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Adverse Drug Events in U.S. Hospitals, 2010 Versus 2014

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Introduction

An adverse drug event (ADE) involves harms to patients caused by medication use. ADEs are the leading type of nonsurgical adverse event occurring in hospitals in the United States, with an estimated 1.6 million events in 2010.[1] Some ADEs are the result of medication errors that may occur when a drug is prescribed or administered improperly, but ADEs also may occur when medications are taken correctly. Overall, patients hospitalized with an ADE have an increased length of stay, higher costs, and increased risk of in-hospital death compared with those not experiencing an ADE.[2]

ADEs are increasingly common,[3] in part because of the substantial increase in prescription drug use. Between 2011 and 2014, 91 percent of U.S. adults aged 65 years and older reported use of a prescription drug in the past 30 days, compared with 74 percent reporting prescription drug use between 1988 and 1994.[4] The percentage of Americans aged 65 years and older who reported taking five or more drugs increased from 14 to 41 percent over the same time period.[5] Preventing ADEs is a top priority in health care in the U.S.[6]

This Healthcare Cost and Utilization Project (HCUP) Statistical Brief presents characteristics of hospital inpatient stays involving an ADE from 28 States in 2010 and 2014. ADE-related stays are reported by the origin of the ADE: those that originated during the inpatient stay versus those that were

[1] Agency for Healthcare Research and Quality. Saving Lives and Saving Money: Hospital-Acquired Conditions Update: Interim Data From National Efforts to Make Care Safer, 2010-2014. Agency for Healthcare Research and Quality. www.ahrq.gov/sites/default/files/publications/files/interimhacrate2014_2.pdf. Accessed January 4, 2018.
[2] Poudel DR, Acharya P, Ghimire S, Shital R, Bharati R. Burden of hospitalizations related to adverse drug events in the USA: a retrospective analysis from large inpatient database. Pharmacoepidemiology and Drug Safety. 2017;26(6):635–41.
[3] Ibid.
[4] National Center for Health Statistics. Health, United States, 2016: With Chartbook on Long-Term Trends in Health. Hyattsville, MD: National Center for Health Statistics; 2017.
[5] Ibid.
[6] U.S. Department of Health and Human Services. National Action Plan for Adverse Drug Event Prevention. U.S. Department of Health and Human Services. 2014. health.gov/hcq/pdfs/ade-action-plan-508c.pdf. Accessed September 29, 2017.

Highlights

- The overall number of hospital stays involving an adverse drug event (ADE) remained relatively stable from 2010 to 2014, but stays shifted from ADEs that originated during the stay to ADEs that were present on admission. In 2014, 70.5 percent of ADEs were present on admission, compared with 61.0 percent in 2010.
- Antibiotics and anti-infectives, systemic agents, and hormones were the most common specific causes of ADE-related hospital stays.
- From 2010 to 2014, the rate of stays involving an ADE increased the most for ADEs caused by smooth muscle and respiratory drugs (up 24 percent) and decreased the most for ADEs caused by cardiovascular drugs (down 18 percent).
- Among ADEs that originated during the hospital stay:
  - Rate of stays decreased 24 percent, but the average cost, length of stay, and mortality rate increased (27, 19, and 12 percent, respectively).
  - Rate of stays decreased most for cardiovascular drugs; average costs and length of stay increased most for water, mineral, and uric acid metabolism drugs.
- Among ADEs that were present on admission:
  - Rate of stays increased 16 percent, and average costs increased 15 percent; length of stay and mortality rate remained relatively stable.
  - Rate of stays increased most for systemic agents; average costs increased most for sedatives or hypnotics.

present on admission to the hospital. The most common causes of ADEs are presented overall and based on origin of the ADE. Differences between 2010 and 2014 are provided for the rate, average cost, and average length of stay involving ADEs by the cause and origin of the ADE.

Findings

Characteristics of inpatient stays involving adverse drug events, 2010 and 2014
Table 1 presents utilization and patient characteristics of inpatient stays involving an ADE based on whether the ADE originated during the stay or was present on admission to the hospital, in 2010 and 2014.

Table 1. Characteristics of inpatient stays involving an adverse drug event, 28 States, 2010 and 2014

Characteristic	Originated during stay			Present on admission		
	2010	2014	Percentage change	2010	2014	Percentage change
Utilization characteristics						
Number of stays	638,937	465,456	–27.2	997,892	1,110,725	11.3
Rate per 10,000 stays	282.0	214.9	–23.8	440.5	512.7	16.4
Cost per stay, mean $	22,115	28,089	27.0	11,577	13,308	14.9
Length of stay, mean days	8.6	10.2	19.1	5.6	5.9	4.2
In-hospital mortality, mean %	3.5	3.9	11.5	3.2	3.2	2.3
Patient characteristics, rate per 10,000 stays						
Age group, years						
0–17	64.3	61.7	–4.1	91.9	126.9	38.2
18–44	174.9	137.2	–21.5	313.5	339.0	8.1
45–64	348.4	267.8	–23.1	542.6	645.7	19.0
65+	409.8	300.1	–26.8	616.3	712.7	15.6
Sex						
Male	289.1	223.3	–22.8	446.8	520.8	16.5
Female	276.9	208.6	–24.7	435.9	506.7	16.3
Primary expected payer						
Medicare	405.4	297.3	–26.7	638.9	735.7	15.2
Medicaid	178.0	142.4	–20.0	274.8	346.7	26.1
Private insurance	220.3	173.5	–21.2	319.7	372.6	16.5
Uninsured	195.9	148.5	–24.2	464.1	429.3	–7.5
Community-level income						
Quartile 1 (poorest)	258.0	202.6	–21.5	422.1	491.4	16.4
Quartile 2	283.6	214.6	–24.3	450.3	519.3	15.3
Quartile 3	292.2	219.9	–24.7	450.5	525.2	16.6
Quartile 4 (wealthiest)	304.2	226.2	–25.6	444.5	524.4	18.0
Hospital region						
Northeast	170.5	184.3	8.1	451.0	488.2	8.3
Midwest	221.1	197.1	–10.9	508.9	521.9	2.6
South	275.8	265.1	–3.9	503.0	521.8	3.7
West	420.8	195.2	–53.6	310.5	513.4	65.3

Notes: The table reports values rounded to the nearest tenth. Percentage change is calculated using unrounded data input values. Other payers are not reported.

