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Spectrum of Dizziness Visits to US Emergency Departments: Cross-Sectional Analysis From a Nationally Representative Sample

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Abstract

OBJECTIVE—To describe the spectrum of visits to US emergency departments (EDs) for acute dizziness and determine whether ED patients with dizziness are diagnosed as having a range of benign and dangerous medical disorders, rather than predominantly vestibular ones.

PATIENTS AND METHODS—A cross-sectional study of ED visits from the National Hospital Ambulatory Medical Care Survey (NHAMCS) used a weighted sample of US ED visits (1993–2005) to measure patient and hospital demographics, ED diagnoses, and resource use in cases vs controls without dizziness. Dizziness in patients 16 years or older was defined as an NHAMCS reason-for-visit code of dizziness/vertigo (1225.0) or a final *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnosis of dizziness/vertigo (780.4) or of a vestibular disorder (386.x).

RESULTS—A total of 9472 dizziness cases (3.3% of visits) were sampled over 13 years (weighted 33.6 million). Top diagnostic groups were otologic/vestibular (32.9%), cardiovascular (21.1%), respiratory (11.5%), neurologic (11.2%, including 4% cerebrovascular), metabolic (11.0%), injury/poisoning (10.6%), psychiatric (7.2%), digestive (7.0%), genitourinary (5.1%), and infectious (2.9%). Nearly half of the cases (49.2%) were given a medical diagnosis, and 22.1% were given only a symptom diagnosis. Predefined dangerous disorders were diagnosed in 15%, especially among those older than 50 years (20.9% vs 9.3%; $P<.001$). Dizziness cases were evaluated longer (mean 4.0 vs 3.4 hours), imaged disproportionately (18.0% vs 6.9% undergoing computed tomography or magnetic resonance imaging), and admitted more often (18.8% vs 14.8%) (all $P<.001$).

CONCLUSION—Dizziness is not attributed to a vestibular disorder in most ED cases and often is associated with cardiovascular or other medical causes, including dangerous ones. Resource use is substantial, yet many patients remain undiagnosed.

Dizziness is estimated to account for 5% of walk-in clinic[1] and 4% of emergency department (ED) visits.[2] Although most ED patients with dizziness are said to have benign vestibular or cardiovascular disorders,[3] possible etiologies include numerous diseases from

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various organ systems; in one study, 46 different diagnoses were given to 106 patients presenting with dizziness.[4] In contrast to the outpatient setting, where only a few cases are attributed to dangerous causes, such as cerebrovascular accident (6%) or cardiac arrhythmia (1%),[5] in the ED, small studies have estimated that up to 30% of patients with dizziness have a serious disorder causing their symptoms, including 15% with stroke, transient ischemic attack, cardiac arrhythmia, acute infection, or anemia.[3]

Emergency department physicians must differentiate dizziness requiring only symptom management from that requiring further diagnostic work-up for serious, yet treatable, causes. Some consider dizziness the most difficult symptom to diagnose,[6] and there is growing evidence that misdiagnosis of ED patients with dizziness is not rare.[7–9] A lack of access to robust estimates for disease prevalence could hinder ED physicians' ability to make accurate diagnoses. Using data from the National Hospital Ambulatory Medical Care Survey (NHAMCS), we sought to estimate the prevalence of dizziness presentations across demographic groups in the ED, the spectrum of diagnoses identified, the frequency of imaging and other diagnostic tests, and the disposition of ED patients with dizziness. We expected to corroborate findings from other settings indicating dizziness is common, particularly among older patients and women.[6] We speculated that the spectrum of identified causes would be broad and more "medical" than "vestibular," with frequent diagnoses of serious underlying disorders, particularly among older patients. Finally, we anticipated that diagnostic tests (especially advanced imaging) would be used frequently and that overall ED resource use for patients with dizziness would be substantial, as seen in small samples.[10]

PATIENTS AND METHODS

This cross-sectional study of US ED patients with dizziness analyzed public-use data from NHAMCS sampled from all US ED visits occurring between January 1, 1993, and December 31, 2005. Study years (1993–2005) were determined on the basis of data availability. NHAMCS is a 4-stage probability sample of visits to randomly selected US hospitals, including noninstitutional general and short-stay hospitals but excluding federal, military, and Veterans Affairs hospitals.[11] NHAMCS data are gathered annually, and the sampling protocol, which covers geographic primary sampling units, hospitals within primary sampling units, EDs within hospitals, and patients within EDs, has been described previously.[11]

Because children have a different spectrum of causes than older adolescents and adults and are much less likely to experience dizziness, we restricted our study population to ED patients aged 16 years or older. Dizziness cases were defined as any patient with an NHAMCS-assigned patient reason-for-visit classification (RFV code)[12] of vertigo/dizziness (1225.0) in any of the 3 RFV code fields, *or* a final *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) symptom diagnosis of vertigo/ dizziness (780.4), *or* a final *ICD-9-CM* disease diagnosis of a vestibular disorder (386.x) in any of the 3 final diagnosis fields.[11] Controls without dizziness were defined as *not* NHAMCS RFV code 1225.0, *or ICD-9-CM* 386.x, *or ICD-9-CM* 780.4.

Study Procedures

As part of the NHAMCS protocol, trained hospital staff members gather data from ED visit records during a randomly assigned 4-week data period for each sampled hospital. [11] A structured data entry form is used.[11] Completed forms are sent to Constella Group (Durham, NC), where data abstraction and medical coding are performed.[13] Data entry and coding have previously been verified using a 2- way independent 10% subsample,[11] and keying and coding error rates are known to be very low (0%–2%).[13] National population estimates are obtained from the raw sampled data through use of assigned patient visit weights, which

account for probability of visit selection, nonresponse, and ratio of sampled hospitals to hospital universe.[11]

Outcome measures were taken directly or derived from the NHAMCS data set, including patient demographic and hospital characteristics, *ICD-9-CM* diagnoses, ED visit details (eg, mode of arrival, length of stay), reason for visit (ie, primary symptom or problem), diagnostic tests (eg, mean number of tests performed; proportion undergoing computed tomography [CT] or magnetic resonance imaging [MRI]), and final disposition (admit, discharged, other). Missing data are reported as missing or unknown, as coded in the NHAMCS data set.

Simple analysis of the most frequent *ICD-9-CM* diagnosis codes in NHAMCS is subject to potential biases related to differences in clinical coding specificity. To eliminate such bias, we grouped *ICD-9-CM* diagnoses using the Healthcare Cost and Utilization Project's Clinical Classifications Software (HCUP-CCS) for multilevel diagnoses.[14] This standardized coding schema groups all *ICD-9-CM* diagnosis codes into 16 mutually exclusive, top-level etiologic classes familiar to most physicians (eg, "infectious and parasitic diseases," "neoplasms," "mental disorders"), as well as pertinent subclasses (eg, "eye" and "ear" within the major class "diseases of the nervous system and sense organs") (Appendix 1). We prospectively identified 2 HCUP-CCS subclasses of particular interest for dizziness diagnosis ("cerebrovascular" [HCUP-CCS 7.3] and "ear" [HCUPCCS 6.8]), along with several individual *ICD-9-CM* diagnoses selected a priori, chosen to reflect the spectrum of benign and dangerous disorders known to cause dizziness in the ED (Appendix 2).

