Disconnect Between Charted Vestibular Diagnoses and Emergency Department Management Decisions: A Cross-sectional Analysis From a Nationally Representative Sample

David E. Newman-Toker, MD, PhD, Carlos A. Camargo, Jr, MD, DrPH, Yu-Hsiang Hsieh, PhD, MS, Andrea J. Pelletier, MPH, MS, and Jonathan A. Edlow, MD

Abstract

Objectives: The most common vestibular disorders seen in the emergency department (ED) are benign paroxysmal positional vertigo (BPPV) and acute peripheral vestibulopathy (APV; i.e., vestibular neuritis or labyrinthitis). BPPV and APV are two very distinct disorders that have different clinical presentations that require different diagnostic and treatment strategies. BPPV can be diagnosed without imaging and is treated with canalith-repositioning maneuvers. APV sometimes requires neuroimaging by magnetic resonance imaging (MRI) to exclude posterior fossa stroke mimics and should be treated with vestibular sedatives and corticosteroids. We sought to determine if emergency physicians (EPs) apply best practices to diagnose and treat these common vestibular disorders.

Methods: This was a cross-sectional study of ED visits from the National Hospital Ambulatory Medical Care Survey (NHAMCS). A weighted sample of U.S. ED visits (1993–2005) was used. Patients at least 16 years of age who were given a final ED diagnosis of BPPV (International Classification of Diseases, 9th Revision [ICD-9], 386.11) or APV (ICD-9 386.12 or 386.3x) comprised the study population. The frequency of imaging and drug therapy in those diagnosed as BPPV or APV versus controls was the main outcome measure.

Results: A total of 9,472 dizzy patient visits were sampled over 13 years (weighted estimate 33.6 million U.S. ED visits over that period). A weighted estimate of 2.5 million patients (7.4%) were given a vestibular diagnosis, mostly BPPV (weighted 0.2 million) or APV (weighted 1.9 million). Patients given BPPV (19%) and APV (19%) diagnoses were more likely to undergo imaging (all by computed tomography [CT]) than controls (7%; p < 0.001). Patients given BPPV (58%) and APV (70%) diagnoses were more likely to receive meclizine than controls (0.1%; p < 0.001). Corticosteroid administration was rarely documented (2% BPPV, 1% APV).

Conclusions: Patients given a vestibular diagnosis in the ED may not be managed optimally. Patients given BPPV and APV diagnoses undergo imaging (predominantly CT) with equal frequency, suggesting overuse of CT (BPPV) and probably underuse of MRI (APV). Most patients diagnosed with BPPV are given meclizine, which is not indicated. Specific therapy for APV (corticosteroids) is probably underutilized. Educational initiatives and clinical guidelines merit consideration.

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Keywords: dizziness, vertigo, vestibular diseases, diagnosis, medical error, cross-sectional studies
Dizziness, including vertigo, is responsible for 4% of emergency department (ED) visits.1 Small, systematic studies of dizzy ED patients suggest that 24%–43% have a peripheral vestibular disorder.2,3 The most common peripheral vestibular disorders are benign paroxysmal positional vertigo (BPPV) and acute peripheral vestibulopathy (APV).4 BPPV results from the accumulation of mobile crystalline debris (canaliths) within the semicircular canals.5 APV is a generic term referring to any of three related pathoanatomic diagnoses: labyrinthitis (labyrinthine inflammation), vestibular neuritis (vestibular nerve inflammation), and vestibular neuronitis (vestibular ganglion inflammation), all possibly linked to herpetic infections.6 Although in the general population BPPV is more common,7 in the ED, APV appears more prevalent,8,9 presumably because the symptoms are generally more severe and therefore more likely to prompt an ED visit.

The primary clinical feature distinguishing BPPV from APV is symptom timing. BPPV presents with episodic, brief, recurrent dizziness lasting seconds, while APV presents with continuous dizziness during a monophasic illness lasting days to weeks. Even in the minority of cases where APV is heralded by a single, transient episode of dizziness, such spells typically last hours to days and uniformly last at least several minutes,9 exceeding the duration of spells seen in BPPV that invariably last less than a minute.10 Although APV is identified as a risk factor for developing BPPV in about 15% of cases, when this occurs, BPPV generally follows the resolution of APV by a week or more.10,11 Thus, the two disorders do not simultaneously co-occur and should be readily distinguishable from one another clinically.