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID) for 28 States, 2010 and 2014

- **From 2010 to 2014, in these 28 States, the number of inpatient stays involving an ADE overall remained relatively stable but shifted from ADEs that originated during the stay to ADEs that were present on admission.**

  The total number of inpatient stays involving an ADE remained relatively stable in 2014 compared with 2010, at approximately 1.6 million stays each year. However, the number of stays involving an ADE that originated during the hospital stay decreased 27.2 percent, from 638,937 in 2010 to 465,456 in 2014. At the same time, the number of stays involving an ADE that were present on admission increased 11.3 percent, from 997,892 in 2010 to 1,110,725 in 2014. Overall, the percentage of stays with an ADE that were present on admission increased from 61.0 percent in 2010 to 70.5 percent in 2014.

  Consistent with the number of stays from 2010 to 2014, the rate of stays involving an ADE decreased 23.8 percent for ADEs that originated during the stay (from 282.0 per 10,000 stays in 2010 to 214.9 per 10,000 stays in 2014) but increased 16.4 percent for ADEs that were present on admission (from 440.5 per 10,000 stays in 2010 to 512.7 per 10,000 stays in 2014).

- **The average cost per stay, length of stay, and in-hospital mortality rate for stays involving an ADE were higher when the ADE originated during the inpatient stay than when the ADE was present on admission.**

  Compared with stays in which the ADE was present on admission, stays in which the ADE originated during the hospital stay involved, using 2014 data as an example:

  - Higher average cost per stay ($28,089 when originating during the stay vs. $13,308 when present on admission)
  - Higher average length of stay (10.2 vs. 5.9 days)
  - Higher in-hospital mortality rate (3.9 vs. 3.2 percent)

- **The costs, length, and mortality rate for stays involving an ADE that originated during the stay increased more from 2010 to 2014 than for stays involving an ADE that was present on admission.**

  Compared with inflation-adjusted hospital costs in 2010, the average cost for an inpatient stay involving an ADE that originated during the stay was 27.0 percent higher in 2014 ($28,089 vs. $22,115). For stays in which the ADE was present on admission, the average hospital cost was 14.9 percent higher in 2014 than in 2010 ($13,308 vs. $11,577).

  The average length of an inpatient stay was 1.6 days longer (19.1 percent higher) in 2014 than in 2010 for stays involving an ADE that originated during the stay (10.2 vs. 8.6 days). In contrast, the length of stay was less than half a day longer (4.2 percent higher) in 2014 than in 2010 for stays involving an ADE that was present on admission (5.9 vs. 5.6 days).

  Similarly, the average in-hospital mortality rate was 11.5 percent higher in 2014 than in 2010 for stays involving an ADE that originated during the stay (3.9 vs. 3.5 percent). In contrast, the mortality rate was virtually unchanged at approximately 3.2 percent in 2010 and 2014 for stays in which the ADE was present on admission.

- **Among western States, the rate of stays involving an ADE that originated during the stay decreased from 2010 to 2014, whereas the rate involving an ADE that was present on admission increased.**

  Between 2010 and 2014, the rate of stays involving an ADE that originated during the stay decreased 53.6 percent among western States, from 420.8 to 195.2 per 10,000 stays. During this same time period, the rate of stays involving an ADE that was present on admission increased 65.3 percent, from 310.5 to 513.4 per 10,000 stays. In other regions, the change in rates was of much smaller magnitude but was in the same direction (decreasing for ADEs that originated during the stay and

increasing for ADEs that were present on admission), with one exception. Among northeastern States, the rate of stays involving ADEs that originated during the stay increased 8.1 percent.

Specific causes of adverse drugs events among inpatient stays, 2010 and 2014
Table 2 shows the percentage and rate of inpatient stays involving ADEs (of any origin) by the cause of ADE in 2010 and 2014, sorted by the most common ADEs in 2014. The percentage change in the rate of stays for the 2 years also is presented.

Table 2. Percentage and rate of inpatient stays involving an ADE, 28 States, 2010 and 2014

ADE cause	All ADE stays, %[a]		Rate per 10,000 stays		Percentage change in rate
	2010	2014	2010	2014	
Any ADE	**100.0**	**100.0**	**675.9**	**702.0**	**3.9**
Antibiotics and anti-infectives	20.3	21.6	137.2	151.5	10.5
Nonspecific ADE causes (drug type not specified)	14.1	14.4	95.4	101.3	6.1
Systemic agents	11.5	13.5	78.0	94.6	21.3
Hormones	14.0	13.3	94.9	93.3	–1.7
Analgesics	13.5	13.1	91.4	91.9	0.6
Agents affecting blood constituents	10.4	10.0	70.4	69.9	–0.7
Psychotropic agents	8.6	8.1	58.4	57.2	–2.1
Cardiovascular drugs	8.3	6.6	56.1	46.2	–17.7
Water, mineral, and uric acid metabolism drugs	5.0	4.9	33.6	34.6	3.0
Sedatives or hypnotics	3.6	3.6	24.2	25.0	3.1
Anticonvulsants and anti-Parkinson drugs	2.8	2.5	18.9	17.7	–6.4
CNS depressants and anesthetics	2.0	1.9	13.6	13.0	–4.4
Smooth muscle and respiratory drugs	1.1	1.3	7.2	8.9	24.1
Central nervous system drugs	1.1	1.0	7.6	7.2	–5.3
Autonomic nervous system drugs	0.7	0.7	4.9	4.6	–6.1
GI system drugs	0.4	0.4	2.8	2.8	–0.4
Skin, eye, and mucous membrane drugs	0.3	0.3	2.2	1.9	–11.1
Vaccines	0.1	0.1	0.6	0.6	–12.8
Other specific drugs	0.1	0.0	0.3	0.3	–16.1

Abbreviations: ADE, adverse drug event; CNS, central nervous system; GI, gastrointestinal

Note: Hormones include steroids, insulin, and other hormones. Analgesics include opiates/narcotics and nonsteroidal anti-inflammatory drugs (NSAIDS). Systemic agents include antineoplastic drugs, antiallergy and antiemetic drugs, and other systemic agents.

