Published in final edited form as:

JAMA. 2016 November 22; 316(20): 2115–2125. doi:10.1001/jama.2016.16201.

US Emergency Department Visits for Outpatient Adverse Drug Events, 2013-2014

Nadine Shehab, PharmD, MPH,
Division of Healthcare Quality Promotion, US Centers for Disease Control and Prevention, Atlanta, Georgia

Maribeth C. Lovegrove, MPH,
Division of Healthcare Quality Promotion, US Centers for Disease Control and Prevention, Atlanta, Georgia

Andrew I. Geller, MD,
Division of Healthcare Quality Promotion, US Centers for Disease Control and Prevention, Atlanta, Georgia

Kathleen O. Rose, BSN,
Northrup Grumman Corporation, Atlanta, Georgia

Nina J. Weidle, PharmD, and
Chenega Government Consulting, Atlanta, Georgia

Daniel S. Budnitz, MD, MPH
Division of Healthcare Quality Promotion, US Centers for Disease Control and Prevention, Atlanta, Georgia

Abstract

Corresponding Author: Nadine Shehab, PharmD, MPH, Division of Healthcare Quality Promotion, US Centers for Disease Control and Prevention, 1600 Clifton Rd NE, Mailstop D-26, Atlanta, GA 30333 (ftn0@cdc.gov).

Author Contributions: Dr Shehab had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Concept and design: Shehab, Budnitz.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: Shehab.
Critical revision of the manuscript for important intellectual content: All authors.
Statistical analysis: Shehab, Geller.
Administrative, technical, or material support: All authors.
Additional Contributions: We thank Arati Baral, MS, and Alex Tocitu, BS, MBA (Northrop Grumman, a contractor to the CDC), for programming assistance, Thomas Schroeder, MS, and Herman Burney, MS (both with the US Consumer Product Safety Commission [CPSC]), and the CPSC data abstractors for assistance with data acquisition. No individuals named received compensation for their contributions.

Conflict of Interest Disclosures: The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

Role of the Funder/Sponsor: Federal government employees had a role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; preparation, review, or approval of the manuscript; and decision to submit the manuscript for publication.

Disclaimer: The findings and conclusions in this study are those of the authors and do not necessarily represent the official position of the US Centers for Disease Control and Prevention (CDC).

IMPORTANCE—The Patient Protection and Affordable Care Act of 2010 brought attention to adverse drug events in national patient safety efforts. Updated, detailed, nationally representative data describing adverse drug events can help focus these efforts.

OBJECTIVE—To describe the characteristics of emergency department (ED) visits for adverse drug events in the United States in 2013-2014 and describe changes in ED visits for adverse drug events since 2005-2006.

DESIGN, SETTING, AND PARTICIPANTS—Active, nationally representative, public health surveillance in 58 EDs located in the United States and participating in the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project.

EXPOSURES—Drugs implicated in ED visits.

MAIN OUTCOMES AND MEASURES—National weighted estimates of ED visits and subsequent hospitalizations for adverse drug events.

RESULTS—Based on data from 42 585 cases, an estimated 4.0 (95% CI, 3.1-5.0) ED visits for adverse drug events occurred per 1000 individuals annually in 2013 and 2014 and 27.3% (95% CI, 22.2%-32.4%) of ED visits for adverse drug events resulted in hospitalization. An estimated 34.5% (95% CI, 30.3%-38.8%) of ED visits for adverse drug events occurred among adults aged 65 years or older in 2013-2014 compared with an estimated 25.6% (95% CI, 21.1%-30.0%) in 2005-2006; older adults experienced the highest hospitalization rates (43.6%; 95% CI, 36.6%-50.5%). Anticoagulants, antibiotics, and diabetes agents were implicated in an estimated 46.9% (95% CI, 44.2%-49.7%) of ED visits for adverse drug events, which included clinically significant adverse events, such as hemorrhage (anticoagulants), moderate to severe allergic reactions (antibiotics), and hypoglycemia with moderate to severe neurological effects (diabetes agents). Since 2005-2006, the proportions of ED visits for adverse drug events from anticoagulants and diabetes agents have increased, whereas the proportion from antibiotics has decreased. Among children aged 5 years or younger, antibiotics were the most common drug class implicated (56.4%; 95% CI, 51.8-61.0%). Among children and adolescents aged 6 to 19 years, antibiotics also were the most common drug class implicated (31.8%; 95% CI, 28.7%-34.9%) in ED visits for adverse drug events, followed by antipsychotics (4.5%; 95% CI, 3.3-5.6%). Among older adults (aged ≥65 years), 3 drug classes (anticoagulants, diabetes agents, and opioid analgesics) were implicated in an estimated 59.9% (95% CI, 56.8%-62.9%) of ED visits for adverse drug events; 4 anticoagulants (warfarin, rivaroxaban, dabigatran, and enoxaparin) and 5 diabetes agents (insulin and 4 oral agents) were among the 15 most common drugs implicated. Medications to always avoid in older adults according to Beers criteria were implicated in 1.8% (95% CI, 1.5%-2.1%) of ED visits for adverse drug events.

CONCLUSIONS AND RELEVANCE—The prevalence of emergency department visits for adverse drug events in the United States was estimated to be 4 per 1000 individuals in 2013 and 2014. The most common drug classes implicated were anticoagulants, antibiotics, diabetes agents, and opioid analgesics.

Adverse drug events are the most common cause of iatrogenic harm in health care and have recently received attention in national patient safety initiatives. The Patient Protection and Affordable Care Act of 2010 incentivized new programs that target adverse drug event prevention within hospitals and during care transitions between inpatient and outpatient

settings. However, in outpatient settings, in which 90% of US prescription drug expenditures occur,[1] preventing adverse drug events remains a public health and patient safety challenge, with efforts often focused on medication errors and reducing potentially inappropriate prescribing for older adults (aged ≥65 years) as defined by the Beers criteria.[2,3] Patients in ambulatory care and some postacute care settings can have complex medication regimens, at times prescribed by multiple clinicians, with far less monitoring compared with hospitalized patients.

The US Centers for Disease Control and Prevention collaborates with the US Consumer Product Safety Commission and the US Food and Drug Administration to conduct active, nationally representative public health surveillance for outpatient adverse drug events resulting in emergency department (ED) visits.[4] The purpose of this study was to describe ED visits for adverse drug events in 2013-2014 to help advance medication safety initiatives for outpatient settings.

Methods

Data Sources and Data Collection Methods

The National Electronic Injury Surveillance System-Cooperative Adverse Drug Event Surveillance (NEISS-CADES) project is an active public health surveillance system based on a nationally representative, size-stratified probability sample of US hospitals (excluding psychiatric and penal institutions) that have a minimum of 6 beds and a 24-hour emergency department, with 4 strata based on hospital size (assessed by the total number of annual ED visits), and 1 pediatric hospital stratum.[5] Since 2004, between 58 and 63 hospitals have participated in the NEISS-CADES project.

As described previously,[4] trained Consumer Product Safety Commission data abstractors at each hospital review the clinical records of every ED visit to identify any clinician-diagnosed adverse drug events that are the reason for the ED visit, and report up to 2 medications implicated in the adverse event, as well as any concomitant medications documentedin the medical record. Abstractors also record narrative descriptions of adverse drug events, including preceding events, clinician diagnosis or clinical impression, “chief complaint,” clinical and laboratory testing, treatments administered in the ED or by emergency medical services, and discharge disposition.