Finally, we identified the proportion of patients receiving *any* symptom diagnosis (eg, "dizziness" or "chest pain"), *only* a symptom diagnosis, and specifically a *dizziness* symptom diagnosis (*ICD-9-CM* 780.4 "dizziness and giddiness; light-headedness; vertigo NOS" [not otherwise specified]). Patients were considered to have a symptom diagnosis if they had 1 or more symptom diagnosis codes (*ICD-9-CM* 780–789) but no diagnosis codes listed outside that range (ie, no etiologic diagnosis) in the other 2 diagnosis fields.

The study was exempted from institutional board review by the Partners Healthcare Institutional Review Board.

Statistical Analyses

Data across years (1993–2005) were combined for analysis, except as noted. For data available only from particular years in the NHAMCS data set, analyses reflect combined data from that subset of years (eg, mean visit length, 2001–2004). For demographic and visit outcomes, we compare dizziness cases to controls without dizziness and report number of visits sampled, national weighted proportion or mean national estimate, and 95% confidence interval (CI). Crude or group-specific rates per 1000 US population were calculated using data from the US Census Bureau,[15] and rates per 1000 ED visits were calculated using projected NHAMCS estimates.

Visits were classified by urgency (urgent, nonurgent, unknown). Coding for this variable has shifted several times in the NHAMCS data set during the years studied (1993–2005). Visits from 1993–1996 and 2001–2004 were coded simply as urgent/emergent or nonurgent. However, data in years 1997–2000 and 2005 were coded using expected wait times at triage. We coded visits with expected wait time less than 1 hour as "urgent," those with expected wait times over 1 hour as "nonurgent," and those with this field blank or coded unknown as "unknown."

We compare resource use parameters, including mode of arrival, length of ED visit, and diagnostic tests across dizziness cases and controls without dizziness. Data regarding type of diagnostic imaging are limited in the NHAMCS data set. NHAMCS advanced imaging data are not subclassified by body part scanned, and the type of imaging (ie, CT vs MRI) was only recorded in certain years (1995–2000, 2005). As a result, we provide 2 separate analyses, the first across all years with CT and MRI results combined; the second for available years with CT and MRI results separate. We also assessed imaging trends for dizziness cases and controls over time by comparing scan rates (overall vs CT vs MRI) in individual years 1995 and 2005.

NHAMCS *ICD-9-CM* diagnosis codes were linked to HCUP-CCS multilevel codes in Microsoft Access 2003 (Microsoft Corporation, Redmond, WA). We report the frequency of etiologic class (HCUP-CCS) diagnoses, individual benign and dangerous diagnoses of interest, and proportion of symptom-only diagnoses, comparing dizziness cases to controls without dizziness and providing an odds ratio (OR) estimate for relative disease frequency in those with dizziness vs controls. For HCUP-CCS etiologic classes, we assessed frequency for all top-level diagnostic categories and for the 2 subclasses "cerebrovascular" (HCUP-CCS 7.3) and "ear" (HCUP-CCS 6.8). We also defined that subset with *any* "general medical" diagnosis (HCUP-CCS 1 [infectious], 3 [metabolic], 4 [hematologic], 7 [circulatory *except for 7.3 cerebrovascular*], 8 [respiratory], 9 [digestive], 10 [genitourinary]) (Appendix 1) and those with *only* a "general medical" diagnosis (ie, no other diagnostic class listed in either of the 2 remaining diagnostic fields).

We calculated 95% CIs using the relative standard error of the estimate, using a method approved of by the National Center for Health Statistics (NCHS).[16] As NHAMCS recommends for standard analysis, we did not calculate 95% CIs for samples with fewer than 30 cells.[17] When appropriate, we offer subgroup comparisons by demographic category. Comparison of proportions was assessed by χ^2 test, and comparison of means was assessed by *t* test. All *P* values are 2-sided with $P<.05$ considered significant. Statistical analyses were performed using SAS 9.1 SURVEYFREQ, SURVEYMEANS, and SURVEYREG procedures for survey data (SAS Institute, Cary, NC). Area-proportional Venn diagrams were drawn using Microsoft Visio 2003 (Microsoft Corporation).

RESULTS

The total 13-year sample of dizziness cases was 9472, yielding a weighted estimate of 33.6 million ED visits nationally over that same period. This estimate corresponds to 2.6 million visits annually in the United States and 3.3% of all ED visits during that period. Among these, 92% were coded with dizziness as a presenting symptom (Figure 1). There was a bimodal age distribution for ED dizziness visits with a small peak in the third decade and an escalating frequency among those 50 years and older, peaking in the oldest (≥ 80 years) group (Table 1). Patients with dizziness were somewhat older (mean age, 51.0 vs 43.7 years; $P<.001$) than their counterparts without dizziness, and a greater fraction were female (61.4% vs 55.1%; $P<.001$) (Table 2). Dizziness cases were slightly more likely to use private (42.7% vs 41.3%) or public (34.7% vs 28.8%) insurance than controls, rather than self-pay (13.2% vs 16.9%) or other insurance (4.3% vs 7.3%) ($P<.001$ for the aggregate comparison). There were minor differences between cases and controls by race, urban status, and geographic region (Table 2).

Dizziness cases were given an average of 1.7 diagnoses, with 22.1% receiving only a symptom diagnosis (eg, "dizziness…vertigo NOS" and "headache"), and nearly half of those (9.6%) specifically only a symptom diagnosis of dizziness (ie, "dizziness…vertigo NOS"). Symptom diagnoses without accompanying etiologic diagnoses were more common

among dizziness cases than controls (22.1% vs 8.4%; OR, 3.1; $P<.001$). Among both cases and controls, 91% of diagnoses were classifiable using the HCUPCCS schema (codes 1–16). Top *ICD-9-CM* diagnostic categories (grouped using HCUP-CCS) for dizziness cases and controls are listed in Table 3. Considering oto-vestibular diagnoses separate from other neurologic disorders, and placing cerebrovascular disorders with neurologic (rather than cardiovascular) disorders, the 10 most frequent classes of diagnoses made were oto-vestibular (32.9%), cardiovascular (21.1%), respiratory (11.5%), neurologic (11.2%, including 4% cerebrovascular), metabolic (11.0%), injury/poisoning (10.6%), psychiatric (7.2%), digestive (7.0%), genitourinary (5.1%), and infectious (2.9%). In total, 49.2% (95% CI, 47.9%-50.5%) of ED dizziness cases were given at least 1 general medical diagnosis, and 40.3% (95% CI, 39.1%-41.5%) were given *only* a general medical diagnosis (with no associated oto-vestibular, neurologic, psychiatric, or other diagnosis). Several diagnostic groups were at least twice as likely among dizziness cases: oto-vestibular (OR, 34.4), cerebrovascular (OR, 4.0), metabolic (OR, 2.7), and cardiovascular (OR, 2.1). Others were at least twice as likely among controls without dizziness: dermatologic (OR, 0.2), musculoskeletal (OR, 0.3), and injury/poisoning (OR, 0.3).