[a] Percentages across all ADEs sum to greater than 100 percent because some inpatient stays involved more than one ADE cause.

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID) for 28 States, 2010 and 2014

- **Antibiotics and anti-infectives, systemic agents, and hormones were the most common specific causes of ADEs associated with inpatient stays in 2014.**

  In 2014, over 20 percent of all inpatient stays involving ADEs were caused by antibiotics and anti-infectives. From 2010 to 2014, the rate of stays involving ADEs caused by antibiotics and anti-infectives increased by 10.5 percent, from 137.2 to 151.5 per 10,000 stays.

  Systemic agents were the third most common cause of ADEs among inpatient stays overall (behind nonspecific ADE causes), at 13.5 percent of stays involving ADEs in 2014. From 2010 to 2014, the

rate of stays involving ADEs caused by systemic agents increased 21.3 percent, from 78.0 to 94.6 per 10,000 stays.

The fourth most common ADE cause was hormones, at 13.3 percent of stays involving an ADE in 2014. The rate of stays involving ADEs caused by hormones remained relatively stable over time, at 94.9 per 10,000 stays in 2010 and 93.3 per 10,000 stays in 2014.

- **From 2010 to 2014, the rate of stays involving an ADE increased the most for ADEs caused by smooth muscle and respiratory drugs and decreased the most for ADEs caused by cardiovascular drugs.**

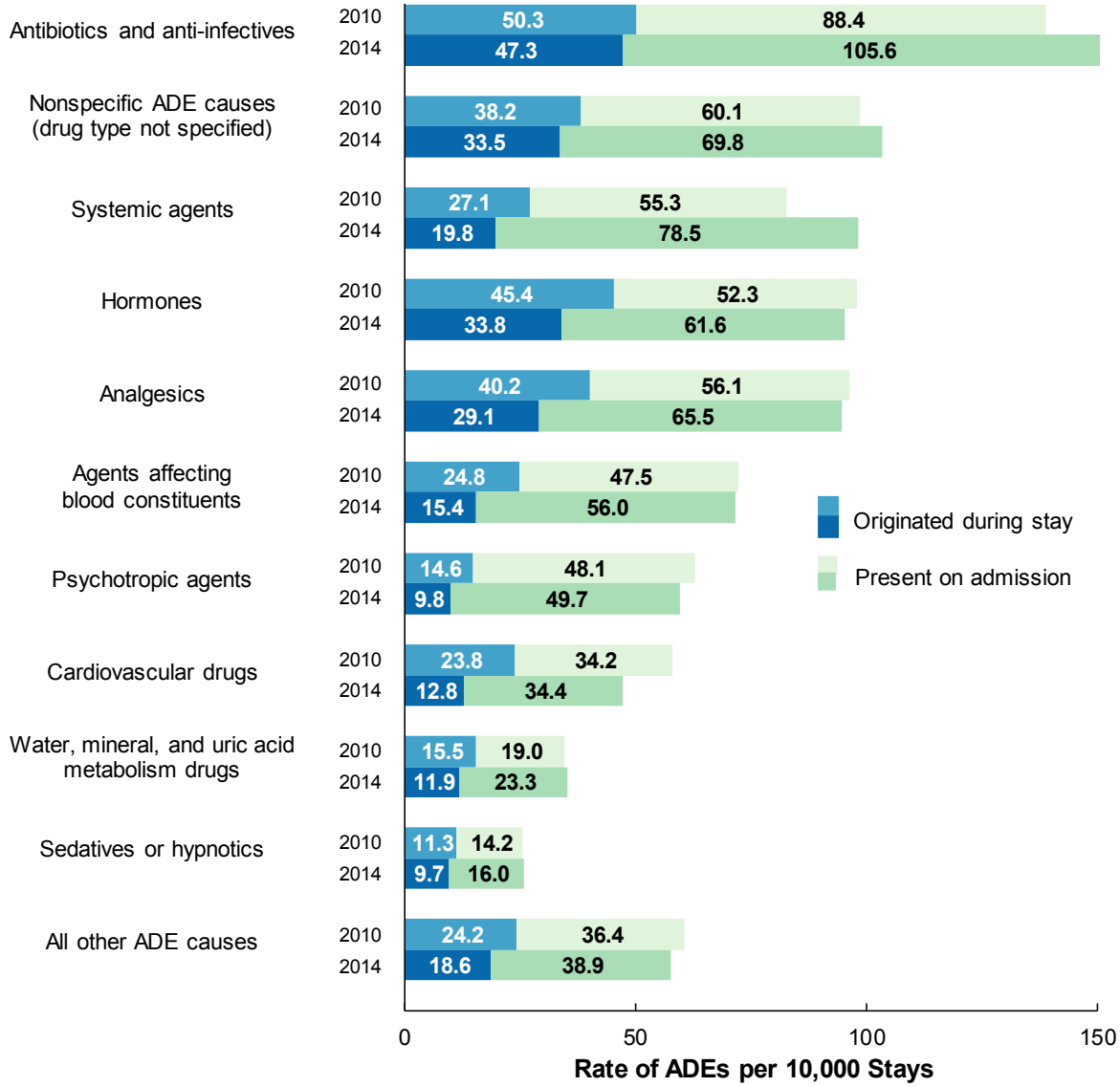
  The largest increases in rate of stays involving an ADE between 2010 and 2014 occurred for ADEs caused by smooth muscle and respiratory drugs (24.1 percent increase), systemic agents (21.3 percent increase), and antibiotics and anti-infectives (10.5 percent increase).

  The largest decreases in rate of stays involving ADEs between 2010 and 2014 occurred for ADEs caused by cardiovascular drugs (17.7 percent decrease), other specific drugs (16.1 percent decrease), and vaccines (12.8 percent decrease).

Characteristics of common causes of adverse drugs events among inpatient stays, 2010 and 2014
Figures 1–4 present information about the 10 most common causes of ADEs identified in Table 1. Less common ADE causes are combined into a single "all other ADE causes" category in these figures.

Figure 1 presents the rate of inpatient stays for the most common causes of ADEs in 2010 and 2014. Results are presented separately for ADEs that originated during the inpatient stay and those present on admission to the hospital.