Reports were coded by the Centers for Disease Control and Prevention using the Medical Dictionary for Regulatory Activities version 9.1 to describe diagnosis, symptoms, and, if documented, medication errors. Names of implicated drugs were standardized to active ingredients. Data collection from the NEISS-CADES project hospitals has been deemed a public health surveillance activity by the Centers for Disease Control and Prevention human subject oversight bodies and did not require institutional review board approval.[6]

Definitions

Cases included ED visits in which prescription or over-the-counter medications, dietary supplements (eg, herbals, vitamins, or minerals), homeopathic products, or vaccines were implicated in the adverse events. Adverse drug events were classified as adverse effects,

allergic reactions, supratherapeutic effects or excess dose, secondary effects (such as choking or injection site reactions), unsupervised ingestion by a child, or vaccination reactions. Drug withdrawal, drug therapeutic failures, occupational exposures, intentional self-harm, recreational drug use or abuse, and adverse events from treatments received in the ED were excluded. Follow-up visits for previously diagnosed adverse drug events and deaths in or en route to the ED also were excluded.

Potentially inappropriate medications for older adults included all drugs in the American Geriatrics Society's 2015 updated Beers criteria for potentially inappropriate medication use, except for insulin (inappropriate in sliding scale doses) and aspirin (inappropriate at doses >325 mg/d).[3] Potentially inappropriate medications to "always avoid" (the most common adaptation of the Beers criteria in national health care quality measures[7,8]) included drugs considered potentially inappropriate for any indication or in any dose, duration, or formulation, such as first-generation antihistamines, skeletal muscle relaxants, and short- and intermediate-acting benzodiazepines.

Medication errors included (1) administration of incorrect drugs; (2) incorrect dose, schedule, rate, duration, or site of drug administration (including accidental needle stick); and (3) administration of expired medications, old prescriptions, or use of medications prescribed or belonging to another individual. Hospitalization was defined as admission to the inpatient setting, observation status admission, or transfer to another facility.

Statistical Analysis

Each case from the NEISS-CADES project was assigned a sample weight based on hospital sampling design and inverse probability of selection.[5] Weights were adjusted for brief periods of nonresponse and poststratified to account for changes in the total number of ED visits each year in the United States.[5] Adverse drug event population rates were calculated using population estimates from the US Census Bureau; population estimates were considered free of sampling error.[9] Nationally projected (estimated) proportions of ED visits and hospitalizations with corresponding 95% CIs were calculatedusing the SURVEYMEANS procedure in SAS version 9.3 (SAS Institute Inc) to account for sample weights and complex sample design.

Estimates based on small numbers of cases (<20) are considered statistically unreliable and are not shown. Estimates with a coefficient of variation greater than 30% may be statistically unreliable and are noted. Select estimated population rates and proportions of ED visits for adverse drug events in 2013-2014 were compared with estimates from 2005-2006.

Results

Based on 42 585 cases, there were an estimated 4.0 (95% CI, 3.1-5.0) ED visits for adverse drug events per 1000 individuals annually in the United States in 2013-2014. An estimated 34.5% (95% CI, 30.3%-38.8%) of ED visits for adverse drug events occurred in older adults (aged ≥65 years) in 2013-2014 (Table 1) compared with an estimated 25.6% (95% CI, 21.1%-30.0%) in 2005-2006 (eTable 1 in the Supplement). The population rate of ED visits for adverse drug events among older adults (aged ≥65 years) was 9.7 (95% CI, 6.6-12.9)

visits per 1000 individuals compared with 3.1 (95% CI, 2.6-3.6) visits per 1000 individuals for those younger than 65 years.

Compared with 2005-2006, population rates of ED visits for adverse drug events increased among older adults aged 65 years or older (5.2 [95% CI, 3.2-7.2] visits per 1000 individuals in 2005-2006 vs 9.7 [95% CI, 6.6-12.9] visits per 1000 individuals in 2013-2014) and among adults aged 50 years to 64 years (2.5 [95% CI, 1.8-3.1] visits per 1000 individuals in 2005-2006 vs 4.3 [95% CI, 3.3-5.3] visits per 1000 individuals in 2013-2014), whereas population rates for other age groups were similar for both periods (eTable 2 in the Supplement). More ED visits for adverse drug events involved females (57.1%; 95% CI, 55.6%-58.7%).

A single medication was implicated in most ED visits for adverse drug events (83.8%; 95% CI, 81.5%-86.1%). Supra-therapeutic effects or ingestion of excess dose was the most common type of adverse drug event (37.2%; 95% CI, 34.7%-39.6%). Medication errors were documented in 1 of 10 ED visits for adverse drug events (10.5%; 95% CI, 8.9%-12.2%).

An estimated 27.3% (95% CI, 22.2%-32.4%) of ED visits for adverse drug events resulted in hospitalization. Hospitalization rates were highest for older adults (aged ≥65 years), of whom an estimated 43.6% (95% CI, 36.6%-50.5%) were hospitalized. When adjusted for the US population, the hospitalization rate for adverse drug events among adults aged 65 years or older was 7 times higher (4.2 [95% CI, 2.5-6.0] hospitalizations per 1000 individuals) than for those younger than 65 years (0.6 [95% CI, 0.4-0.8] hospitalizations per 1000 individuals).

In 2013-2014, the most commonly implicated drug classes were anticoagulants (17.6%), systemically administered (oral or injectable) antibiotics (16.1%), diabetes agents (13.3%), opioid analgesics (6.8%), antiplatelets (6.6%), renin-angiotensin system inhibitors (3.5%), antineoplastic agents (3.0%), and sedative or hypnotic agents (3.0%) (Table 2). The top 3 drug classes (anticoagulants, antibiotics, and diabetes agents) were implicated in an estimated 46.9% (95% CI, 44.2%-49.7%) of ED visits for adverse drug events. Since 2005-2006, the proportions of ED visits for adverse drug events involving anticoagulants, antiplatelets, and diabetes agents have increased, whereas the proportion involving antibiotics has decreased (eTable 3 in the Supplement).

Hospitalization rates were highest for ED visits for adverse drug events in which digitalis glycosides (82.1%), antineoplastic agents (59.7%), immune modulators (55.7%), oral diabetes agents (53.0%), andanticoagulants (48.8%) were implicated, and lowest for ED visits in which vaccines (3.0%), dermatologic agents (3.6%), and systemically administered antibiotics (7.1%) were implicated; however, the hospitalization rate for ED visits for adverse drug events from quinolone antibiotics was higher (14.5%) than the rates for all other antibiotic classes.

The most common drug products implicated in ED visits for adverse drug events varied by patient age (Table 3). Among children and adolescents aged 19 years or younger, the 15 most common drug products implicated were involved in an estimated 49.9% (95% CI,

46.8%-53.0%) of ED visits for adverse drug events, excluding unsupervised ingestions by children. Eight of the 15 most common drug products implicated in ED visits among children and adolescents aged 19 years or younger were antibiotics, and 2 were neuropsychiatric agents (methylphenidate and risperidone).

