

27. Colledge NR, Wilson JA, Macintyre CC, et al. The prevalence and characteristics of dizziness in an elderly community. *Age Ageing*. 1994;23:117-120.
28. Tinetti ME, Williams CS, Gill TM. Dizziness among older adults: a possible geriatric syndrome. *Ann Intern Med*. 2000;132:337-344.
29. Labiche LA, Chan W, Saldin KR, et al. Sex and acute stroke presentation. *Ann Emerg Med*. 2002;40:453-460.
30. Mosca L, Manson JE, Sutherland SE, et al. Cardiovascular disease in women: a statement for healthcare professionals from the American Heart Association Writing Group. *Circulation*. 1997; 96:2468-2482.
31. Stiell IG, Eagles D, Clement CM, et al. An international survey of priorities of emergency physicians for future development of clinical decision rules. *Ann Emerg Med*. 2006;48:S54.