Optimal management of BPPV and APV differs substantially (Table 1).10,12–36 BPPV can be confidently diagnosed at the bedside,10,14,15 while APV sometimes requires advanced diagnostic tests such as neuroimaging by magnetic resonance imaging (MRI) to exclude stroke.22,37–39 BPPV is cured by bedside physical maneuvers,14,15,25 while APV treatment is focused on mitigating symptoms and vestibular damage through early pharmacotherapy.29 Agents recommended in APV include antiemetic and vestibular suppressant drugs, along with corticosteroids, with or without antiviral treatments.32 Therefore, diagnostic and therapeutic management of ED patients given BPPV and APV diagnoses should differ substantially. However, like others,40,41 we have noticed an overgeneralized approach to frontline management of patients with “dizziness” or “vertigo.” Recent reports suggest that ED and other primary care providers may not be entirely comfortable interpreting bedside findings in vestibular disorders.92,43

We hypothesized that management of BPPV and APV would differ from best practices and would be inappropriately similar. Specifically, we anticipated overuse of diagnostic tests (especially neuroimaging by computed tomography [CT]) and vestibular sedatives (particularly meclizine) for BPPV and underuse of diagnostic tests (especially MRI) and disease-specific pharmacotherapy (corticosteroids) for APV. To test our hypothesis, we conducted a cross-sectional analysis of a nationally representative sample of U.S. ED visits from the National Hospital Ambulatory Medical Care Survey (NHAMCS) data set. Our objectives were to describe and compare management of patients given a vestibular diagnosis to those given a symptom-only dizziness diagnosis and nondizzy controls.

**METHODS**

**Study Design**

This was a cross-sectional study of U.S. ED dizzy patients, using public-use data from the National Center for Health Statistics (NCHS) provided in the NHAMCS microdata files,44 years 1993–2005. The study was deemed exempt from human subjects committee review by the Partners HealthCare institutional review board.

**Study Setting and Population**

The NHAMCS is a four-stage probability sample of visits to randomly selected U.S. hospitals, including noninstitutional general and short-stay hospitals, but excluding federal, military, and Veterans Affairs hospitals.43 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.45

**Study Protocol**

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

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<td>Sometimes16–24</td>
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<tr>
<td>Canalith-repositioning maneuvers</td>
<td>Proven benefit26,26 and recommended14,15,27</td>
<td>Not indicated</td>
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<td>Corticosteroids</td>
<td>Not indicated</td>
<td>Proven benefit28–30 and recommended31,32</td>
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<tr>
<td>Vestibular sedatives</td>
<td>Ineffective14,15,33,34 and potentially harmful from exacerbation of balance disturbance5,13,15 or delay in repositioning maneuvers5,15,35</td>
<td>Standard treatment8,17,20,32,36</td>
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APV = acute peripheral vestibulopathy; BPPV = benign paroxysmal positional vertigo.

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**Table 1**

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sampled hospital. A structured data entry form is used. Completed forms are sent to Constella Group Inc. (Durham, NC) where data abstraction and medical coding are performed. Data entry and coding have previously been verified using a two-way independent 10% subsample, and keying and coding errors rates are known to be very low (0%–2%). 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.

We included ED patients at least 16 years of age. Younger patients are less likely to be dizzy and suffer from a different spectrum of causes than older teens and adults and may be less capable of describing their symptoms. Dizzy cases were defined as any sampled subject with an NCHS-assigned Patient Reason-for-Visit Classification (RFV) code of vertigo/dizziness (1225.0) in any of the three RFV fields, or a final International Classification of Diseases, 9th Revision [ICD-9], diagnosis of vertigo/dizziness (780.4), or a final ICD-9 diagnosis of a vestibular disorder (386.x) in any of the three final diagnosis fields. Patients with symptom-only dizziness diagnoses and patients without dizziness served as controls.