Among children aged 5 years or younger, antibiotics alone were the most common drug class implicated in ED visits for adverse drug events (56.4%; 95% CI, 51.8%-61.0%). Among children and adolescents aged 6 to 19 years, antibiotics were implicated in 31.8% (95% CI, 28.7%-34.9%) of ED visits for adverse drug events (Table 4 and eFigure in the Supplement). Antipsychotics alone were the second most common singly implicated drug class among children and adolescents aged 6 to 19 years comprising 4.5% (95% CI, 3.3%-5.6%) of estimated ED visits for adverse drug events. In this age group, at least 1 neuropsychiatric agent (anticonvulsant, antidepressant, antipsychotic, opioid analgesic, sedative or hypnotic agent, or stimulant) was implicated in an estimated 23.5% (95% CI, 21.1%-26.1%) of ED visits for adverse drug events.

Among older adults, the 15 most common drug products implicated were involved in an estimated 68.5% (95% CI, 64.5%-72.5%) of ED visits for adverse drug events (Table 4). Four of the 15 most common drug products implicated in ED visits for adverse drug events among older adults were anticoagulants (warfarin, rivaroxaban, dabigatran, and enoxaparin) and 5 were diabetes agents (insulin, metformin, glipizide, glyburide, and glimepiride). Anticoagulants alone were implicated in 27.5% (95% CI, 23.3%-31.7%) of ED visits for adverse drug events among adults aged 65 to 79 years and in 38.8% (95% CI, 33.7%-43.8%) of ED visits for adverse drug events among those aged 80 years or older (Table 4 and eFigure in the Supplement).

Warfarin was implicated in an estimated 85.7% (95% CI, 82.8%-88.6%) of ED visits for anticoagulant adverse drug events among older adults (aged ≥65 years) and target-specific oral anticoagulants (apixaban, dabigatran, and rivaroxaban) were implicated in an estimated 12.0% (95% CI, 8.9%-15.1%) of ED visits for anticoagulant adverse drug events. Among older adults, the hospitalization rate for ED visits for adverse drug events from target-specific oral anticoagulants (55.7%; 95% CI, 45.6%-65.9%) was similar to the rate for warfarin (49.8%; 95% CI, 42.9%-56.7%).

Three drug classes (anticoagulants, diabetes agents, and opioid analgesics) recently targeted by federal patient safety initiatives[4] were implicated in an estimated 59.9% (95% CI, 56.8%-62.9%) of ED visits for adverse drug events among older adults (aged ≥65 years). Potentially inappropriate medications according to the Beers criteria were implicated in an estimated 3.4% (95% CI, 2.8%-4.0%) of ED visits for adverse drug events and potentially inappropriate medications to always avoid were implicated in 1.8% (95% CI, 1.5%-2.1%) of ED visits for adverse drug events.

The most commonly implicated drug classes were involved in clinically significant adverse events (Table 5). There was documented hemorrhage in an estimated 79.4% (95% CI, 75.2%-83.6%) of ED visits for adverse drug events involving anticoagulants alone; moderate to severe allergic reactions in an estimated 18.2% (95% CI, 15.4%-21.0%) of ED visits for

adverse drug events involving antibiotics alone; hypoglycemia with moderate to severe neurological effects (eg, loss of consciousness or altered mental status) in an estimated 47.6% (95% CI, 39.4%-55.7%) of ED visits for adverse drug events involving diabetes agents alone; and moderate to severe neurological effects in an estimated 33.9% (95% CI, 29.1%-38.7%) of ED visits for adverse drug events involving opioid analgesics alone.

Discussion

The most common drug classes implicated in ED visits for adverse drug events in the United States are the same ones identified a decade ago–anticoagulants, antibiotics, diabetes agents, and opioid analgesics.[4] Even after accounting for prescribing frequency, the rate of ED visits for adverse drug events per prescription previously has been found to be significantly higher for anticoagulants and diabetes agents than for most other medications, including those that are currently considered high risk in nationally recognized health care quality measures.[10] For antibiotics, per-prescription risk has been found to outweigh benefits for many outpatient upper respiratorytract infections.[11,12] Targeting adverse drug events common among specific patient populations, such as among the youngest (aged ≤19 years) and oldest (aged ≥65 years), may help further focus outpatient medication safety efforts.

Outpatient antibiotic prescribing has declined during the past decade; however, prescribing rates remain highest for children[13] and antibiotics continue to account for most ED visits for adverse drug events among young children.[11] More than half of US antibiotic prescriptions for children aged 14 years or younger are for acute respiratory tract infections, which are commonly viral, or infections for which watchful waiting is recommended.[14] Reducing inappropriate antibiotic use with interventions, such as clinical decision support and benchmarking of outpatient prescribing rates, may help to reduce the risk of medication harms and antimicrobial resistance.[15]

Antipsychotics were the second most commonly implicated drug class in ED visits for adverse drug events among older children and adolescents. The American Psychiatric Association currently warns against using antipsychotics as first-line therapy in children and adolescents for conditions other than psychotic disorders[16]; however, antipsychotic prescribing has increased sharply during the last 2 decades.[17] Up to 75% of antipsychotic use in children and adolescents is estimated to be for off-label indications and there is evidence of low adherence to recommendations for safety monitoring.[18,19] Quality reporting measures and revisions to payment policies have reduced unnecessary use of antipsychotic prescriptions among older adults (aged ≥65 years).[20] Improving safe use of antipsychotics in children and adolescents may require similar strategies.

The proportion of ED visits for adverse drug events involving anticoagulants has increased during the last decade along with increased anticoagulant use. From 2009 to 2014, oral anticoagulant use increasedby approximately 38%,[21] whereas the proportion of ED visits for anticoagulants increased by 57% (eTable 3 in the Supplement). The additional increase in ED visits for anticoagulant adverse drug events may be from improved case identification since 2006, when data abstractors received supplemental training after anticoagulant adverse drug events were found to be underidentified.[22]

Although not all anticoagulant-related bleeding is preventable, anticoagulant management services and patient self-testing and self-management programs have been shown to reduce adverse drug events from anticoagulants.[23] However, most outpatients do not participate in these programs,[24,25] and these strategies are not well incentivized under public and private payer safety policies for patients.[26] A recent report from the US Department of Health and Human Services calls for enhanced adverse drug event prevention efforts for anticoagulants.[26]

New clinical performance improvement measures for systematic and coordinated outpatient management of anticoagulants have been introduced by the Centers for Medicare & Medicaid Services as part of the Merit-Based Incentive Payment System and will replace the sustainable growth rate formula payment structure for many physicians.[27] It is unknown whether payment policies that incentivize practices and physicians to more optimally manage anticoagulant treatments will reduce the burden of adverse drug events; however, the recognition by a national quality payment program of the value of evidence-based anticoagulant management in improving the quality of care for older adults (aged ≥65 years) is an important step toward improving anticoagulant use.