Figure 1. Rate of inpatient stays involving ADEs by cause and origin of ADE, 28 States, 2010 and 2014



Abbreviation: ADE, adverse drug event

Notes: Some stays included ADEs that originated during the stay and ADEs that were present on admission. These stays are counted once for each origin type; thus, the sum of the rates across origins may be higher than the overall rate for ADEs (as shown in Table 2).

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID) for 28 States, 2010 and 2014

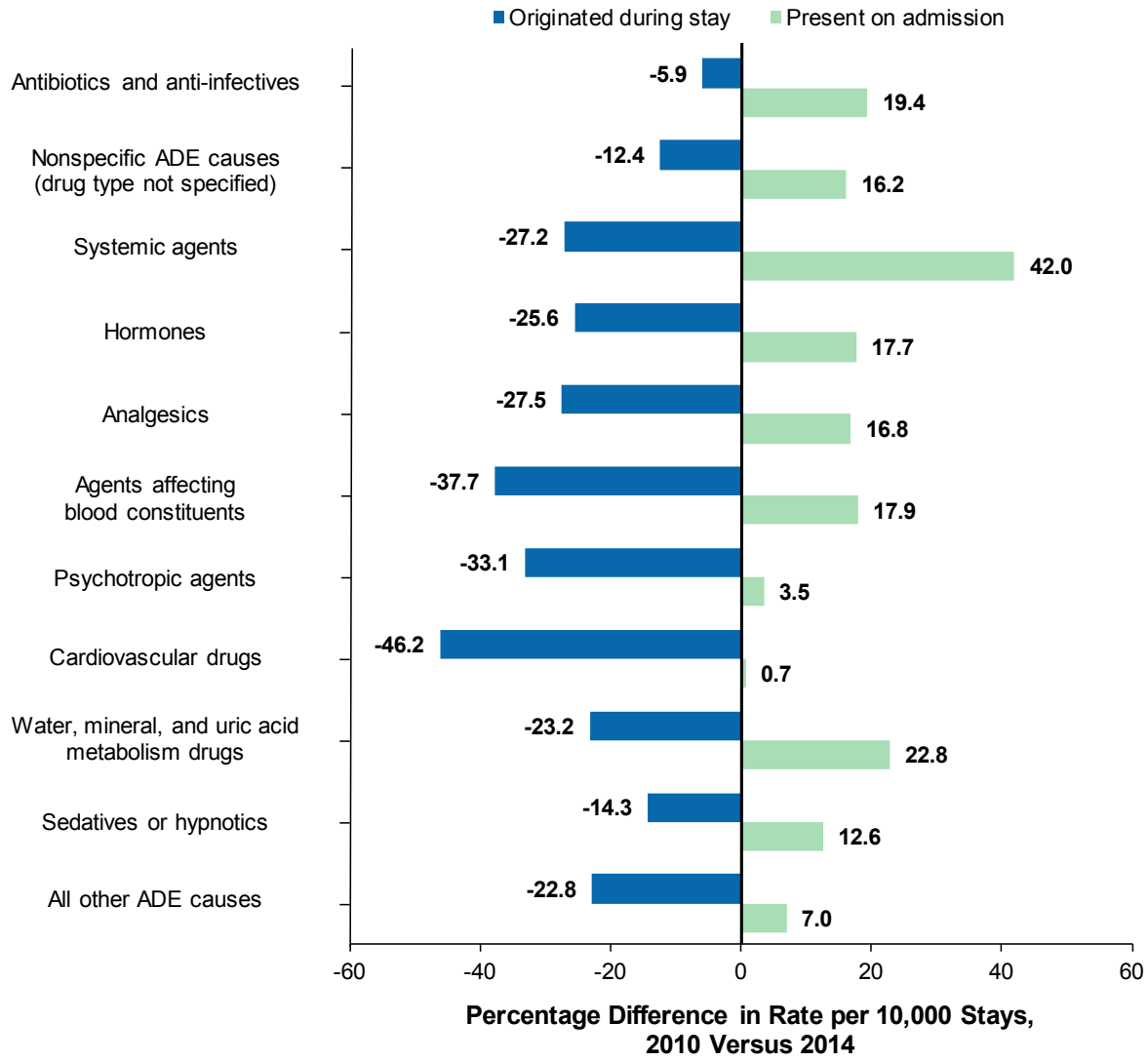
- **Across all ADEs, the rate of hospitalization involving ADEs that originated during the stay was lower in 2014 than in 2010. Conversely, the rate of ADE stays present on admission was higher in 2014 than in 2010.**

  For all causes of ADEs that originated during the inpatient stay, the rate of stays was lower in 2014 than in 2010. For example, the rate of stays involving ADEs caused by antibiotics and anti-infectives that originated during the stay decreased from 50.3 to 47.3 per 10,000 stays from 2010 to 2014.

  For all causes of ADEs that were present on admission, the rate of stays was higher in 2014 than in 2010. For example, the rate of stays involving ADEs caused by antibiotics and anti-infectives that were present on admission increased from 88.4 to 105.6 per 10,000 stays from 2010 to 2014.

Figure 2 shows the percentage difference from 2010 to 2014 in the rate per 10,000 inpatient stays involving ADEs by the most common causes of ADEs. Results are presented separately for ADEs that originated during the hospital stay and those present on admission to the hospital.

Figure 2. Percentage difference in rate of inpatient stays involving an ADE by cause and origin of ADE, 28 States, 2010 versus 2014



Abbreviation: ADE, adverse drug event

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID) for 28 States, 2010 and 2014