The frequency of prospectively defined benign and dangerous diagnoses is listed in Table 4. Vestibular neuritis/ labyrinthitis, benign paroxysmal positioning vertigo, and Meniere disease diagnoses were found only among dizziness cases, because we included vestibular disorders in our case definition. Among other benign diagnoses assessed, several were at least twice as likely among dizziness cases: orthostatic hypotension (OR, 22.4), vasovagal syncope (OR, 8.8), and panic disorder (OR, 3.9). Among dangerous diagnoses assessed, several were at least twice as likely among dizziness cases: carbon monoxide poisoning (OR, 7.4); transient ischemic attack (OR, 5.7); stroke/intracerebral hemorrhage (OR, 5.4); subarachnoid hemorrhage/ intracranial aneurysm/cervicocranial vascular dissection (OR, 4.4); arrhythmia (OR, 3.5); hypoglycemia (OR, 3.2); fluid and electrolyte disorders (OR, 3.1); aortic dissection/ ruptured aneurysm (OR, 2.0); and anemia (OR, 2.0). Among the prospectively defined benign diagnoses, the “top 10” represented 16% of the diagnoses made among dizziness cases. Similarly, among the prospectively defined dangerous diagnoses, the “top 10” represented 15% of the diagnoses made among dizziness cases. The frequency of dangerous diagnoses was high across age groups but rose with increasing age (Figure 2) and was substantially greater in those older than 50 years than in those younger than 50 years (20.9%; 95% CI, 19.2%–22.6% vs 9.3%; 95% CI, 8.3%–10.3%; $P<.001$).

Dizziness cases were associated with greater health care resource use than were controls without dizziness (Table 5). They were more likely to arrive by ambulance (23.5% vs 17.1%), be seen as an urgent visit (57.2% vs 50.8%), have a longer ED stay (4.0 hours vs 3.4 hours), be tested extensively (mean number of diagnostic tests 4.6 vs 3.2), undergo cardiac monitoring (18.5% vs 9.2%), undergo imaging by CT or MRI (18.0% vs 6.9%), and be admitted to the hospital (18.8% vs 14.8%) (all listed comparisons, $P<.001$). Rates of imaging were higher in recent years for both cases (24.0% in 2005 vs 10.0% in 1995; $P<.001$) and controls (12.6% in 2005 vs 3.4% in 1995; $P<.001$), but there was no evidence that MRI had displaced CT as the primary imaging modality in the ED for either group as of 2005 (Table 5).

DISCUSSION

Our study demonstrates that dizziness is an extremely common ED symptom that preferentially affects older adults. We confirm prior literature that suggests the most frequent diagnostic category is oto-vestibular; however, our results also indicate general medical diagnoses are prevalent in this acute care population, and the proportion harboring a dangerous underlying disorder is high. Resource use for dizziness is disproportionate,

particularly for diagnostic imaging, yet many patients leave the ED without an etiologic diagnosis.

From these nationally representative data, at least 3.3% of all ED visits are associated with dizziness or vertigo as a presenting symptom. This fraction is similar to those obtained from chart reviews at single institutions (1.7% ED chief complaint; 6.7% any charted complaint[10]) but lower than those obtained with prospective case capture (4.0% chief complaint[18]) or direct patient interview (4.4% main reason for the ED visit; 28.8% at least part of the reason for visit; 50.4% any recent dizziness[2]). These differences probably reflect differences in sensitivity across techniques for determining the presence of dizziness or its relevance to the visit.[19]

Our findings corroborate a higher prevalence of dizziness among older ED patients, in accordance with community-based estimates.[6] Among those older than 50 years, dizziness represented roughly 5% of all ED visits, about twice that of younger adults. As hypothesized, there was a strong association between the frequency of dangerous diagnoses and increasing age. Notably, even among younger patients, nearly 1 in 10 harbored a dangerous underlying diagnosis. Our findings also confirm a slightly higher frequency of dizziness symptoms among women, described previously in population-based studies.[20,21] None of the minor differences we identified between cases and controls in geographic distribution, race, or insurance status appear to be important from a clinical or public health standpoint.

The results confirm our hypothesis that dizziness is often medical. When considered in aggregate, general medical diagnoses (49.2%) were more common than otovestibular ones (32.9%). Nearly half of the medical disorders diagnosed were cardiovascular, in keeping with prior data from both EDs and general medical settings.[6] Psychiatric diagnoses were less common (7.2%) than reported in settings other than acute care (eg, chronic dizziness in primary care 40%[22] or subspecialty clinic 21%[23]).

Because we did not exhaustively classify *all* diagnoses as benign or dangerous, we cannot provide a robust estimate of absolute prevalence of benign or dangerous conditions. However, we can offer an estimate of relative prevalence: prospectively defined dangerous diagnoses (15%) were about as frequent as prospectively defined benign diagnoses (16%). Cerebrovascular diagnoses were not rare (4.0%) and, in aggregate, were the second most common dangerous diagnosis after fluid and electrolyte disturbances (5.6%), outpacing cardiac arrhythmias (3.2%), angina and myocardial infarction (1.7%), anemia (1.6%), and hypoglycemia (1.4%). Three dangerous disorders, although rare (<0.5%), were associated in our sample with a presenting symptom of dizziness (carbon monoxide poisoning [OR, 7.4; 95% CI, 4.0–13.6], subarachnoid hemorrhage/intracranial aneurysm/cervicocranial vascular dissection [OR, 4.4; 95% CI, 0.9–22.0], and aortic dissection/ruptured aneurysm [OR, 2.0; 95% CI, 0.4–9.1]). These disorders were chosen prospectively because of demonstrated dizziness symptoms in disease-based case reports or series,[24–29] but their small numbers even in this very large data set underscore the difficulty in describing predictors of rare but critical diagnoses.

Our findings extend prior work suggesting that patients with dizziness consume substantial resources in EDs.[13] Given the broad diagnostic spectrum and high risk of dangerous disorders, this consumption is probably appropriate. However, the frequent and disproportionate use of diagnostic imaging technology among dizziness cases vs controls (18.0% vs 6.9% across all years, and 24.0% vs 12.6% in 2005) deserves consideration. Although we cannot be sure that all imaging obtained for dizziness cases was focused on the head or brain, prior research indicates a high rate of neuroimaging among ED patients with

dizziness.[10] Virtually all imaging was by CT, rather than MRI, even in more recent years (22.8% vs 1.8% in 2005). However, for ED patients with dizziness, the diagnostic yield of head CT is known to be low,[30] and CT has recently been shown to identify only about 16% of all acute ischemic strokes (even those imaged 12 hours or more after symptom onset).[31] Computed tomography probably identifies even fewer strokes in the posterior cranial fossa because of radiographic artifacts emanating from the skull base.[32] Some ED physicians might be falsely reassured by normal results from head CT,[33] so heavy use of CT in these patients could be both costly and dangerous. Emergency department physicians worldwide would apparently welcome guidance in making imaging decisions among patients with dizziness or vertigo,[33,34] so this represents an important area for future study.