Newly approved, target-specific oral anticoagulants are marketed as safer alternatives to warfarin; however, these agents are increasingly implicatedin ED visits for anticoagulant adverse drug events, particularly among older adults (aged ≥65 years). Rivaroxaban is now the fifth and dabigatran the tenth most commonly implicated drug in ED visits for adverse drug events among older adults. Although these drugs do not currently require routine laboratory monitoring, their optimal use is dependent on the adjustment of dosages for special populations, ensuring adherence because of short half-lives, monitoring drug interactions, and managing perioperative and reversal strategies.[28] Anticoagulation management services intended for patients taking warfarin may now have a role in improving thromboembolic and hemorrhagic outcomes for new oral agents as well.[28]

The Beers criteria include lists of potentially inappropriate medications such as first-generation antihistamines, skeletalmuscle relaxants, and short- and intermediate-acting benzodiazepines that should always be avoided in most older adults (aged ≥65 years) owing to the availability of safer or more effective alternatives.[3] The Beers criteria also include potentially inappropriate medications to be avoided under certain circumstances, such as long-term use of nonsteroidal anti-inflammatory drugs and proton-pump inhibitors.[3] Among older adults, potentially inappropriate medications to always avoid according to the most updated Beers criteria were implicated in only 1.8% of estimated ED visits for adverse drug events and all potentially inappropriate medications were implicated in 3.4% of estimated ED visits for adverse drug events in 2013-2014. These findings are similar to the proportions of US ED visits for adverse drug events from potentially inappropriate medications identified in 2004-2005.[10]

The prevalence of potentially inappropriate medication use in older adults (aged ≥65 years) remains high,[29] suggesting that the Beers criteria have limited utility in identifying patient populations who are at highest risk for adverse drug events. Despite the Beers criteria being primarily intended for practicing clinicians as a useful tool to guide clinical decision making

for an individual patient,[3] the criteria have become one of the primary methods for assessment of patient safety in older adults used by public and private payers,[7,8] supplanting other interventions that may have a larger effect on outpatient medication safety. For example, diabetes agents were implicated in 1 of 8 ED visits for adverse drug events overall and in 1 of 5 ED visits for adverse drug events among older adults. Recent diabetes treatment guidelines recommend increasing glycemic thresholds for older patients at risk for hypoglycemia, particularly those with certain comorbidities or limited life expectancy, and residing in long-term care facilities.[30-32]

There are a number of study limitations that likely lead to underestimation of outpatient adverse drug events. First, this study includes only adverse drug events diagnosed and treated in EDs; patients directly admitted or treated in other settings (eg, physician offices) are not included. Second, ED physicians are less likely to identify low-severity or insidious adverse drug events, those that do not contribute to the patient's "chief complaint," and those that require extensive evaluation to diagnose.[33,34] Third, fatal adverse drug events are not included because ED documentation practices vary for recording deaths. Fourth, estimates do not include visits related to pharmaceutical abuse or self-harm attempts.

The rapid increase in mortality from opioid analgesics in the United States has been well documented[35]; however, updated national morbidity data on pharmaceutical abuse are limited. Future inclusion of ED visits from abuse or self-harm of pharmaceutical products in the NEISS-CADES project is planned. Fifth, per-prescription rates of ED visits for adverse drug events, which can more accurately identify the direction of trends, were not calculated. Sixth, the NEISS-CADES project data are based on a sample of US hospital EDs and not a census; therefore, estimates are subject to sampling errors.

Direct comparison with previously published estimates of adverse drug events from other sources is challenging. Anti-coagulants, diabetes agents, and opioid analgesics also have been identified as the most common causes of medication-related harm in both inpatient and long-term care settings.[26] Studies using *International Classification of Diseases* (*ICD*) codes to identify ED visits for adverse drug events have found lower estimates during previous years,[36] but *ICD* codes have low sensitivity for identifying adverse drug events.[37] Other nationally representative diagnostic code-based studies have identified additional drug classes (eg, corticosteroids) to be common causes of adverse drug events; however, without supporting clinical data, it is uncertain if these ED visits represent drug-induced harm or another drug-related problem, such as nonadherence or inadequate treatment.[38]

Some studies using pharmacist case review to identify adverse drug events resulting in ED visits have found additional events and drugs that ED physicians did not document. However, these studies used a broader outcome of medication-related "problems" that included nonadherence, therapeutic failures, and lack of therapy.[33,39] Failing to prescribe or take a drug limits effectiveness, but is not an adverse drug event (harm caused by the use of a drug).[40] Distinguishing conditions due to the absence of therapy from those due to drug-induced effects is necessary to implement appropriate interventions. Improving recognition of adverse drug events by ED physicians is certainly important, but in the interim there is ample opportunity to improve patient safety by focusing attention on the adverse drug events

consistently found to be common, serious, and measurable. Targeting adverse drug events due to anticoagulants and diabetes agents in the inpatient setting has contributed to reductions in health care-related harm in US hospitals.[41,42] Achieving measurable reductions in outpatient adverse drug events may also require focusing on the most common drugs implicated and the highest risk patients.

Conclusions

The prevalence of emergency department visits for adverse drug events in the United States was estimated to be 4 per 1000 individuals in 2013 and 2014. The most common drug classes implicated were anticoagulants, antibiotics, diabetes agents, and opioid analgesics.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding/Support: This study was funded by the US federal government.

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Key Points

Question What are the characteristics of adverse drug events that lead to US emergency department (ED) visits?

Findings Based on 2013-2014 nationally representative surveillance data, an estimated 4 ED visits for adverse drug events occurred per 1000 individuals annually Among children (aged ≤5 years), antibiotics were most commonly implicated; among older children and adolescents (aged 6-19 years), antibiotics were most commonly implicated, followed by antipsychotics; and among older adults (aged ≥65 years), anticoagulants, diabetes agents, and opioid analgesics were implicated in approximately 60% of ED visits for adverse drug events.

Meaning Adverse drug events from anticoagulants, antibiotics, diabetes agents, opioid analgesics, and antipsychotics are a common reason for ED visits and may benefit from patient safety initiatives.

Table 1.

US Emergency Department (ED) Visits for Adverse Drug Events (ADEs), 2013-2014[a]

Case Characteristic	ED Visits for ADEs		ED Visits for ADEs Resulting in Hospitalization[b]	
	No. of Cases	National Estimate, % (95% CI)[c]	No. of Cases Hospitalized	National Estimate, % Hospitalized (95% CI)[c]
Patient age group, y[d]				
≤5	5133	9.7 (7.7-11.6)	846	10.5 (7.7-13.2)
6-19	3452	6.8 (5.7-7.9)	571	8.9 (5.4-12.4)
20-34	5638	13.7 (12.4-15.0)	667	10.2 (7.3-13.2)
35-49	5928	14.3 (13.0-15.6)	1230	18.5 (14.2-22.8)
50-64	8797	21.0 (19.4-22.6)	3003	31.4 (25.9-37.0)
65-79	8266	21.1 (18.6-23.7)	3563	41.1 (33.8-48.3)
≥80	5370	13.4 (11.3-15.5)	2718	47.5 (40.7-54.3)
Patient sex				
Female	23 934	57.1 (55.6-58.7)	6754	25.8 (21.1-30.4)
Male	18 651	42.9 (41.3-44.4)	5844	29.3 (23.6-35.1)
No. of implicated medications				
1	35 142	83.8 (81.5-86.1)	9716	25.7 (20.8-30.6)
≥2	7443	16.2 (13.9-18.5)	2882	35.7 (29.4-42.0)
Type ofADE				
Adverse effect[e]	12 081	27.8 (24.9-30.7)	3957	29.4 (23.2-35.5)
Allergic reaction (immunologically mediated effects)	10 435	26.0 (23.5-28.6)	1080	9.2 (6.3-12.0)
Supratherapeutic effect of a drug or ingestion of excess dose	15 718	37.2 (34.7-39.6)	6835	42.1 (35.6-48.7)
Secondary effect[f]	835	2.0 (1.7-2.3)	94	11.9 (8.5-15.3)
Unsupervised ingestion bya child[g]	2604	4.9 (3.8-5.9)	590	16.6 (12.4-20.7)
Vaccination reaction (anyadverse effect from a vaccine)	912	2.2 (1.7-2.6)	42	2.9 (1.6-4.3)
Documented medication error[h]				
Yes	4747	10.5 (8.8-12.2)	1205	24.6 (19.3-29.9)
No	37 838	89.5 (87.8-91.2)	11393	27.6 (22.4-32.8)