Outcome Measures
Outcome measures were taken directly or derived from the NHAMCS data set, including patient demographic and ED visit characteristics, diagnostic tests (mean number of tests, proportion undergoing CT or MRI imaging, proportion undergoing cardiac monitoring), and medication treatments (top medication classes administered and proportion receiving meclizine, corticosteroids, or herpetic antiviral therapies). Diagnoses reflect charted emergency physician (EP) diagnoses, locally recorded for sampled ED visits, and medically coded at a central facility (described above).

Data Analysis
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. We compared two groups given a specific vestibular diagnosis (BPPV, ICD-9 386.11 and APV, ICD-9 386.12 or 386.3x) to two control groups: symptom-only dizziness diagnosis (ICD-9 780.4) not ICD-9 386.x [vestibular] nor any other “etologic” ICD-9 code outside the “symptom” range ICD-9 780.x-789.x) and nondizzy controls (not NHAMCS RFV 1225.0 nor ICD-9 386.x nor ICD-9 780.4). We report number of visits sampled, national weighted proportion or mean national estimate, and where appropriate, associated 95% confidence intervals (CIs). As NHAMCS recommends for standard analysis, we did not calculate 95% CIs for estimates with fewer than 30 sampled visits.

The NHAMCS advanced imaging data did not permit analysis by body part scanned (head vs. other) in any year. Due to NHAMCS coding protocol variations from year to year, data on the type of advanced imaging (i.e., CT vs. MRI) were gathered in certain years (1995–2000, 2005), but not others (2001–2004). For the primary analysis of the proportion of patients undergoing any imaging, we combined CT and MRI results across years. We also assessed imaging trends over time comparing scan rates for vestibular patients in two epochs (1995–2000 vs. 2001–2005). A secondary analysis examined the proportion of vestibular patients undergoing CT as opposed to MRI (1995–2000). We could not assess imaging trends over time for MRI among vestibular patients because there were too few sampled visits. As a surrogate, we compared the proportion of CT and MRI for all patients with dizziness in two individual years (1995 vs. 2005).

We assessed medications administered grouped using the National Drug Classification (NDC) two-digit category, representing 22 major medication classes (e.g., antimicrobials [NDC 03], drugs for relief of pain [NDC 17]). Individual drug codes in the NHAMCS data set were linked to the two-digit coding schema for analysis. We report the top four NDC medication classes administered to patients given a diagnosis of BPPV and APV and compare the frequency within the top class across our four diagnostic groups (APV, BPPV, symptom-only dizziness diagnoses, and nondizzy controls). We also analyzed individual medical treatments of interest.

Analyses were performed using SAS 9.1 SURVEYFREQ, SURVEYMEANS, and SURVEYREG procedures for survey data (SAS Institute Inc., Cary, NC). We calculated 95% CIs using the relative standard error of the estimate, using a method approved of by the NCHS. All p-values are two-sided with p < 0.05 considered significant.

RESULTS
The total 13-year sample of dizzy patients was 9,472, corresponding to a weighted national estimate of 33.6 million ED visits in the United States over the 13-year period. Dizzy patients were more likely than nondizzy control subjects to be older (mean age = 51 years vs. 44 years), female (61% vs. 55%), in the ED longer (mean hours = 4.0 vs. 3.4), more extensively tested (mean number of tests = 4.6 vs. 3.2), imaged by CT/MRI (18.0% vs. 6.9%), treated for vertigo or vomiting (16% vs. 0.1%), and admitted (19% vs. 15%; all p < 0.001). The weighted national estimate of ED visits for each study group is shown in Table 2. Among 9,472 dizzy patients, 7.4% were diagnosed as having a vestibular disorder, and 84% of these were given a diagnosis of BPPV or APV. A large fraction (22.1%) received only a symptomatic diagnosis of dizziness (ICD-9 780.4) without a vestibular, medical, or other etiologic diagnosis. As hypothesized, patients given BPPV and APV diagnoses were managed very similarly, but differently than symptomatically diagnosed dizzy patients and very differently than nondizzy controls (Table 3).