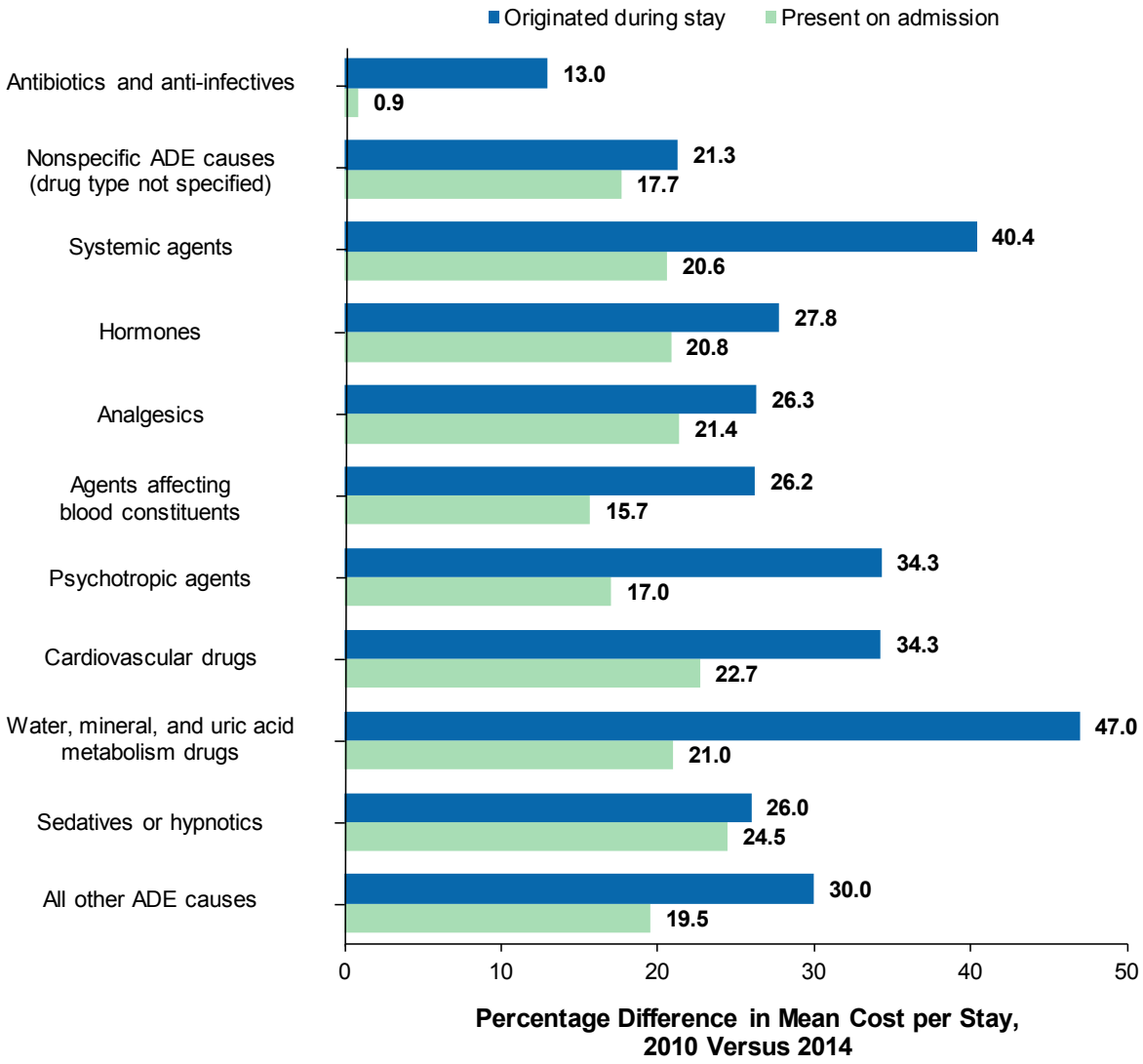
- **ADEs due to cardiovascular drugs had the largest decrease in rate among ADEs that originated during the inpatient stay. ADEs due to systemic agents had the largest increase in rate among ADEs that were present on admission.**

  Rates decreased from 2010 to 2014 across all ADE causes that originated during the hospital stay. The largest decreases were for cardiovascular drugs (down 46.2 percent), agents affecting blood constituents (down 37.7 percent), and psychotropic agents (down 33.1 percent).

  Rates increased from 2010 to 2014 across all ADE causes that were present on admission. The largest increases were for systemic agents (up 42.0 percent); water, mineral, and uric acid metabolism drugs (up 22.8 percent); and antibiotics and anti-infectives (up 19.4 percent).

Figure 3 shows the percentage difference from 2010 to 2014 in the average inflation-adjusted cost of stays involving ADEs by the most common causes. Results are presented separately for ADEs that originated during the inpatient stay and those present on admission to the hospital.

Figure 3. Percentage difference in mean inflation-adjusted cost[a] of stays involving an ADE by cause and origin of ADE, 28 States, 2010 versus 2014



Abbreviation: ADE, adverse drug event

[a] Mean cost per stay in 2010 was inflation adjusted using 2014 as the base year.

