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Overview of Operating Room Procedures During Inpatient Stays in U.S. Hospitals, 2014

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Highlights

- In 2014, 10.1 million inpatient hospital stays involved operating room (OR) procedures with a total of 14.2 million OR procedures. Aggregate hospital costs for stays with OR procedures were $187.1 billion.
- Although just over one-quarter (28.6 percent) of all hospital stays involved OR procedures, these stays accounted for nearly half (48.4 percent) of aggregate hospital costs.
- Compared with stays without OR procedures, stays involving OR procedures were longer on average (5.1 vs. 4.4 days) and had higher average costs ($18,500 vs. $7,900).
- In 2014, 36.7 percent of stays that were privately insured involved OR procedures compared with 23–25 percent of stays among other types of payers.
- Cesarean section, knee arthroplasty, hip replacement, and percutaneous coronary angioplasty (PTCA) were among the five most common OR procedures (along with circumcision) and the five OR procedures with the highest aggregate hospital costs (along with spinal fusion).
- Three musculoskeletal procedures—hip replacement, knee arthroplasty, and spinal fusion—accounted for 12.2 percent of all OR procedures and 19.6 percent of aggregate costs for all inpatient stays with a first-listed OR procedure.

Introduction

The majority of patients admitted to the hospital undergo at least one type of procedure during their stay.[1] Many diagnostic and therapeutic procedures, such as x-rays and blood transfusions, are performed outside of the operating room (OR), whereas surgical procedures, such as Cesarean sections and hip replacements, take place in the OR. On average, hospital costs for stays with OR procedures are more than double the costs for inpatient stays without OR procedures.[2,3]

Identifying the characteristics, costs, and volume of OR procedures can guide health care improvement efforts. Such information can also provide baseline data for assessing the potential impact of advances in medical practice and technology and changes in health care provider arrangements.

This Healthcare Cost and Utilization Project (HCUP) Statistical Brief updates previous HCUP reports focused on OR procedures in the inpatient setting,[4,5,6,7] presenting data from U.S. hospitals in 2014, the last full year that procedures were coded using ICD-9-CM. In this Statistical Brief, OR procedures are defined using