Despite greater ED length of stay and extensive testing, dizziness cases are admitted with greater frequency than controls. Because admissions to the intensive care unit were comparable (2.2% vs 1.8%; P=.15), dizziness cases were probably not appreciably “sicker” (in a medical sense) than controls without dizziness. Considering the high frequency of symptom-only diagnoses (22.1% vs 8.4%), perhaps many of the non-ICU admissions among dizziness cases (16.6% vs 13.0%; P<.001) reflect residual diagnostic uncertainty, rather than admission for specific treatment. This suggests a need for new approaches to diagnosis, among them perhaps clinical decision rules, diagnostic protocols, or computer-based diagnostic decision support.[35]

Data from NHAMCS on ED visits are from a large, nationally representative sample that offers many advantages in ascertaining the overall spectrum of dizziness presentations to the ED. However, the lack of independent diagnostic confirmation and follow-up makes it impossible to precisely gauge the accuracy of diagnoses and appropriateness of diagnostic testing. We identified several potential limitations to our study findings.

The NHAMCS data set does not provide sufficient data to analyze details of clinical presentation. For instance, we cannot be sure, in those cases in which dizziness was one of 2 or 3 presenting symptoms, whether dizziness was the primary symptom. Also, we cannot know how the type of dizziness (vertigo, presyncope, disequilibrium, other) or presence of certain signs (eg, nystagmus) influenced the final diagnosis; nor can we use such data to generate clinical prediction rules.

Because ED diagnoses were unconfirmed, we cannot have absolute confidence that the diagnoses given were accurate, which might bias results. Misdiagnoses could be common with certain vestibular disorders, including cerebrovascular causes of dizziness.[7,8] Perhaps 35% of those presenting to the ED with dizziness of confirmed cerebrovascular cause are misdiagnosed.[7] However, at least for cerebrovascular disorders, ED overdiagnosis and underdiagnosis appear to be of similar magnitude,[36] likely making our prevalence estimate roughly accurate despite diagnostic misclassification. In support of this notion, the one study of a population-based community sample of cerebrovascular diagnoses among ED patients with dizziness estimated a rate of confirmed cerebrovascular cases (3.2%)[7] similar to that seen in our study (4.0%).

Overdiagnoses might be frequent for some benign disorders (eg, vasovagal syncope) but are unlikely among acute, life-threatening diseases with well-established diagnostic tests (eg, myocardial infarction, aortic dissection). Underdiagnoses might also be frequent, given the high rate of symptom-only diagnoses. This might be particularly so for certain vestibular disorders, such as multisensory disequilibrium (common among older patients[37] but not available as a specific *ICD-9-CM* diagnosis code) or vestibular migraine (common at any age but probably unrecognized by many physicians[38]). Finally, perhaps some diagnoses

were incidental to the symptom of dizziness. This is plausible for some diagnoses (eg, diabetes, hypertension) but less so for others (eg, labyrinthitis, aortic dissection).

CONCLUSION

There are roughly 2.6 million visits for dizziness in the United States annually. Emergency department patients with dizziness tend to be older and to use more medical resources than their counterparts without dizziness. They do not conform to traditional textbook notions of "the dizzy patient." Dizziness is not attributed to a vestibular disorder in most cases and is often associated with cardiovascular or other medical causes. Dangerous disorders are frequently identified, even among younger adults. Despite extensive testing in the ED (including advanced imaging in approximately 1 of every 4 patients in recent years), dizziness often is undiagnosed at the end of ED assessment. Detailed studies in cohorts of unselected patients with dizziness are required to better understand this common ED symptom. Future research should focus on ways to streamline the diagnosis of ED patients with dizziness, taking into consideration the full range of associated dangerous medical and neurologic disorders.

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Glossary

CI	confidence interval
CT	computed tomography
ED	emergency department
HCUP-CCS	Healthcare Cost and Utilization Project's Clinical Classifications Software
ICD-9-CM	*International Classification of Diseases, Ninth Revision, Clinical Modification*
MRI	magnetic resonance imaging
NHAMCS	National Hospital Ambulatory Medical Care Survey
NOS	not otherwise specified
OR	odds ratio
RFV code	NHAMCS reason-for-visit classification

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APPENDIX 1

Multilevel Classification Using Healthcare Cost and Utilization Project's Clinical Classifications Software (HCUPCCS) (Level 1 Codes and Some Level 2 Codes of Interest)

1	Infectious and parasitic diseases[a]	
2	Neoplasms	
3	Endocrine, nutritional, and metabolic diseases and immunity disorders	
4	Diseases of the blood and blood-forming organs	
5	Mental disorders	
6	Diseases of the nervous system and sense organs	
	6.1	Central nervous system infection
	6.2	Hereditary and degenerative nervous system conditions
	6.3	Paralysis

	6.4	Epilepsy, convulsions
	6.5	Headache, including migraine
	6.6	Coma, stupor, and brain damage
	6.7	Eye disorders
	6.8	Ear conditions[b]
	6.9	Other nervous system disorders
7	Diseases of the circulatory system	
	7.1	Hypertension
	7.2	Diseases of the heart
	7.3	Cerebrovascular disease[c]
	7.4	Diseases of arteries, arterioles, and capillaries
	7.5	Diseases of veins and lymphatic system
8	Diseases of the respiratory system	
9	Diseases of the digestive system	
10	Diseases of the genitourinary system	
11	Complications of pregnancy, childbirth, and the puerperium	
12	Diseases of the skin and subcutaneous tissue	
13	Diseases of the musculoskeletal system and connective tissue	
14	Congenital anomalies	
15	Certain conditions originating in the perinatal period	
16	Injury and poisoning	
17	Symptoms, signs, and ill-defined conditions and factors influencing health status	
18	Residual codes, unclassified, all E codes [259 and 260]	

[a] Infectious and parasitic diseases category includes systemic infections. However, in the HCUP-CCS system, localized infections (eg, meningitis, ocular infections) are generally listed within the affected organ system.

[b] Ear conditions are listed with “Diseases of the nervous system and sense organs” in the HCUP-CCS system. In our study, we analyzed these otovestibular diagnoses (HCUP-CCS 6.8) as a separate category.

[c] Cerebrovascular disorders are listed with “Diseases of the circulatory system” in the HCUP-CCS system. In our study, we analyzed these cerebrovascular diagnoses (HCUP-CCS 7.3) as a special subcategory of “Diseases of the nervous system and sense organs.”

APPENDIX 2

Benign and Dangerous Diagnoses of Interest Among Emergency Department Patients With Dizziness (*ICD-9-CM* or HCUP-CCS Codes)[a]

Benign disorders
Orthostatic hypotension (458.0)
Vasovagal syncope (780.2)
Migraine (346.x)
Multiple sclerosis (340)
Benign paroxysmal positional vertigo (386.11)
Vestibular neuritis/labyrinthitis (386.12 or 386.3x)
Meniere disease (386.0x)
Panic disorder (300.01 or 300.21)

Depression (296.2, 296.3, 296.5, 296.82, 300.4, 311, 309.0, or 309.1)
Alcohol intoxication (305.0, 291.4, or 303.0)
Dangerous disorders
Angina (413.x or 411.1)
Myocardial infarction (410.x)
Arrhythmia (427.x *not* 427.5 [cardiac arrest])
Aortic dissection/ruptured aneurysm (441.0, 441.1, 441.3, 441.5, or 441.6)
Pulmonary embolism (451.1x)
Transient ischemic attack (435.x)
Stroke/intracerebral hemorrhage (433.x, 434.x, or 431)
Subarachnoid hemorrhage/intracranial aneurysm/cervicocranial vascular dissection (430, 443.21, or 443.24)
Bacterial meningitis (320.x or 036.0)
Fluid and electrolyte disorders (HCUP-CCS 3.8.x[b])
Hypoglycemia (251.0, 251.1, 251.2, or 250.8)
Anemia (HCUP-CCS 4.1.x[c])
Adrenal insufficiency (255.4 or 255.5)
Alcohol withdrawal (291.81 or 291.0)
Carbon monoxide poisoning (986)

[a] Diagnoses were designated “benign” or “dangerous” on the basis of imminent risk of preventable morbidity or mortality. HCUP-CCS = Healthcare Cost and Utilization Project’s Clinical Classifications Software; *ICD-9-CM* = *International Classification of Diseases, Ninth Revision, Clinical Modification*.