Case Characteristic	ED Visits for ADEs		ED Visits for ADEs Resulting in Hospitalization[b]	
	No. of Cases	National Estimate, % (95% CI)[c]	No. of Cases Hospitalized	National Estimate, % Hospitalized (95% CI)[c]
Total	42 585	100.0	12 598	27.3 (22.2-32.4)

[a]Data are from the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project, US Centers for Disease Control and Prevention. Cases included ED visits for ADEs from prescription or over-the-counter medications, dietary supplements, homeopathic products, and vaccines. Visits to the ED involving drug withdrawal, drug therapeutic failures, occupational exposures, intentional self-harm, and recreational drug use or abuse were excluded. Adverse events from treatments received in the ED, follow-up visits for previously diagnosed ADEs, and deaths in or en route to the ED also were excluded.

[b]Defined as hospital admission, observation status admission, or transfer to another facility. Discharge disposition missing for 1 case.

[c]Calculated from statistical weighting of cases based on the sample design.

[d]Missing for 1 case.

[e]Defined as undesirable pharmacological or idiosyncratic effects at recommended doses.

[f]Refers to other adverse effects secondary to drug administration such as choking or injection site reactions.

[g]Refers to children aged 10 years or younger ingesting or being found with medications without caregiver supervision.

[h]Refers to drug prescribing, dispensing, or administration errors (eg, wrong drug, wrong dose, wrong duration, wrong route, expired drug, or old prescription), administration of another individual's medication, or accidental needle stick in individuals aged 11 years or older.

Table 2.

US Emergency Department (ED) Visits for Adverse Drug Events (ADEs) by Drug Class, 2013-2014[a]

	ED Visits for ADEs		ED Visits for ADEs Resulting in Hospitalization[b]	
Drug Class	**No. of Cases**	**National Estimate, % (95% CI)[c]**	**No. of Cases Hospitalized**	**National Estimate, % Hospitalized (95% CI)[c]**
Hematologic Agents				
Anticoagulants	7211	17.6 (14.1-21.0)	3691	48.8 (42.0-55.5)
Vitamin K antagonists (warfarin)	6179	15.1 (12.3-17.9)	3156	48.5 (41.8-55.1)
Factor Xa inhibitors	580	1.4 (0.9-2.0)	300	50.4 (43.0-57.8)
Unfractionated and low-molecular-weight heparins	450	0.8 (0.6-1.1)	224	46.5 (38.7-54.4)
Direct thrombin inhibitors (oral)	173	0.5 (0.2-0.7)	107	63.8 (49.8-77.8)
Antiplatelets	2656	6.6 (4.7-8.5)	1312	44.4 (35.7-53.2)
Platelet $P2Y_{12}$ receptor antagonists[d]	1837	4.6 (3.0-6.2)	942	47.8 (37.7-57.9)
Aspirin with or without dipyridamole	1545	3.6 (2.2-5.0)	753	41.2 (32.6-49.8)
Systemic Antimicrobial Agents[e]				
Antibiotics	6426	16.1 (14.4-17.8)	481	7.1 (5.3-9.0)
Amoxicillin-containing penicillins	2198	4.8 (4.2-5.4)	96	3.7 (2.3-5.2)
Sulfonamide-containing agents	1174	3.2 (2.7-3.7)	108	8.9 (6.2-11.5)
Cephalosporins	776	2.0 (1.7-2.4)	63	6.7 (4.2-9.2)
Quinolones	592	1.7 (1.4-1.9)	77	14.5 (11.0-18.0)
Erythromycins and macrolides	410	1.2 (1.0-1.3)	24	5.5 (2.6-8.3)
Lincosamides (clindamycin)	396	1.0 (0.8-1.2)	28	5.5 (2.1-8.8)
Tetracyclines	286	0.7 (0.6-0.8)	16	NA
Metronidazole	195	0.4 (0.3-0.5)	18	NA
Other antibiotics	439	1.1 (0.9-1.3)	68	12.1 (7.6-16.6)
Antivirals and antiretrovirals	148	0.3 (0.2-0.4)	14	NA
Other systemic antimicrobial agents	123	0.3 (0.2-0.4)	16	NA
Hormone-Modifying Agents				
Diabetes agents	5995	13.3 (10.8-15.8)	2314	38.5 (31.4-45.7)

Drug Class	ED Visits for ADEs		ED Visits for ADEs Resulting in Hospitalization[b]	
	No. of Cases	National Estimate, % (95% CI)[c]	No. of Cases Hospitalized	National Estimate, % Hospitalized (95% CI)[c]
Insulin	4859	10.7 (8.6-12.7)	1692	34.8 (27.3-42.2)
Oraldiabetes agents	1595	3.6 (2.8-4.4)	852	53.0 (46.6-59.5)
Adrenocortical steroids	480	1.2 (1.0-1.5)	69	11.4 (6.1-16.6)
Systemic and vaginal contraceptives	279	0.5 (0.4-0.7)	27	8.7 (2.9-14.5)[f]
Other hormone-modifying agents	302	0.7 (0.6-0.9)	36	9.5 (5.7-13.2)
Central Nervous System Agents[g]				
Analgesics	3412	8.4 (7.7-9.1)	878	23.6 (18.7-28.5)
Opioid-containing analgesics	2714	6.8 (6.3-7.4)	729	24.6 (19.7-29.5)
Oxycodone-containing analgesics	856	2.0 (1.7-2.4)	265	30.1 (25.2-35.1)
Hydrocodone-containing analgesics	614	1.7 (1.3-2.1)	94	13.5 (9.0-18.0)
Non-opioid-containing analgesics[h]	655	1.4 (1.1-1.7)	145	20.0 (12.4-27.5)
Sedative or hypnotic agents	1218	3.0 (2.4-3.5)	373	28.2 (19.9-36.4)
Benzodiazepines	822	2.0 (1.6-2.4)	250	27.3 (19.1-35.4)
Nonbenzodiazepine or nonbarbiturate sedatives[i]	276	0.6 (0.4-0.8)	87	33.2 (19.0-47.4)
Antipsychotics	1281	2.7 (2.1-3.2)	320	25.3 (20.1-30.4)
Antidepressants	1045	2.6 (2.2-3.1)	193	15.6 (10.9-20.4)
Anticonvulsants	1029	2.4 (2.1-2.7)	344	30.4 (24.7-36.1)
Stimulants	339	0.7 (0.5-0.9)	53	10.5 (6.4-14.6)
Anesthetics (systemic)	188	0.4 (0.3-0.5)	32	15.5 (8.5-22.5)
Other central nervous system agents	364	0.9 (0.7-1.1)	76	21.1 (14.7-27.5)
Cardiovascular Agents				
Renin-angiotensin system inhibitors[j]	1578	3.5 (2.6-4.4)	516	31.9 (23.2-40.6)
β-Blockers	495	1.3 (1.0-1.6)	186	38.1 (28.5-47.7)
Calcium channelblockers	317	0.8 (0.6-0.9)	94	31.4 (24.3-38.5)
Diuretics	292	0.8 (0.6-1.0)	112	40.8 (29.2-52.4)
Centrally acting antiadrenergics	232	0.4 (0.3-0.6)	91	30.3 (19.5-41.0)