Patients given BPPV and APV diagnoses were equally likely to undergo imaging (19%), apparently almost entirely by CT, rather than MRI. During the 1995–2000 time window (when CT data were recorded separately from MRI in the NHAMCS data set), all imaged BPPV (n = 6 of 34, 15%) and APV (n = 27 of 198, 13%) patients underwent CT, not MRI. Rates of imaging were higher...
Table 2
Number of ED Visits for Dizziness and Vestibular Disorders

<table>
<thead>
<tr>
<th>ED Patient Population</th>
<th>13-year Sampled, n</th>
<th>13-year Weighted National Estimate, in Millions (95% CI)</th>
<th>Annual Weighted National Estimate, in Thousands (95% CI)</th>
<th>Fraction of Total Dizzy Patients, % (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dizziness complaint or diagnosis</td>
<td>9,472</td>
<td>33.6 (31.3–36.0)</td>
<td>2,585 (2,404–2,766)</td>
<td>100</td>
</tr>
<tr>
<td>Symptom-only dizziness diagnosis*</td>
<td>2,130</td>
<td>7.4 (6.7–8.1)</td>
<td>570 (518–622)</td>
<td>22.1 (20.8–23.3)</td>
</tr>
<tr>
<td>Any vestibular diagnosis‡</td>
<td>695</td>
<td>2.5 (2.2–2.8)</td>
<td>192 (169–215)</td>
<td>7.4 (6.7–8.1)</td>
</tr>
<tr>
<td>APV</td>
<td>498</td>
<td>1.9 (1.6–2.1)</td>
<td>145 (126–164)</td>
<td>5.6 (5.0–6.2)</td>
</tr>
<tr>
<td>BPPV</td>
<td>84</td>
<td>0.2 (0.2–0.3)</td>
<td>19 (14–24)</td>
<td>0.7 (0.6–0.9)</td>
</tr>
</tbody>
</table>

*Symptom-only diagnosis of dizziness (ICD-9 780.4) without a vestibular, medical, or other etiologic diagnosis. These patients were allowed to have one or two other symptom codes (ICD-9 780–789) in the two other NHAMCS exit diagnosis fields but no etiologic diagnostic codes (i.e., ICD-9 codes outside this range).
‡Final vestibular diagnoses were associated with a documented initial complaint of dizziness (NHAMCS reason-for-visit code 1225.0) in more than 80% of cases.
APV = acute peripheral vestibulopathy; BPPV = benign paroxysmal positional vertigo.

Table 3
Comparison of Management Strategies Across Vestibular Disorders and Relevant Control Populations*