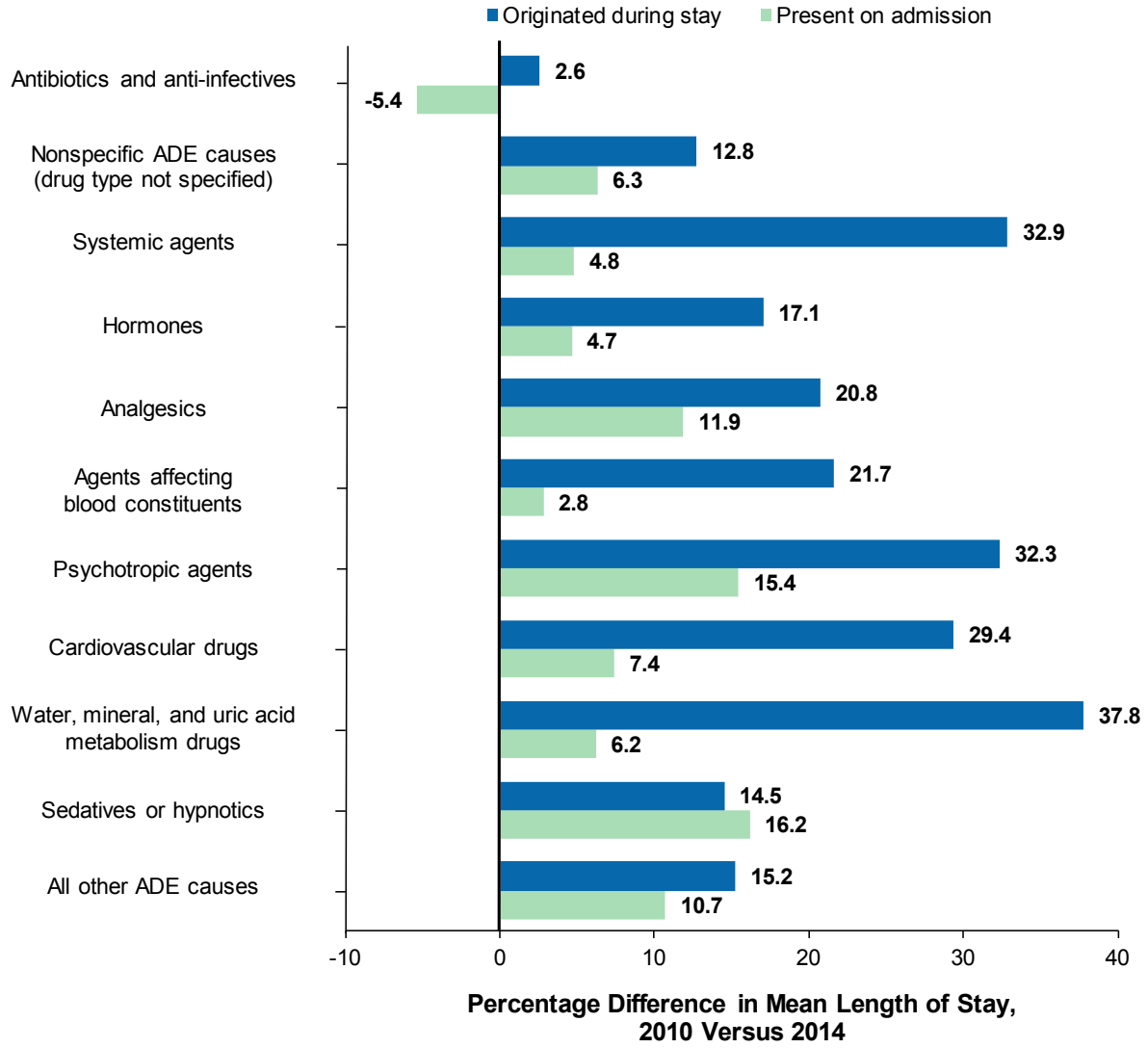
Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID) for 28 States, 2010 and 2014

- **The largest increases in average cost per stay were for ADEs due to water, mineral, and uric acid metabolism drugs (among ADEs that originated during the hospital stay) and sedatives or hypnotics (among ADEs that were present on admission).**

  Compared with 2010, the average inflation-adjusted cost per stay in 2014 was higher for all common ADE causes, regardless of origin of the ADE. However, cost increases were higher for ADEs that originated during the stay than for those present on admission. The largest increases in costs for ADEs that originated during the stay were for water, mineral, and uric acid metabolism drugs (up 47.0 percent) and systemic agents (up 40.4 percent). The largest increases in costs for ADEs that were present on admission were for sedatives or hypnotics (up 24.5 percent) and cardiovascular drugs (up 22.7 percent).

Figure 4 shows the percentage difference from 2010 to 2014 in the average length of stay involving an ADE by the most common causes. Results are presented separately for ADEs that originated during the hospital stay and those present on admission to the hospital.

Figure 4. Percentage difference in mean length of stay involving an ADE by cause and origin of ADE, 28 States, 2010 versus 2014



Abbreviation: ADE, adverse drug event

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), State Inpatient Databases (SID) for 28 States, 2010 and 2014

- **The ADE causes with the largest increases in average length of stay were water, mineral, and uric acid metabolism drugs (among ADEs that originated during the hospital stay) and sedatives or hypnotics (among ADEs that were present on admission).**

  Between 2010 and 2014, the average length of stay increased for all common ADE causes, regardless of origin of the ADE (with one exception: antibiotics and anti-infectives that were present on admission decreased 5.4 percent). For all ADEs except sedatives or hypnotics, the average length of stay increased more when the ADE originated during the stay than when it was present on admission. For ADEs that originated during the stay, the largest increases in length of stay were for water, mineral, and uric acid metabolism drugs (up 37.8 percent) and systemic agents (up 32.9 percent). For ADEs that were present on admission, the largest increases in length of stay were for sedatives or hypnotics (up 16.2 percent) and psychotropic agents (up 15.4 percent).

About Statistical Briefs

HCUP Statistical Briefs provide basic descriptive statistics on a variety of topics using HCUP administrative health care data. Topics include hospital inpatient, ambulatory surgery, and emergency department use and costs, quality of care, access to care, medical conditions, procedures, and patient populations, among other topics. The reports are intended to generate hypotheses that can be further explored in other research; the reports are not designed to answer in-depth research questions using multivariate methods.

Data Source

The estimates in this Statistical Brief are based upon data from the Healthcare Cost and Utilization Project (HCUP) 2010 and 2014 State Inpatient Databases (SID) from 28 States that include data elements designating whether adverse drug event (ADE) diagnoses were present on admission or originated during the stay. The States are Arizona, Arkansas, California, Florida, Hawaii, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Montana, Nebraska, Nevada, New Jersey, New Mexico, New York, Oklahoma, Oregon, Rhode Island, South Carolina, Tennessee, Virginia, and Washington.

All numbers noted in the text and included in the tables are actual values, not estimates, because the data include a census of discharges rather than a sample of discharges. In other words, we count the actual number of hospital stays with an ADE in the 28 States. Because we analyze numbers for the actual population rather than a sample, there is no need to estimate how well the sample represents an underlying population. As a result, there is no sampling error associated with the calculated values presented, and significance testing is not necessary. Differences over time are reported by comparing values in 2010 with values in 2014.

Definitions

Case definition
The specific causes of adverse drug events presented in this Statistical Brief were based on a review of International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis codes and external cause of injury codes (E codes). The specific ICD-9-CM diagnosis codes used for each ADE cause are provided in the separate appendix associated with this Statistical Brief on the HCUP-US website at www.hcup-us.ahrq.gov/reports/statbriefs/sb234-appendix.pdf. This code list is adapted from a list that was previously used to report on ADE causes in 2011 in a prior Statistical Brief.[7] Because the current Statistical Brief covers two different years (2010 and 2014), there were a few clinical code changes that required an adaptation of the earlier code list. These changes are as follows:

- Effective with the fiscal year 2012 revision of ICD-9-CM codes, code 284.1 (pancytopenia) was subdivided into and replaced by codes 284.11 (antineoplastic chemotherapy induced pancytopenia), 284.12 (other drug induced pancytopenia), and 284.19 (other pancytopenia). The original code list included code 284.11 under the "antineoplastic drugs" ADE cause and code 284.12 under the "nonspecific ADE causes" category. Because the earlier 284.1 code, which existed during 2010, could not be discriminated between the two ADE cause categories and included "other pancytopenia," we excluded the pancytopenia codes (284.11 and 284.12) from our analysis to ensure an equivalent comparison between 2010 and 2014.