Drug Class	ED Visits for ADEs		ED Visits for ADEs Resulting in Hospitalization[b]	
	No. of Cases	National Estimate, % (95% CI)[c]	No. of Cases Hospitalized	National Estimate, % Hospitalized (95% CI)[c]
Lipid-lowering agents	124	0.3 (0.2-0.4)	20	11.3 (3.4-19.2)[f]
Digitalis glycosides (digoxin)	116	0.3 (0.2-0.4)	96	82.1 (74.0-90.3)
Antianginals and antiarrhythmics	121	0.3 (0.2-0.4)	46	45.2 (28.4-61.9)
Epinephrine (injection)	150	0.3 (0.2-0.3)	5	NA
Other cardiovascular agents	179	0.4 (0.3-0.5)	48	28.6 (16.6-40.6)
Oncologicaland Immunologic Agents				
Antineoplastic agents	2007	3.0 (1.6-4.3)	1303	59.7 (51.4-68.1)
Immune modulators[k]	182	0.3 (0.2-0.4)	48	55.7 (47.2-64.3)
Musculoskeletal Agents				
Nonsteroidal anti-inflammatory drugs[l]	1199	2.8 (2.4-3.2)	174	12.6 (8.7-16.5)
Skeletal muscle relaxants	407	1.0 (0.8-1.2)	111	24.7 (17.2-32.1)
Respiratory Agents				
Single-ingredient antihistamines	603	1.3 (1.1-1.6)	94	11.9 (6.9-17.0)
Cough and cold remedies[m]	533	1.3 (1.1-1.5)	58	10.9 (7.7-14.1)
Bronchodilators	106	0.3 (0.2-0.3)	6	NA
Gastrointestinal Agents				
Antidiarrheals, laxatives, and antiflatulents	219	0.6 (0.4-0.7)	34	18.0 (10.1-25.9)
Anti-ulcer and antacid agents	202	0.4 (0.3-0.5)	17	NA
Other gastrointestinal agents	226	0.5 (0.4-0.6)	30	11.7 (4.5-18.8)[f]
Other Drug Classes				
Vaccines	916	2.2 (1.7-2.6)	43	3.0 (1.7-4.3)
Dermatologic agents[n]	458	1.1 (0.9-1.4)	23	3.6 (1.1-6.1)[f]
Radiopharmaceutical agents	302	0.7 (0.5-0.9)	44	10.9 (5.4-16.4)
Ophthalmic, otic, and nasal agents	266	0.6 (0.5-0.7)	11	NA
Genitourinary agents	163	0.4 (0.3-0.5)	26	16.5 (10.1-22.8)
Dietary Supplements and Related Products				

Drug Class	ED Visits for ADEs		ED Visits for ADEs Resulting in Hospitalization[b]	
	No. of Cases	National Estimate, % (95% CI)[c]	No. of Cases Hospitalized	National Estimate, % Hospitalized (95% CI)[c]
Herbals (systemic and topical) and homeopathic agents	488	1.2 (1.0-1.4)	60	10.0 (6.4-13.5)
Vitamins, minerals, trace elements, and combinations	500	1.1 (0.9-1.3)	69	12.9 (7.3-18.5)
Other agents	182	0.5 (0.4-0.6)	21	9.0 (3.1-14.8)[f]
Unknown agents	681	1.8 (1.4-2.2)	132	16.4 (11.4-21.4)

Abbreviation: NA, estimates based on fewer than 20 cases are considered statistically unreliable and are not shown.

[a] Data are based on 42 585 cases from the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project, US Centers for Disease Control and Prevention. Specific drug classes are shown if they were implicated in 0.3% or greater of all estimated ED visits for ADEs in 2013-2014. Drug classes are not mutually exclusive. For some ED visits, a medication from more than 1 drug class was implicated in the ADE; therefore, percentages may total more than 100%.

[b] Defined as hospital admission, observation status admission, or transfer to another facility.

[c] Calculated from statistical weighting of cases based on the sample design.

[d] Clopidogrel, prasugrel, ticagrelor, and ticlopidine.

[e] Antibiotics in combination with anti-ulcer agents (eg, amoxicillin-clarithromycin-lansoprazole) are categorized asgastrointestinal agents.

[f] Coefficient of variation greater than 30%.

[g] Excludes ED visits for abuse or self-harm.

[h] Excludes single-ingredient aspirin. Includes combination analgesic agents containing aspirin and combinations with antihistamines (eg, acetaminophen-diphenhydramine).

[i] Eszopiclone, zaleplon, and zolpidem.

[j] Single ingredient and in combination with diuretics (eg, hydrochlorothiazide-lisinopril) and calcium channel blockers (eg, amlodipine-benazepril).

[k] Immunoglobulins, immune suppressants, interferons, and other immune modulators.

[l] Includes nonsteroidal anti-inflammatory agents in combination with antihistamines (eg, ibuprofen-diphenhydramine).

[m] Single-ingredient antitussives, decongestants, expectorants; and antitussives, decongestants, and expectorants in combination with antihistamines.

[n] Topically administered agents and acne agents (systemically administered or topically administered).

Table 3.

US Emergency Department (ED) Visits for Adverse Drug Events (ADEs) From the Most Commonly Implicated Drug Products by Patient Age, 2013-2014[a]

	ED Visits for ADEs	
Drug Product	**No. of Cases**	**National Estimate, % (95% CI)[b]**
All Patients (N = 42 585)		
Warfarin	6179	15.1 (12.3-17.9)
Insulin	4859	10.7 (8.6-12.7)
Clopidogrel	1778	4.4 (2.9-5.9)
Amoxicillin	1780	3.8 (3.3-4.3)
Aspirin	1518	3.5 (2.2-4.9)
Sulfamethoxazole-trimethoprim	1152	3.2 (2.7-3.7)
Lisinopril	1096	2.4 (1.8-3.0)
Metformin	766	1.7 (1.4-2.1)
Ibuprofen	722	1.6 (1.3-2.0)
Rivaroxaban	526	1.3 (0.8-1.8)
Acetaminophen-hydrocodone	492	1.3 (1.0-1.6)
Cephalexin	431	1.2 (0.9-1.5)
Acetaminophen-oxycodone	459	1.1 (0.8-1.4)
Acetaminophen	479	1.0 (0.8-1.2)
Amoxicillin-clavulanate	422	1.0 (0.9-1.2)
Patients Aged ≤19 y (n = 5981)[c]		
Amoxicillin	1264	21.5 (19.8-23.1)
Sulfamethoxazole-trimethoprim	244	5.3 (3.9-6.7)
Ibuprofen	173	3.6 (2.7-4.5)
Azithromycin	128	3.0 (2.5-3.6)
Amoxicillin-clavulanate	186	2.9 (2.3-3.5)
Cefdinir	153	2.6 (1.4-3.8)
Cephalexin	120	2.5 (1.7-3.3)
Insulin	106	1.7 (1.1-2.3)
Acetaminophen	81	1.6 (1.0-2.1)
Clindamycin	88	1.3 (0.9-1.8)
Penicillin	49	1.1 (0.6-1.5)
Influenza vaccine	58	1.0 (0.6-1.4)
Methylphenidate	51	0.9 (0.6-1.3)
Diphenhydramine	52	0.9 (0.5-1.3)
Risperidone	50	0.9 (0.4-1.3)
Patients Aged ≥65 y (n = 13 636)		
Warfarin	4397	31.9 (27.6-36.2)