<table>
<thead>
<tr>
<th>BPPV (n = 84) (ICD-9 386.11)</th>
<th>APV (n = 498) (ICD-9 386.12 or 386.3x)</th>
<th>Symptom-only Dizziness Diagnosis (n = 2,130) (ICD-9 780.4, Nothing Outside Range 780–789)</th>
<th>Nondizzy (n = 281,158) (Not RFV 1225.0 nor ICD-9 386.x nor 780.4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnostic tests</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of diagnostic tests†</td>
<td>57</td>
<td>3.7 (2.7–4.6)</td>
<td>337</td>
</tr>
<tr>
<td>CT or MRI imaging</td>
<td>14</td>
<td>19.0 (NC)</td>
<td>89</td>
</tr>
<tr>
<td>Cardiac monitor‡</td>
<td>14</td>
<td>23.1 (NC)</td>
<td>49</td>
</tr>
<tr>
<td>Top NDC Class for BPPV/AVP§</td>
<td>Otologic drugs</td>
<td>55</td>
<td>62.7 (49.3–76.0)</td>
</tr>
<tr>
<td>Specific Drug Therapy</td>
<td>Meclizine</td>
<td>52</td>
<td>58.4 (44.8–72.1)</td>
</tr>
<tr>
<td>Corticosteroids*</td>
<td>1</td>
<td>2.3 (NC)</td>
<td>8</td>
</tr>
<tr>
<td>Herpetic antiviral**</td>
<td>0</td>
<td>0.0 (NC)</td>
<td>0</td>
</tr>
<tr>
<td>Disposition</td>
<td>Admitted</td>
<td>1</td>
<td>0.6 (NC)</td>
</tr>
<tr>
<td>Dead</td>
<td>0</td>
<td>0.0 (NC)</td>
<td>0</td>
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*Values reported are sampled n and weighted national estimate of proportions (95% CI), except for number of diagnostic tests performed, presented as mean (95% CI). Note that weighted proportions may differ between cells, even with the same sampled n, as a result of assigned patient visit weights in the NHAMCS data set (see Methods for details). Those with a dual diagnosis of BPPV and APV (sampled n = 4) were not excluded. Sampled n do not sum to a total of 9,472 because not all categories are represented (i.e., those with a non-BPPV, non-APV vestibular diagnosis [n = 113], those with an exit diagnosis of dizziness plus a nonvestibular etiologic diagnosis [n = 205], and those with a visit reason of dizziness/vertigo who left with a nondizziness, nonvestibular diagnosis [n = 6,442]). NC = not calculated as per standard NHAMCS analysis guidelines for sampled n < 30.
†Data available 1997–2005.
§NDC = National Drug Classification. The top four two-digit NDC class categories for BPPV were the same as for APV (otologic, central nervous system, respiratory tract, and pain relief). We present data from the top category, otologic drugs (NDC 16), which includes drugs for vertigo/motion sickness/vomiting (four-digit NDC subcategory 1671), which, in turn, includes meclizine (the drug most commonly administered to both BPPV and APV patients by a wide margin).
*For meclizine we included NHAMCS codes 53275 MECLIZINE, 18555 MECLIZINE, or 02250 ANTIVERT.
For corticosteroid therapies we included any medications from the NDC 1032 adrenal corticosteroids category. Because of the small numbers of patients treated in the BPPV and APV groups, we did not subclassify which corticosteroid medications were administered.
**For herpetic antiviral drugs we included NHAMCS codes 53275 ACYCLOVIR, 91061 ACYCLOVIR, 35341 ZOVIRAX, 59619 VALACYCLOVIR, 97135 VALACYCLOVIR, 96043 VALTREX, 59712 FAMCICLOVIR, 97060 FAMCICLOVIR, 57062 FAMVIR, or 95017 FAMVIR.
APV = acute peripheral vestibulopathy; BPPV = benign paroxysmal positional vertigo.
in more recent years among vestibular patients (13% [1995–2000] vs. 28% [2001–2005], p < 0.001), but there was no evidence that MRI has displaced CT as the primary imaging modality in the ED. Comparing rates from 1995–2000 with those in 2005, both CT (4.7% vs. 13%) and MRI (0.2% vs. 0.6%) roughly tripled in frequency among patients ≥16 years of age.

The top four NDC medication classes recorded for BPPV and APV were the same for the two groups and administered to patients in nearly identical proportions (data not shown). The top NDC medication class for both groups was otologic drugs (including meclizine; Table 3). Meclizine was the specific drug most often administered to those diagnosed with BPPV (58%) and APV (70%); it was also commonly given to those with only a symptomatic dizziness diagnosis (26%), but not those without dizziness or vestibular diagnosis (0.1%). Corticosteroid treatments were rarely documented.

**DISCUSSION**

Our results suggest that real-world management of patients diagnosed with common vestibular disorders in the ED is suboptimal. This may indicate that vestibular diagnoses are inaccurate, knowledge of best practices in vestibular diagnosis is limited, or both. We found that ED management strategies for patients given a diagnosis of BPPV or APV were inappropriately similar. Patients given a diagnosis of BPPV underwent CT as often as those given a diagnosis of APV; MRI was rarely documented. This suggests likely overuse of CT (since imaging is not recommended for diagnosis of BPPV) and possible underuse of MRI (since MRI is required to exclude posterior fossa stroke in some APV-like presentations). Patients diagnosed as having BPPV were treated with vestibular sedatives (meclizine) almost as often as those diagnosed as having APV, suggesting medication overuse in BPPV, a problem that has been identified in primary care settings as well. Specific therapy for APV (corticosteroids) appears underutilized, although it is possible that this relates to underdocumentation rather than underuse (e.g., if physicians provided prescriptions for outpatient steroid treatment, but failed to document their intent in the ED chart).