[b] HCUP-CCS 3.8 “Fluid and electrolyte disorders” includes the following: 3.8.1 Hyposmolality, 3.8.2 Hypovolemia, 3.8.3 Hyperpotassemia, 3.8.4 Hypopotassemia, and 3.8.5 Other fluid and electrolyte disorders. These incorporate *ICD-9-CM* codes 276.x as follows: 276.0, 276.1, 276.2, 276.3, 276.4, 276.5, 276.50, 276.51, 276.52, 276.6, 276.7, 276.8, and 276.9.

[c] HCUP-CCS 4.1 “Anemia” includes the following: 4.1.1 Acute posthemorrhagic anemia; 4.1.2 Sickle cell anemia; 4.1.3 Deficiency and other anemia; 4.1.3.1 Iron deficiency anemia; 4.1.3.2 Other deficiency anemia; 4.1.3.3 Aplastic anemia; 4.1.3.4 Chronic blood loss anemia; 4.1.3.5 Acquired hemolytic anemia; 4.1.3.6 Other specified anemia; 4.1.3.7 Anemia; unspecified. These incorporate *ICD-9-CM* codes in the 280–285 range, as follows: 280.0, 280.1, 280.8, 280.9, 281.0, 281.1, 281.2, 281.3, 281.4, 281.8, 281.9, 282.0, 282.1, 282.2, 282.3, 282.4, 282.41, 282.42, 282.49, 282.5, 282.60, 282.61, 282.62, 282.63, 282.64, 282.68, 282.69, 282.7, 282.8, 282.9, 283.0, 283.1, 283.10, 283.11, 283.19, 283.2, 283.9, 284.0, 284.8, 284.9, 285.0, 285.1, 285.21, 285.22, 285.29, 285.8, and 285.9.

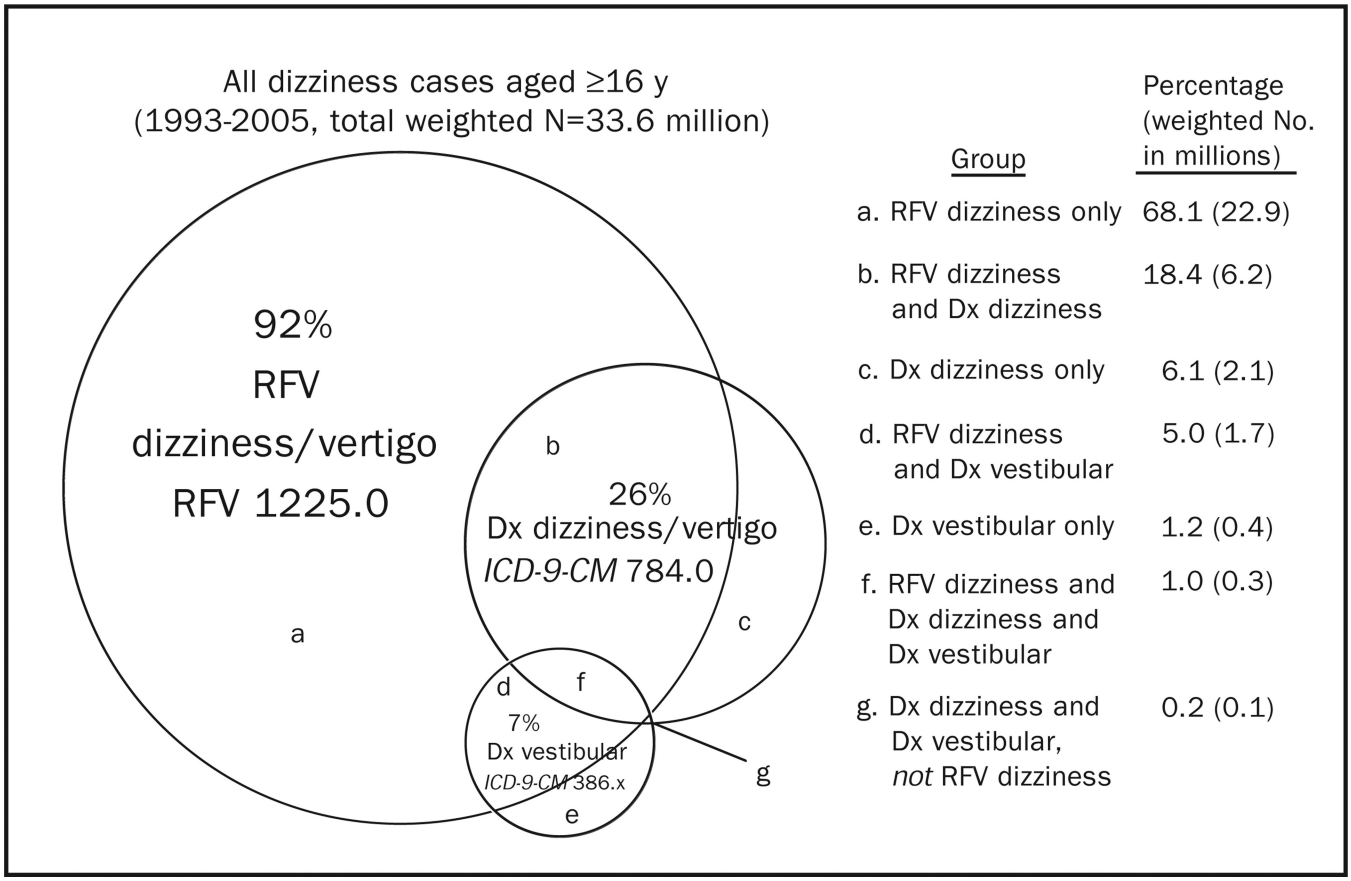

Figure 1.
Proportional and absolute makeup of weighted study population. Numbers do not sum because of rounding. Dx = Diagnosis; *ICD-9-CM* = *International Classification of Diseases, Ninth Revision, Clinical Modification*; RFV = National Hospital Ambulatory Medical Care Survey reason for visit.