- Effective with the fiscal year 2011 revision of ICD-9-CM codes, code 970.8 (poisoning by other specified central nervous system stimulants) was subdivided into and replaced by codes 970.81 (poisoning by cocaine) and 970.89 (poisoning by other central nervous system stimulants). Both 970.81 and 970.89 were classified under the "central nervous system drugs" ADE cause on the

[7] Weiss AJ, Elixhauser A, Bae J, Encinosa W. Origin of Adverse Drug Events in U.S. Hospitals, 2011. HCUP Statistical Brief #158. July 2013. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/reports/statbriefs/sb158.pdf. Accessed November 30, 2017.

original code list. We added code 970.8 to “central nervous system drugs” to account for this type of poisoning in 2010.

- Effective with the fiscal year 2012 revision of ICD-9-CM codes, code 999.4 (anaphylactic reaction due to serum) was subdivided into and replaced by codes 999.41 (anaphylactic reaction due to administration of blood and blood products), 999.42 (anaphylactic reaction due to vaccination), and 999.49 (anaphylactic reaction due to other serum). The original code list included code 999.42 under the “vaccines” ADE cause. Because the earlier 999.4 code included anaphylactic reactions due to causes other than vaccines, we excluded code 999.42 from our analysis to ensure an equivalent comparison between 2010 and 2014.

- Effective with the fiscal year 2012 revision of ICD-9-CM codes, code 999.5 (other serum reaction) was subdivided into and replaced by codes 999.51 (other serum reaction due to administration of blood and blood products), 999.52 (other serum reaction due to vaccination), and 999.59 (other serum reaction). The original code list included code 999.52 under the “vaccines” ADE cause. Because the earlier 999.5 code included serum reactions due to causes other than vaccines, we excluded code 999.52 from our analysis to ensure an equivalent comparison between 2010 and 2014.

Table 3 summarizes specific ADE causes that are included within each ADE cause category reported in this Statistical Brief. The exact diagnoses that are included in each ADE cause category are provided in the appendix for this Statistical Brief.

Table 3. Specific ADE causes included in ADE cause categories

ADE cause category	Specific ADE causes included
Antibiotics and anti-infectives	Antibiotics, *clostridium difficile* infection, other anti-infectives
Nonspecific ADE causes (drug type not specified)	N/A
Systemic agents	Antineoplastic drugs, antiallergy and antiemetic drugs, other systemic agents
Hormones	Steroids, insulin and hypoglycemic, and other hormones
Analgesics	Opiates/narcotics and NSAIDS
Agents affecting blood constituents	Anticoagulants and other agents that affect blood constituents
Psychotropic agents	Antidepressants, antipsychotics, benzodiazepine, and other psychotropic drugs
Cardiovascular drugs	Digoxin, antiadrenergics, and other cardiovascular drugs
Water, mineral, and uric acid metabolism drugs	Saluretics, other diuretics, and other drugs affecting mineral and uric acid metabolism
Sedatives or hypnotics	N/A
Anticonvulsants and anti-Parkinson drugs	Hydantoin, other anticonvulsants, and anti-Parkinson drugs
CNS depressants and anesthetics	N/A
Smooth muscle and respiratory drugs	N/A
Central nervous system drugs	N/A
Autonomic nervous system drugs	N/A
GI system drugs	N/A
Skin, eye, and mucous membrane drugs	N/A
Vaccines	N/A
Other specific drugs	N/A

Abbreviations: ADE, adverse drug event; CNS, central nervous system; GI, gastrointestinal; N/A, not applicable; NSAIDS, nonsteroidal anti-inflammatory drug

Note: Refer to the separate appendix available on the HCUP-US website for the detailed list of all ICD-9-CM diagnosis codes included for each ADE cause.

Present on admission was determined for each discharge diagnosis based on two types of present-on-admission indicator flags in the SID: (1) a diagnosis-specific flag that indicates whether each diagnosis was present on admission and (2) an E code flag that indicates whether each external cause of injury was present on admission.

After discharges that did not meet standard present-on-admission edit checking were excluded,[8] the final analysis file for this Statistical Brief included 44,316,684 discharges (95.8 percent of all discharges across the 28 States in 2010 and 2014).

Types of hospitals included in HCUP State Inpatient Databases
This analysis used State Inpatient Databases (SID) limited to data from community hospitals, which are defined as short-term, non-Federal, general, and other hospitals, excluding hospital units of other institutions (e.g., prisons). Community hospitals include obstetrics and gynecology, otolaryngology, orthopedic, cancer, pediatric, public, and academic medical hospitals. Excluded for this analysis are long-term care facilities such as rehabilitation, psychiatric, and alcoholism and chemical dependency

[8] Barrett ML, Owens PL, Bolhack J, Sheng M. Examination of the Coding of Present-on-Admission Indicators in Healthcare Cost and Utilization Project (HCUP) State Inpatient Databases (SID). 2015. HCUP Methods Series Report #2015-06. September 1, 2015. U.S. Agency for Healthcare Research and Quality. www.hcup-us.ahrq.gov/reports/methods/2015-06.pdf. Accessed September 27, 2017.

hospitals. However, if a patient received long-term care, rehabilitation, or treatment for a psychiatric or chemical dependency condition in a community hospital, the discharge record for that stay was included in the analysis.

Unit of analysis
The unit of analysis is the hospital discharge (i.e., the hospital stay), not a person or patient. This means that a person who is admitted to the hospital multiple times in 1 year will be counted each time as a separate discharge from the hospital.