The undue similarity in management could reflect an overgeneralized approach to all patients with “dizziness” or “vertigo.” In keeping with this notion was the high proportion of patients receiving a symptom-only dizziness label without a specific etiologic diagnosis (22.1%), approximately threefold greater than the proportion given vestibular diagnoses (7.4%). This differs from ED-based clinical research studies that used a systematic bedside and testing approach to identify a specific vestibular cause in 24% to 43% of possible cases. Like vestibular diagnosis patients, these symptom-only dizziness diagnosis patients were also frequently imaged and treated with meclizine (Table 3). This overly “symptomatic” approach to handling ED dizzy patients could result, in part, from a degree of unfamiliarity with vestibular disorders.

The dearth of etiology-specific diagnostic and therapeutic strategies may also reflect misplaced emphasis in the bedside assessment of dizzy patients. There is growing evidence that physicians focus on dizziness symptom type (i.e., vertigo vs. nonvertiginous dizziness) to the relative exclusion of dizziness timing, triggers, and associated symptoms. This is not surprising, because major texts and other resources across disciplines teach this quality-of-symptoms approach. BPPV and APV patients experience similar symptom quality (usually vertigo) but different symptom tempo (frequent, repetitive, brief spells vs. sustained, continuous dizziness). Overfocus on symptom quality and underfocus on symptom timing and triggers could help explain an unduly uniform approach to management of “vertigo.”

Suboptimal management for these patients likely affects both health care cost and quality. Those with BPPV are probably overimaged and overprescribed anti-vertigo medication at an estimated cost of more than $2,000 per patient. Vestibular sedatives are ineffective and potentially harmful, but may be continued for months or years by primary physicians once initiated. Use of medications in BPPV is associated with failure to provide proven treatment (canalith repositioning), which, in turn, may increase the risk of falls and depression, especially among older patients. For those with APV, underuse of corticosteroids is probably associated with unnecessary morbidity. Chronic dizziness, imbalance, head motion intolerance, and oscillopsia associated with poorly compensated unilateral vestibulopathy occur after untreated APV in about half of patients, but corticosteroids reduce nonrecovery roughly threefold. Because chronic dizziness is an independent risk factor for falls and hip fractures, additional adverse health effects and costs probably accrue from failure to optimally manage APV. The most important mismatch between ideal and real-world management might be the underuse of neuroimaging for patients diagnosed as having APV, since some may instead harbor misdiagnosed strokes, most of which would have been disclosed by brain MRI, but not CT.

Immediate solutions to the problem of suboptimal management of vestibular disorders may not exist. The suggestion to have neurologists routinely available in the ED or to partner with teams of EPs is not currently feasible, given the small number of hospital-based and consulting neurologists available at most institutions. More aggressive use of neuroimaging is another possible approach, but a “blanket” strategy of obtaining MRI in all ED patients with dizziness or vertigo would be costly and ineffective. MRI for all acute vestibular syndrome patients (i.e., high-risk patients who may harbor either APV or a central mimic) might be cost-effective, but would still require that ED physicians distinguish APV-like presentations from BPPV. Furthermore, it would necessitate transfers from EDs without MRI capability and would be logistically challenging, even in EDs with access to MRI.

Education, algorithms, and computer-based decision support systems offer more promising long-range alternatives to improve bedside vestibular diagnosis and treatment. The distinction between BPPV and APV is relatively straightforward at the bedside, once symptom timing becomes the primary focus of inquiry. Validated clinical decision rules would apparently be
welcomed by frontline physicians to assist with imaging decisions for patients with dizziness or vertigo, and an international survey of ED providers indicates that this is a top priority. Recent evidence suggests a three-step bedside eye examination can reliably identify the subset of high-risk patients in need of urgent MRI or admission. If such simple rules prove unable to capture the complexity of ED management of vestibular presentations, computer-based diagnostic decision support could be an alternative.