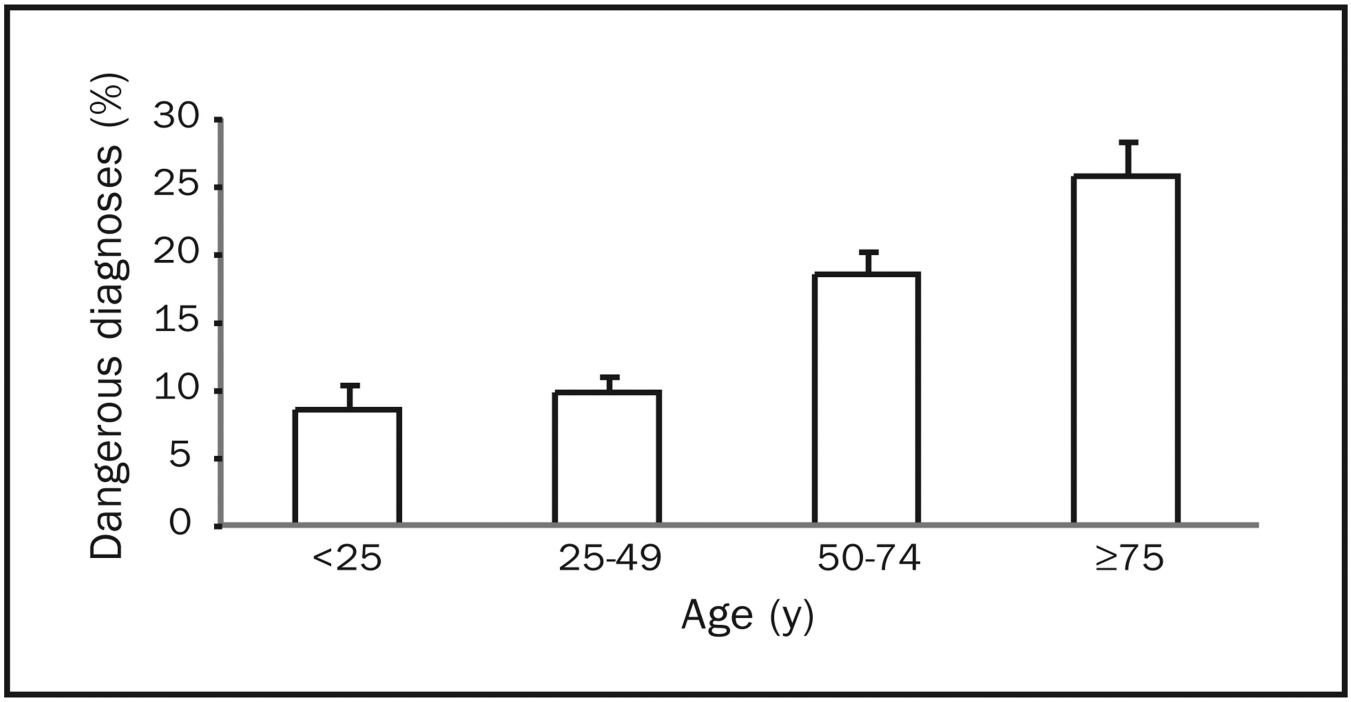

Figure 2.
Frequency of dangerous diagnoses in 25-year age groups. Note that these point estimates are likely conservative given that only prospectively defined dangerous diagnoses are considered. Error bars represent 95% confidence interval upper bounds on point estimates.

TABLE 1

Population and Emergency Department (ED) Visit Rates for Dizziness by Demographic Group[a]

Demographic group	No. of sampled visits	US ED visits (millions) No. (95% CI)	Per 1000 US population[b] Rate (95% CI)	Per 1000 ED visits Rate (95% CI)
Overall	9472	33.6 (31.3–35.9)	12.0 (11.2–12.9)	32.9 (32.0–33.8)
Age (y)				
16–19	448	1.7 (1.4–1.9)	8.2 (7.0–9.5)	20.6 (18.1–23.0)
20–29	1456	5.3 (4.8–5.8)	10.6 (9.6–11.6)	23.9 (22.2–25.6)
30–39	1399	5.1 (4.6–5.5)	9.0 (8.2–9.8)	25.1 (23.6–26.7)
40–49	1335	4.5 (4.1–5.0)	8.4 (7.6–9.2)	27.1 (25.2–29.0)
50–59	1269	4.5 (4.1–5.0)	11.5 (10.5–12.8)	41.3 (38.3–44.4)
60–69	1168	3.9 (3.5–4.3)	14.4 (12.9–15.8)	47.9 (44.4–51.5)
70–79	1302	4.7 (4.3–5.1)	22.7 (20.7–24.7)	57.2 (53.1–61.2)
≥80	1095	3.9 (3.4–4.3)	32.5 (28.9–36.1)	51.8 (47.8–55.9)
Sex				
Female	5799	20.6 (19.1–22.2)	11.6 (10.7–12.5)	36.5 (35.2–37.9)
Male	3673	13.0 (12.0–13.9)	7.8 (7.2–8.4)	28.4(27.2–29.6)
Race				
White	7057	25.9 (24.0–27.9)	10.7 (9.9–11.6)	33.0 (31.9–34.0)
Black	1989	6.6 (5.8–7.3)	19.4 (17.1–21.7)	31.6 (29.7–33.5)
Other	426	1.1 (0.9–1.4)	5.9 (4.5–7.1)	41.5 (34.5–48.5)
Ethnicity[c]				
Hispanic	1076	3.2 (2.9–3.6)	9.2 (8.0–10.5)	33.1 (30.4–35.8)
Non-Hispanic	7626	27.2 (25.2–29.2)	9.4 (8.6–10.2)	33.0 (32.0–34.0)
Urban status[b]				
Metropolitan statistical area	8177	27.3 (24.8–29.8)	…	33.7 (32.6–34.7)
Nonmetropolitan	1245	6.3 (4.6–8.0)	…	30.0 (27.9–32.1)
US region[b]				
Northeast	2506	7.2 (6.3–8.1)	…	34.4 (32.5–36.3)
Midwest	2159	8.5 (7.2–9.8)	…	33.1 (31.4–34.9)
South	2896	11.6 (10.1–13.1)	…	31.3 (29.7–32.8)
West	1911	6.3 (5.5–7.2)	…	34.2 (31.5–36.9)

[a] CI = confidence interval.

[b] Missing data reflect the fact that the US census bureau does not provide annual population demographic data broken down by urban status or US region for all age ranges necessary to complete these calculations.

[c] Ethnicity categories do not total 100% because of 9% missing values in National Hospital Ambulatory Medical Care Survey data set.