Payer
Payer is the expected payer for the hospital stay. To make coding uniform across all HCUP data sources, payer combines detailed categories into general groups:

- Medicare: includes patients covered by fee-for-service and managed care Medicare
- Medicaid: includes patients covered by fee-for-service and managed care Medicaid
- Private Insurance: includes Blue Cross, commercial carriers, and private health maintenance organizations (HMOs) and preferred provider organizations (PPOs)
- Uninsured: includes an insurance status of *self-pay* and *no charge*
- Other: includes Workers' Compensation, TRICARE/CHAMPUS, CHAMPVA, Title V, and other government programs

Hospital stays billed to the State Children's Health Insurance Program (SCHIP) may be classified as Medicaid, Private Insurance, or Other, depending on the structure of the State program. Because most State data do not identify patients in SCHIP specifically, it is not possible to present this information separately.

For this Statistical Brief, when more than one payer is listed for a hospital discharge, the first-listed payer is used. Other payers were not reported.

Community-level income
Community-level income is based on the median household income of the patient's ZIP Code of residence. Quartiles are defined so that each State's population is evenly distributed. Cut-offs for the quartiles are determined annually using ZIP Code demographic data obtained from Claritas, a vendor that adds value to data from the U.S. Census Bureau.[9] The value ranges for the income quartiles vary by year. The income quartile is missing for patients who are homeless or foreign.

Region
Region is one of the four regions defined by the U.S. Census Bureau. The following States used for this analysis fell into these regions:

- Northeast: Maine, Massachusetts, Rhode Island, New York, New Jersey
- Midwest: Indiana, Illinois, Michigan, Minnesota, Iowa, Nebraska, Kansas
- South: Maryland, Virginia, South Carolina, Florida, Kentucky, Tennessee, Arkansas, Oklahoma
- West: Montana, New Mexico, Arizona, Nevada, Washington, Oregon, California, Hawaii

About HCUP

The Healthcare Cost and Utilization Project (HCUP, pronounced "H-Cup") is a family of health care databases and related software tools and products developed through a Federal-State-Industry partnership and sponsored by the Agency for Healthcare Research and Quality (AHRQ). HCUP databases bring together the data collection efforts of State data organizations, hospital associations, and private data organizations (HCUP Partners) and the Federal government to create a national information resource of encounter-level health care data. HCUP includes the largest collection of longitudinal hospital care data in the United States, with all-payer, encounter-level information beginning in 1988. These databases enable research on a broad range of health policy issues, including cost and quality of health

[9] Claritas. Claritas Demographic Profile. www.claritas.com. Accessed June 23, 2017.

services, medical practice patterns, access to health care programs, and outcomes of treatments at the national, State, and local market levels.

HCUP would not be possible without the contributions of the following data collection Partners from across the United States:

Alaska Department of Health and Social Services
Alaska State Hospital and Nursing Home Association
Arizona Department of Health Services
Arkansas Department of Health
California Office of Statewide Health Planning and Development
Colorado Hospital Association
Connecticut Hospital Association
District of Columbia Hospital Association
Florida Agency for Health Care Administration
Georgia Hospital Association
Hawaii Health Information Corporation
Illinois Department of Public Health
Indiana Hospital Association
Iowa Hospital Association
Kansas Hospital Association
Kentucky Cabinet for Health and Family Services
Louisiana Department of Health
Maine Health Data Organization
Maryland Health Services Cost Review Commission
Massachusetts Center for Health Information and Analysis
Michigan Health & Hospital Association
Minnesota Hospital Association
Mississippi State Department of Health
Missouri Hospital Industry Data Institute
Montana Hospital Association
Nebraska Hospital Association
Nevada Department of Health and Human Services
New Hampshire Department of Health & Human Services
New Jersey Department of Health
New Mexico Department of Health
New York State Department of Health
North Carolina Department of Health and Human Services
North Dakota (data provided by the Minnesota Hospital Association)
Ohio Hospital Association
Oklahoma State Department of Health
Oregon Association of Hospitals and Health Systems
Oregon Office of Health Analytics
Pennsylvania Health Care Cost Containment Council
Rhode Island Department of Health
South Carolina Revenue and Fiscal Affairs Office
South Dakota Association of Healthcare Organizations
Tennessee Hospital Association
Texas Department of State Health Services
Utah Department of Health
Vermont Association of Hospitals and Health Systems
Virginia Health Information
Washington State Department of Health
West Virginia Department of Health and Human Resources, West Virginia Health Care Authority
Wisconsin Department of Health Services
Wyoming Hospital Association

About the SID

The HCUP State Inpatient Databases (SID) are hospital inpatient databases from data organizations participating in HCUP. The SID contain the universe of the inpatient discharge abstracts in the participating HCUP States, translated into a uniform format to facilitate multistate comparisons and analyses. Together, the SID encompass more than 95 percent of all U.S. community hospital discharges. The SID can be used to investigate questions unique to one State, to compare data from two or more States, to conduct market-area variation analyses, and to identify State-specific trends in inpatient care utilization, access, charges, and outcomes.

For More Information

For other information on adverse events and patient safety in U.S. hospitals, including adverse drug events, refer to the HCUP Statistical Briefs located at www.hcup-us.ahrq.gov/reports/statbriefs/sb_adverse.jsp.

For additional HCUP statistics, visit:

- HCUP Fast Stats at www.hcup-us.ahrq.gov/faststats/landing.jsp for easy access to the latest HCUP-based statistics for health information topics
- HCUPnet, HCUP's interactive query system, at www.hcupnet.ahrq.gov/

For more information about HCUP, visit www.hcup-us.ahrq.gov/.

For a detailed description of HCUP and more information on the design of the State Inpatient Databases (SID), please refer to the following database documentation:

Agency for Healthcare Research and Quality. Overview of the State Inpatient Databases (SID). Healthcare Cost and Utilization Project (HCUP). Rockville, MD: Agency for Healthcare Research and Quality. Updated June 2016. www.hcup-us.ahrq.gov/sidoverview.jsp. Accessed January 31, 2017.

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AHRQ welcomes questions and comments from readers of this publication who are interested in obtaining more information about access, cost, use, financing, and quality of health care in the United States. We also invite you to tell us how you are using this Statistical Brief and other HCUP data and tools, and to share suggestions on how HCUP products might be enhanced to further meet your needs. Please e-mail us at hcup@ahrq.gov or send a letter to the address below:

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