**LIMITATIONS**

Some readers may be concerned that errors in assigning a vestibular diagnosis could confound any potential association between charted diagnosis and management strategy. Although the rate of NHAMCS coding errors has been shown to be extremely low, this only confirms that database diagnoses accurately reflect charted EP diagnoses. It remains possible that charted ED diagnoses were wrong from the outset. However, even if physician misdiagnosis was common, this would not invalidate our findings regarding management choices. Logic dictates that a physician making a specific vestibular diagnosis would manage the patient under the presumption that his or her diagnosis was correct. Therefore, the frequent disconnect between charted diagnosis and management choice (e.g., imaging and giving meclizine to a patient diagnosed with BPPV) remains a concern and supports our conclusions.

The sampled number of BPPV diagnoses in our study was relatively small, and many of the events (e.g., number of CT/MRI scans) were too infrequent to calculate a statistically valid 95% CI. However, the strength of our findings is bolstered by the similarity in management between BPPV and APV, because the number of APV cases and associated events was adequate to calculate stable point estimates and CIs.

The NHAMCS data set fails to provide sufficiently granular data to analyze nuances of clinical presentation and bedside management. For example, we cannot know how often the Dix-Hallpike test or Epley canalith-repositioning maneuvers were applied. However, these maneuvers appear to be applied only rarely in the ED. Regardless, this should not change the fact that, in general, BPPV patients need not be imaged and typically should not be treated with meclizine. It is conceivable that these discrepancies reflect inadequate or erroneous documentation, rather than wrong diagnoses or management. However, studies of diagnosis and management of confirmed causes for ED dizziness such as BPPV or stroke suggest real errors are frequent.

Because there are no codes in the NHAMCS data set that distinguish the body part imaged, we cannot be sure that all CT imaging was actually neuroimaging. If there were a systematic difference in the body part imaged between patients with BPPV (e.g., all chest imaging) and APV (e.g., all head imaging), our conclusions about similarity of management might be flawed. However, prior research indicates a high rate of neuroimaging in ED dizzy patients, and it is difficult to envision why BPPV or APV patients would disproportionately have needed some other body part imaged by CT.

Many of the guidelines offered for management of vestibular disorders have been published only in recent years; it may be that clinical practice is already changing and our analysis is skewed toward historical differences that no longer exist. However, misplaced emphasis in the assessment of ED patients with dizziness still appears prevalent. Finally, we cannot know whether discordant management decisions were partly a function of external constraints (e.g., lack of timely availability of MRI for patients with APV) or the decisions of others (e.g., neurology consultants recommending CT in patients with BPPV).

**CONCLUSIONS**

Specific vestibular disorders are probably underdiagnosed in the ED, and when they are diagnosed, patients may not be receiving optimal treatments. Although benign paroxysmal positional vertigo and acute peripheral vestibulopathy should be managed very differently, ED management is quite similar in actual practice across the United States. Although many factors might be responsible, this could relate, in part, to overemphasis on dizziness symptom quality, which appears to divert attention from important temporal features that help distinguish the two disorders. Regardless of the cause, there appears to be a mismatch between resource needs and resource utilization, with evidence of both overutilization (presumably leading to higher costs) and underutilization (presumably resulting in worse clinical outcomes, particularly for patients with missed posterior circulation strokes).

Future efforts should examine ways to ensure accurate and timely diagnosis and treatment for dizzy ED patients. This research should include a focus on the nature of barriers to diffusion of current scientific knowledge in the management of dizziness and vestibular disorders and potential ways to overcome them. Sensitivity to real-world ED constraints such as availability of consultants or technology (e.g., MRI) will be critical to finding implementable solutions. In the interim, the development and dissemination of clinical decision rules and explicit management guidelines for vestibular disorders, particularly those established by emergency medicine societies, should be a priority.

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