	ED Visits for ADEs	
Drug Product	**No. of Cases**	**National Estimate, % (95% CI)[b]**
Insulin	1950	13.0 (10.3-15.8)
Clopidogrel	1373	9.9 (7.3-12.5)
Aspirin	1052	7.1 (4.0-10.2)
Rivaroxaban	412	2.9 (2.1-3.8)
Lisinopril	380	2.6 (1.9-3.3)
Metformin	373	2.6 (2.0-3.2)
Glipizide	295	1.8 (1.3-2.4)
Sulfamethoxazole-trimethoprim	153	1.4 (1.1-1.7)
Dabigatran	154	1.2 (0.7-1.7)
Acetaminophen-hydrocodone	131	1.1 (0.8-1.4)
Metoprolol	105	1.0 (0.7-1.3)
Enoxaparin	179	1.0 (0.7-1.3)
Glyburide	131	1.0 (0.7-1.3)
Glimepiride	132	0.9 (0.6-1.2)

[a]Data are from the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project, US Centers for Disease Control and Prevention. Data exclude ED visits for abuse or self-harm. Drug products are not mutually exclusive; for some ED visits, more than 1 drug product was implicated in the ADE. Drugs that were not identified at the active ingredient level (eg, unnamed antibiotic or unknown drug) are not shown.

[b]Calculated from statistical weighting of cases based on the sample design. National estimates may vary for similar Nos. of cases because of statistical weighting.

[c]Excludes ED visits for unsupervised medication ingestions by children aged 10 years or younger.

Table 4.

US Emergency Department (ED) Visits for Adverse Drug Events (ADEs) From Commonly Implicated Drug Classes by Patient Age, 2013-2014[a]

	ED Visits for ADEs													
	Patient Age ≤5 y[b]		Patient Age 6-19 y[b]		Patient Age 20-34 y		Patient Age 35-49 y		Patient Age 50-64 y		Patient Age 65-79 y		Patient Age ≥80 y	
Drug Class	No. of Cases (n = 2741)	National Estimate, % (95% CI)[c]	No. of Cases (n = 3240)	National Estimate, % (95% CI)[c]	No. of Cases (n = 5638)	National Estimate, % (95% CI)[c]	No. of Cases (n = 5928)	National Estimate, % (95% CI)[c]	No. of Cases (n = 8797)	National Estimate, % (95% CI)[c]	No. of Cases (n = 8266)	National Estimate, % (95% CI)[c]	No. of Cases (n = 5370)	National Estimate, % (95% CI)[c]
Antibiotics	1460	56.4 (51.8-61.0)	870	31.8 (28.7-34.9)	1257	24.2 (21.5-26.9)	873	16.2 (14.1-18.2)	832	11.1 (9.8-12.4)	447	6.3 (5.3-7.3)	242	5.8 (4.5-7.0)
Anticoagulants	6	NA	13	NA	133	2.1 (1.6-2.6)	454	7.2 (5.2-9.2)	1240	13.7 (11.1-16.4)	2233	27.5 (23.3-31.7)	2206	38.8 (33.7-43.8)
Antidepressants	6	NA	107	3.8 (2.5-5.1)	184	3.5 (2.6-4.3)	157	2.7 (2.0-3.5)	126	1.7 (1.2-2.1)	55	0.8 (0.6-1.0)	24	0.7 (0.1-1.3)[d]
Antineoplastic agents	283	2.8 (0-6.0)[d]	330	2.7 (0-5.8)[d]	106	1.3 (0.5-2.1)[d]	196	2.3 (1.1-3.6)	546	5.2 (3.1-7.4)	384	3.6 (2.0-5.2)	92	1.4 (0.7-2.1)
Antiplatelets	1	NA	16	NA	37	0.5 (0.3-0.7)	68	1.3 (0.7-1.9)	359	4.3 (3.1-5.5)	657	8.0 (5.7-10.4)	615	10.6 (8.3-12.9)
Antipsychotics	7	NA	137	4.5 (3.3-5.6)	340	5.2 (3.9-6.5)	228	3.1 (2.2-4.0)	176	1.9 (1.4-2.4)	41	0.5 (0.3-0.6)	13	NA
Diabetes agents	10	NA	100	2.8 (1.8-3.8)	499	7.3 (5.3-9.2)	891	14.2 (11.3-17.2)	1786	18.2 (14.8-21.7)	1722	18.6 (14.9-22.4)	839	15.2 (11.4-19.0)
Dietary supplements[e]	46	1.8 (0.8-2.8)	55	2.0 (1.3-2.6)	201	3.7 (3.0-4.4)	174	2.9 (2.5-3.4)	125	1.4 (1.0-1.7)	72	1.0 (0.7-1.3)	38	1.0 (0.6-1.3)
Non-opioid-containing analgesics	36	1.6 (0.9-2.4)	49	1.7 (0.9-2.5)	88	1.6 (1.1-2.0)	68	1.1 (0.7-1.5)	31	0.3 (0.1-0.5)[d]	11	NA	5	NA
Nonsteroidal anti-inflammatory drugs	52	2.8 (1.7-3.9)	117	3.9 (2.8-5.0)	225	4.0 (3.2-4.8)	166	3.2 (2.6-3.7)	132	1.5 (1.2-1.8)	69	0.8 (0.5-1.0)	18	NA
Opioid analgesics	20	0.6 (0.1-1.0)[d]	93	3.0 (2.2-3.8)	422	7.8 (6.8-8.8)	382	6.8 (5.7-7.9)	536	6.9 (5.9-8.0)	354	4.6 (3.9-5.4)	151	3.5 (2.6-4.5)
Sedative or hypnotic agents	11	NA	55	2.0 (1.1-2.9)	128	2.3 (1.4-3.1)	160	2.8 (1.8-3.7)	145	1.6 (1.2-2.1)	106	1.4 (0.9-1.9)	53	0.9 (0.5-1.3)
Stimulants	13	NA	116	3.8 (2.8-4.7)	50	0.9 (0.5-1.3)	18	NA	5	NA	4	NA	1	NA
Vaccines	455	19.5 (16.2-22.8)	111	3.7 (2.8-4.6)	89	1.8 (1.3-2.4)	89	1.6 (1.0-2.1)	81	1.1 (0.8-1.3)	64	0.8 (0.5-1.1)	16	NA