TABLE 2

Demographic Characteristics of Dizziness Cases and Controls Without Dizziness[a]

	Dizziness cases		Controls without dizziness		
Demographic group	**No.**	**% or mean (95% CI)**	**No.**	**% or mean (95% CI)**	***P* value**
Age (y)					
Mean age	9472	51.0 (50.4–51.6)	281,158	43.7 (43.4–44.0)	<.001
Sex					
Female	5799	61.4 (60.1–62.7)	153,718	55.1 (54.8–55.4)	<.001
Race					
White	7057	77.1 (75.3–79.0)	209,361	77.0 (75.4–78.6)	
Black	1989	19.5 (17.8–21.3)	62,237	20.4 (18.9–21.9)	
Other	426	3.3 (2.6–4.0)	9560	2.6 (2.3–2.9)	.03
Ethnicity[b]					
Hispanic	1076	9.6 (8.4–10.8)	31,214	9.5 (8.7–10.4)	
Non-Hispanic	7626	81.0 (79.2–82.7)	226,015	80.8 (79.2–82.4)	.86
Urban status					
Metropolitan statistical area	8177	81.3 (76.3–86.3)	240,378	79.4 (74.2–84.7)	.02
US region					
Northeast	2506	21.4 (19.0–23.9)	71,934	20.5 (17.9–23.0)	
Midwest	2159	25.2 (22.0–28.5)	62,098	25.1 (22.1–28.1)	
South	2896	34.5 (31.0–38.0)	92,340	36.4 (32.7–40.0)	
West	1911	18.8 (16.4–21.3)	54,786	18.1 (15.5–20.8)	.05
Insurance type					
Private	3165	42.7 (40.9–44.6)	115,206	41.3 (40.2–42.4)	
Public[c]	3629	34.7 (33.1–36.4)	115,886	28.8 (27.8–29.8)	
Self-pay	1147	13.2 (12.2–14.2)	51,037	16.9 (16.3–17.4)	
Other	562	4.3 (3.7–4.9)	31,068	7.3 (7.1–8.0)	
Missing	484	5.0 (4.3–5.8)	19,102	5.3 (5.0–6.0)	<.001

[a] CI = confidence interval.

[b] Ethnicity sums do not total 100% because of 9% missing values in National Hospital Ambulatory Medical Care Survey data set.

[C] Public insurance includes State Children's Health Insurance Program for 2001.

TABLE 3

Diagnoses of Dizziness Cases vs Controls Grouped by HCUP-CCS Level 1 Diagnostic Category, Listed by Diagnostic Frequency for Dizziness Cases [a]

	Dizziness cases		Controls without dizziness		
Diagnostic category[b]	**No.**	**% (95% CI)**	**No.**	**% (95% CI)**	**OR (95% CI)**
Diseases of nervous system and sense organs	3764	39.4 (38.1–40.7)	21,543	7.8 (7.6–8.0)	7.7 (7.3–8.1)
Oto-vestibular	3125	32.9 (31.6–34.1)	3768	1.4 (1.3–1.5)	34.4 (31.9–37.1)
All others	639	6.6 (5.9–7.2)	17,775	6.4 (6.2–6.6)	1.0 (0.9–1.1)
Diseases of the circulatory system	2357	25.1 (23.8–26.3)	33,625	12.2 (11.9–12.4)	2.4 (2.3–2.6)
Cerebrovascular	358	4.0 (3.5–4.5)	2730	1.0 (1.0–1.1)	4.0 (3.5–4.6)
All others[c]	1999	21.1 (19.9–22.2)	30,895	11.1 (10.9–11.4)	2.1 (2.0–2.3)
Diseases of the respiratory system	1023	11.5 (10.7–12.4)	40,480	14.9 (14.6–15.1)	0.7 (0.7–0.8)
Endocrine, nutritional, and metabolic diseases and immunity disorders	1047	11.0 (10.2–11.8)	12,765	4.4 (4.3–4.6)	2.7 (2.5–2.9)
Injury and poisoning	992	10.6 (9.8–11.4)	84,152	30.7 (30.3–31.1)	0.3 (0.2–0.3)
Mental disorders	714	7.2 (6.5–8.0)	20,839	6.0 (5.8–6.2)	1.2 (1.1–1.4)
Diseases of the digestive system	669	7.0 (6.3–7.6)	25,790	9.3 (9.1–9.4)	0.7 (0.7–0.8)
Diseases of the genitourinary system	482	5.1 (4.5–5.7)	23,198	8.3 (8.2–8.5)	0.6 (0.5–0.7)
Infectious and parasitic disease	291	2.9 (2.5–3.4)	8812	3.0 (2.9–3.1)	1.0 (0.8–1.1)
Diseases of the musculoskeletal system and connective tissue	268	2.8 (2.3–3.2)	22,764	8.1 (7.9–8.3)	0.3 (0.3–0.4)
Diseases of blood and blood-forming organs	203	2.1 (1.7–2.4)	3091	1.1 (1.0–1.1)	1.9 (1.6–2.3)
Complications of pregnancy, childbirth, and the puerperium	155	1.7 (1.3–2.0)	7146	2.3 (2.2–2.4)	0.7 (0.6–0.9)
Neoplasms	101	0.9 (0.7–1.2)	3230	1.0 (0.9–1.0)	1.0 (0.7–1.3)
Diseases of the skin and subcutaneous tissue	69	0.7 (0.5–0.9)	8916	3.1 (2.9–3.2)	0.2 (0.2–0.3)
Congenital anomalies/certain conditions originating in perinatal period	12	0.2 (NC)	263	0.1 (0.1–0.1)	1.6 (0.8–3.2)
Medical diagnosis only[d]	3772	40.3 (39.1–41.5)	123,674	44.8 (44.4–45.2)	1.0 (0.9–1.1)
Symptom diagnosis only[e]	2130	22.1 (20.8–23.3)	22,855	8.4 (8.2–8.7)	3.1 (2.9–3.3)

[a] CI = confidence interval; HCUP-CCS = Healthcare Cost and Utilization Project's Clinical Classifications Software; *ICD-9-CM* = *International Classification of Diseases, Ninth Revision, Clinical Modification*; NC = not calculated because sample had fewer than 30 observations; OR = odds ratio.

[b] Although HCUP-CCS has 18 level 1 categories (Appendix 1), only the first 16 describe an etiologic diagnosis. Therefore, we analyzed only these 16 categories. Because of their diagnostic similarity and infrequency in the patient population under study, we combined HCUP–CCS level 1 categories 14 (congenital anomalies) and 15 (certain conditions originating in the perinatal period) for analysis.

[c] Other diagnoses within the "circulatory system" include cardiovascular and peripheral vascular disease (Appendix 1).

[d] "Medical" diagnoses were defined to include the following HCUP-CCS categories: Diseases of the circulatory system (excluding cerebrovascular); Diseases of the respiratory system; Endocrine, nutritional, and metabolic diseases and immunity disorders; Diseases of the digestive system; Diseases of the genitourinary system; Infectious and parasitic diseases; and Diseases of the blood and blood-forming organs. To be considered a "medical diagnosis only," the emergency visit had to be coded with one or more diagnoses in these specific categories but no diagnoses in any other HCUP-CCS diagnostic category.

[e] Symptom diagnoses were not derived from HCUP-CCS categories, but directly from *ICD-9-CM* codes. Patients diagnosed only with 1 or more symptom codes (*ICD-9-CM* 780–789) but no etiologic diagnostic codes (ie, *ICD-9-CM* codes outside this range) were considered to have been given a symptom-only diagnosis.