	ED Visits for ADEs													
	Patient Age ≤5 y[b]		Patient Age 6-19 y[b]		Patient Age 20-34 y		Patient Age 35-49 y		Patient Age 50-64 y		Patient Age 65-79 y		Patient Age ≥80 y	
Drug Class	No. of Cases (n = 2741)	National Estimate, % (95% CI)[c]	No. of Cases (n = 3240)	National Estimate, % (95% CI)[c]	No. of Cases (n = 5638)	National Estimate, % (95% CI)[c]	No. of Cases (n = 5928)	National Estimate, % (95% CI)[c]	No. of Cases (n = 8797)	National Estimate, % (95% CI)[c]	No. of Cases (n = 8266)	National Estimate, % (95% CI)[c]	No. of Cases (n = 5370)	National Estimate, % (95% CI)[c]
All other drug classes[f]	284	10.5 (8.2-12.7)	860	26.8 (24.6-29.1)	1454	26.3 (24.3-28.3)	1522	26.3 (24.6-28.0)	1986	23.2 (21.0-25.4)	1328	16.9 (14.5-19.3)	548	11.6 (9.0-14.1)
>1 Drug class implicated	51	1.7 (0.9-2.5)	211	6.9 (5.7-8.1)	425	7.5 (6.3-8.8)	482	7.9 (7.0-8.8)	691	7.8 (6.6-8.9)	719	8.8 (7.1-10.6)	509	9.5 (6.8-12.2)

Abbreviation: NA, estimates based on fewer than 20 cases are considered statistically unreliable and are not shown.

[a] Data are based on 42 585 cases from the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project, US Centers for Disease Control and Prevention. Data exclude ED visits for abuse or self-harm. Data for specific drug classes represent only ED visits in which a single drug class was implicated. Patient age missing for 1 case.

[b] Excludes ED visits for unsupervised medication ingestions by children aged 10 years or younger.

[c] Calculated from statistical weighting of cases based on the sample design.

[d] Coefficient of variation greater than 30%.

[e] In addition to related products.

[f] In which a single drug class was implicated.

Table 5.

US Emergency Department (ED) Visits for Adverse Drug Events (ADEs) From Select Drug Classes by Adverse Event Manifestation, 2013-2014[a]

	ED Visits for ADEs	
Adverse Event Manifestation[b]	**No. of Cases**	**National Estimate, % (95% CI)[c]**
Anticoagulants (n = 6290)		
Hemorrhage	5101	79.4 (75.2-83.6)
Central nervous system[d]	262	2.8 (1.4-4.2)
Pulmonary	149	2.3 (1.7-3.0)
Gastrointestinal	1577	27.0 (21.0-32.9)
Genitourinary	547	9.5 (6.6-12.4)
Epistaxis	815	15.0 (11.7-18.3)
Skin, wound, or other minor	1418	18.8 (13.2-24.4)
Other hemorrhage types	333	4.1 (2.5-5.6)
Laboratory abnormality only (eg, elevated international normalized ratio) or unspecified overdose	1116	19.5 (15.5-23.6)
Other or unspecified effect	73	1.1 (0.7-1.5)
Antibiotics (n = 6017)		
Moderate to severe allergic reaction[e]	1107	18.2 (15.4-21.0)
Neurological or psychiatric effect (eg, headache, anxiety)	56	0.9 (0.6-1.2)
Sensory or motor disturbance (eg, dizziness, syncope, muscular weakness)	107	1.8 (1.3-2.3)
Secondary infection (eg, candidiasis, *Clostridium difficile* colitis)	41	0.8 (0.4-1.3)
Gastrointestinal disturbance	690	11.9 (8.4-15.4)
Mild allergic reaction[f]	3843	63.6 (59.7-67.5)
Other or unspecified effect	173	2.8 (2.2-3.3)
Diabetes Agents (n = 5883)		
Hypoglycemia with moderate to severe effect	2697	47.6 (39.4-55.7)
Plus shock, loss of consciousness, or seizure	844	15.6 (10.6-20.6)
Plus fall or other injury (eg, road traffic accident)	295	4.5 (3.1-6.0)
Plus altered mental status or depressed level of consciousness	1558	27.4 (20.8-34.1)

	ED Visits for ADEs	
Adverse Event Manifestation[b]	**No. of Cases**	**National Estimate, % (95% CI)**[c]
Hypoglycemia with mild or unspecified effect	2610	42.1 (34.8-49.5)
Plus presyncope, syncope, or dizziness	499	8.8 (6.2-11.3)
Plus other neurological effect (eg, hyperhidrosis, tremor, dysarthria)	315	5.0 (3.6-6.4)
Plus other effect	236	3.6 (2.6-4.5)
Plus unspecified effect	1560	24.8 (16.6-32.9)
Other or unspecified effect	576	10.3 (7.6-13.0)
Opioid Analgesics (n = 2119)[g]		
Moderate to severe neurological effect	736	33.9 (29.1-38.7)
Loss of consciousness or respiratory distress (eg, respiratory depression, dyspnea, hypoxia)	243	10.7 (8.2-13.3)
Fall or other injury (eg, road traffic accident)	80	3.8 (2.4-5.3)
Altered mental status or depressed level of consciousness	413	19.3 (15.6-23.1)
Moderate to severe allergic reaction[e]	75	3.7 (2.4-5.0)
Mild neurological effect	345	16.3 (13.6-19.0)
Presyncope, syncope, dizziness, muscular weakness, or gait or balance disturbance	202	9.5 (7.2-11.7)
Other neurological or psychiatric effect (eg, lethargy, fatigue, dysarthria)	143	6.8 (4.9-8.7)
Cardiovascular effect (eg, palpitations, hypotension)	25	1.5 (0.8-2.2)
Gastrointestinal or genitourinary disturbance	433	21.4 (17.1-25.7)
Mild allergic reaction[f]	230	11.3 (8.9-13.6)
Other or unspecified effect	275	11.9 (8.9-15.0)

[a]Data are based on 42 585 cases from the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project, US Centers for Disease Control and Prevention. Data represent only ED visits in which a single drug class was implicated (86.9% of estimated ED visits involving anticoagulants; 93.8% of estimated ED visits involving antibiotics; 98.4% of estimated ED visits involving diabetes agents; and 79.8% of estimated ED visits involving opioid analgesics).

[b]Adverse event manifestations are mutually exclusive and were assigned hierarchically for all drug classes. For example, an ED visit in which a patient experienced both rectal bleeding and hematuria while on an anticoagulant would be categorized as gastrointestinal hemorrhage; an ED visit in which a patient experienced both hypoglycemic seizure and a fall while taking a diabetes agent would be categorized as hypoglycemia plus shock, loss of consciousness, or seizure.

[c]Calculated from statistical weighting of cases based on the sample design.

[d]Epidural or subdural hematoma, hemorrhagic stroke, and intracerebral or subarachnoid hemorrhage.

[e] Anaphylaxis, angioedema, drug reaction with eosinophilia and systemic symptoms, erythema multiforme, exfoliative dermatitis, facial-pharyngeal-genital edema, hyperhidrosis or chills, hypersensitivity vasculitis, red man syndrome, allergy-related respiratory compromise (eg, bronchospasm, dyspnea, hyperventilation, tachypnea, throat tightness, wheezing), serum sickness, and Stevens-Johnson syndrome.

[f] Dermatitis, drug eruption, erythema, flushing, localized or peripheral edema, pruritus, rash, and urticaria.

[g] Excludes ED visits for abuse or self-harm.