TABLE 4

Benign and Dangerous Diagnoses of Dizziness Cases vs Controls, Listed by Diagnostic Frequency for Dizziness Cases[a]

	Dizziness cases		Controls without dizziness		
Diagnosis group	**No.**	**% (95% CI)**	**No.**	**% (95% CI)**	**OR (95% CI)**
Benign					
Vasovagal syncope	628	6.6 (5.9–7.3)	2122	0.8 (0.8–0.8)	8.8 (7.8–9.9)
Vestibular neuritis/labyrinthitis[b]	498	5.6 (5.0–6.2)	…	…	…
Migraine	98	1.1 (0.8–1.4)	2894	1.1 (1.0–1.2)	1.0 (0.7–1.3)
Benign paroxysmal positional vertigo[b]	84	0.7 (0.6–0.9)	…	…	…
Orthostatic hypotension	61	0.6 (0.4–0.7)	66	0.0 (0.0–0.0)	22.4 (14.3–35.1)
Depression	82	0.6 (0.4–0.8)	3725	1.0 (1.0–1.1)	0.6 (0.5–0.8)
Panic disorder	46	0.5 (0.3–0.7)	408	0.1 (0.1–0.2)	3.9 (2.6–5.7)
Alcohol intoxication	51	0.5 (0.3–0.7)	3220	1.0 (0.9–1.1)	0.5 (0.3–0.7)
Meniere disease[b]	32	0.3 (0.2–0.5)	…	…	…
Multiple sclerosis	10	0.1 (NC)	157	0.1 (0.0–0.1)	1.6 (0.8–3.5)[c]
Dangerous[d]					
Fluid and electrolyte disorders	539	5.6 (5.0–6.2)	5245	1.9 (1.8–1.9)	3.1 (2.8–3.5)
Arrhythmia	296	3.2 (2.7–3.8)	2550	0.9 (0.9–1.0)	3.5 (3.0–4.2)
Transient ischemic attack	154	1.7 (1.4–2.0)	787	0.3 (0.3–0.3)	5.7 (4.6–7.0)
Anemia	167	1.6 (1.3–1.9)	2255	0.8 (0.7–0.9)	2.0 (1.7–2.5)
Hypoglycemia	110	1.4 (1.0–1.7)	1127	0.4 (0.4–0.5)	3.2 (2.5–4.1)
Angina	87	0.9 (0.6–1.1)	2107	0.8 (0.8–0.9)	1.0 (0.8–1.4)
Myocardial infarction	73	0.8 (0.5–1.0)	2149	0.8 (0.7–0.9)	1.0 (0.7–1.3)
Stroke/intracerebral hemorrhage	39	0.5 (0.3–0.7)	262	0.1 (0.1–0.1)	5.4 (3.6–7.9)
Carbon monoxide poisoning	16	0.2 (NC)	59	0.0 (0.0–0.0)	7.4 (4.0–13.6)[c]
Subarachnoid hemorrhage/intracranial aneurysm/cervicocranial vascular dissection	3	0.1 (NC)	41	0.0 (0.0–0.0)	4.4 (0.9–22.0)[c]
Alcohol withdrawal	7	0.0 (NC)	292	0.1 (0.1–0.1)	0.6 (0.3–1.4)[c]
Aortic dissection/ruptured aneurysm	2	0.0 (NC)	34	0.0 (0.0–0.0)	2.0 (0.4–9.1)[c]

[a] CI = confidence interval; NC = not calculated because sample had fewer than 30 observations; OR = odds ratio.

[b] These vestibular diagnoses were included a priori within dizziness cases; thus, no comparison can be made with the control group without dizziness.

[c] These ORs are potentially unstable estimates given the relatively few sampled diagnoses among dizziness cases.

[d] There were no sampled cases among dizziness cases of pulmonary embolism, bacterial meningitis, or adrenal insufficiency. Likewise, there were too few sampled cases among controls without dizziness to calculate stable point estimates. Thus, we did not report these prospectively defined groups.

TABLE 5

Emergency Department Resource Use of Dizziness Cases vs Controls[a]

	Dizziness cases		Controls without dizziness		
Diagnosis group	**No.**	**% or mean (95% CI)**	**No.**	**% or mean (95% CI)**	***P* value**
Arrival					
Ambulance[b]	1274	23.5 (21.9–25.0)	26,724	17.1 (16.6–17.7)	<.001
Initial visit[c]	3725	90.8 (89.5–92.2)	97,971	87.5 (86.7–88.3)	<.001
Return visit (within 72 h)[d]	131	2.8 (2.2–3.5)	4566	3.4 (3.1–3.6)	.11
Injury-related[e]	1342	15.9 (14.9–16.9)	89,654	37.3 (36.9–37.8)	<.001
Urgent visit	5486	57.2 (55.1–59.4)	143,679	50.8 (49.1–52.5)	<.001
Wait time (min),[b] mean	5274	266.4 (244.0–288.7)	149,377	290.5 (272.4–308.7)	.001
Testing					
Electrocardiography	4295	45.2 (43.7–46.7)	49,623	17.7 (17.3–18.1)	<.001
Cardiac monitor[e]	1494	18.5 (17.0–19.9)	21,000	9.2 (8.8–9.7)	<.001
CT/MRI scan[e]	1556	18.0 (16.8–19.2)	16,998	6.9 (6.5–7.3)	<.001
1995	57	10.0 (6.6–13.4)	516	3.4 (2.9–3.8)	<.001
2005	242	24.0 (20.2–27.8)	3096	12.6 (11.7–13.6)	<.001
CT scan[f]	656	14.5 (13.2–15.9)	7302	5.7 (5.3–6.0)	<.001
1995	54	9.4 (6.0–12.8)	496	3.2 (2.8–3.7)	<.001
2005	231	22.8 (19.1–26.4)	2993	12.3 (11.3–13.2)	<.001
MRI[f]	39	0.8 (0.5–1.1)	373	0.3 (0.2–0.3)	.001
1995	5	1.2 (NC)	26	0.2 (NC)	<.001
2005	19	1.8 (NC)	151	0.5 (0.4–0.7)	<.001
Electroencephalography[c]	39	0.8 (0.5–1.2)	649	0.5 (0.4–0.6)	.01
Diagnostic tests, mean No.[g]	7275	4.6 (4.4–4.8)	205,660	3.2 (3.1–3.3)	<.001
Procedures, mean No.[g]	7330	4.6 (4.0–5.3)	208,383	4.4 (4.0–4.8)	.37
Medications, mean No.	9472	1.7 (1.6–1.8)	281,158	1.8 (1.7–1.8)	.13
Visit length (min), mean No.[c]	4502	242.4 (232.4–252.4)	123,316	201.8 (196.1–207.5)	<.001
Disposition					

Diagnosis group	Dizziness cases		Controls without dizziness		*P* value
	No.	% or mean (95% CI)	No.	% or mean (95% CI)	
Admit	1777	18.8 (17.7–19.9)	43,042	14.8 (14.4–15.3)	<.001
ICU[e]	157	2.2 (1.7–2.7)	4090	1.8 (1.7–1.9)	.15
Left without care[g]	143	1.8 (1.4–2.3)	4072	1.8 (1.7–2.0)	.90
Transferred	125	1.4 (1.0–1.7)	6154	2.1 (1.9–2.2)	<.001
Died	5	0.0 (NC)	918	0.4 (0.3–0.4)	<.001

[a]Aggregate data 1993–2005, except as noted. CI = confidence interval; CT = computed tomography; ICU = intensive care unit; MRI = magnetic resonance imaging; NC = not calculated because sample had fewer than 30 observations.

[b]Data available 1997–2000; 2003–2005.

[c]Data available 2001–2004.

[d]Data available 2001–2005.

[e]Data available 1995–2005.

[f]Data available 1995–2000, 2005.

[g]Data available 1997–2005.