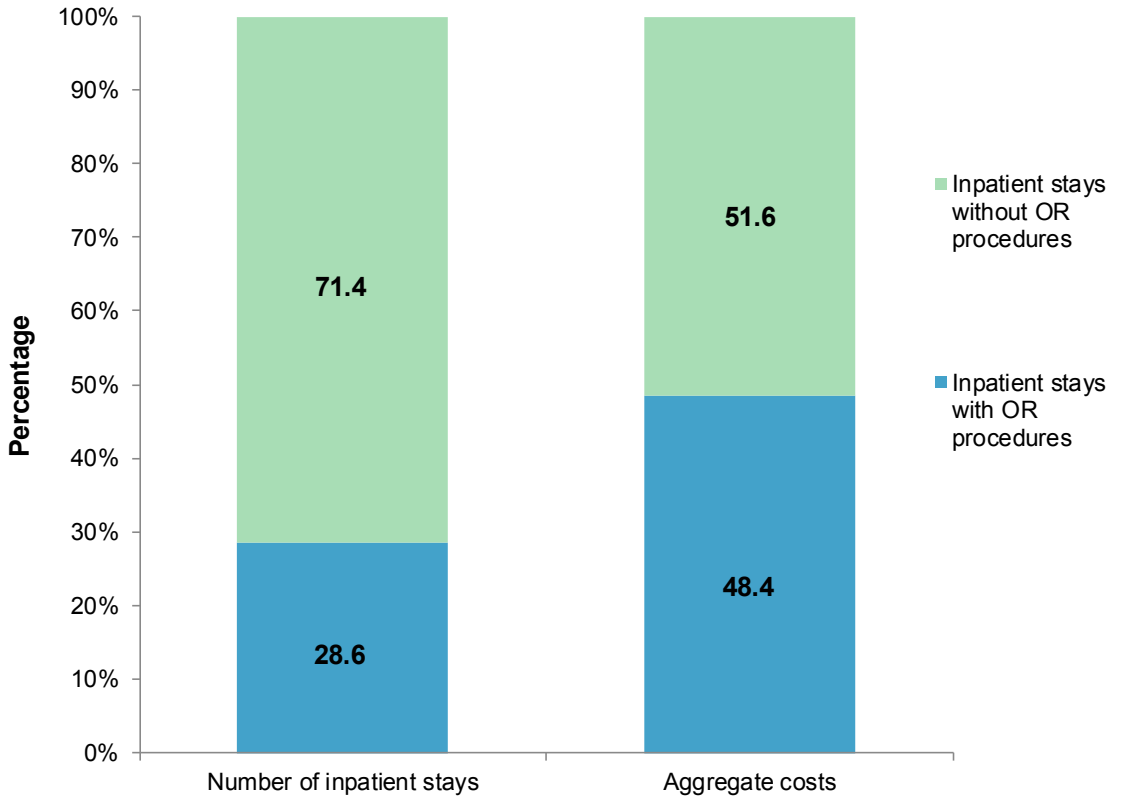
[1] Pfuntner A, Wier LM, Stocks C. Most Frequent Procedures Performed in U.S. Hospitals, 2011. HCUP Statistical Brief #165. October 2013. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/reports/statbriefs/sb165.pdf. Accessed October 9, 2017.
[2] Elixhauser A, Andrews RM. Profile of inpatient operating room procedures in US hospitals in 2007. Archives of Surgery. 2010;145(12):1201–1208.
[3] Weiss AJ, Elixhauser A, Andrews RM. Characteristics of Operating Room Procedures in U.S. Hospitals, 2011. HCUP Statistical Brief #170. February 2014. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/reports/statbriefs/sb170-Operating-Room-Procedures-United-States-2011.pdf. Accessed October 10, 2017.
[4] Fingar KR, Stocks CA, Weiss AJ, Steiner CA. Most Frequent Operating Room Procedures Performed in U.S. Hospitals, 2003–2012. HCUP Statistical Brief #186. December 2014. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/reports/statbriefs/sb186-Operating-Room-Procedures-United-States-2012.pdf. Accessed October 10, 2017.
[5] Weiss AJ, Elixhauser A. Trends in Operating Room Procedures in U.S. Hospitals, 2001–2011. HCUP Statistical Brief #171. March 2014. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/reports/statbriefs/sb171-Operating-Room-Procedure-Trends.pdf. Accessed October 10, 2017.
[6] Elixhauser, Andrews, 2010. Op. cit.
[7] Weiss, Elixhauser, Andrews, 2014. Op cit.

diagnosis-related group (DRG) algorithms, which were based on reviews by clinical panels. The percentage of all inpatient stays involving operating room (OR) procedures and the percentage of aggregate costs attributed to inpatient stays involving OR procedures are presented. Patient characteristics, resource use, and outcomes are provided for inpatient stays with OR procedures. The most frequent and most costly OR procedures are also presented. Differences in estimates of 10 percent or greater are noted in the text.

Findings

Characteristics of inpatient stays involving operating room procedures, 2014
Figure 1 shows the percentage of all inpatient stays with operating room (OR) procedures and the percentage of aggregate hospital costs attributed to stays involving OR procedures.

Figure 1. Percentage of inpatient stays and aggregate costs for inpatient stays with and without operating room (OR) procedures, 2014



Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS), 2014

- **Inpatient stays with OR procedures accounted for more than one-fourth of all hospitalizations and almost half of all aggregate hospital costs in 2014.**

  In 2014, 28.6 percent of all inpatient stays involved at least one OR procedure, but costs for stays with OR procedures constituted 48.4 percent of all aggregate hospital costs.

Table 1 presents select utilization characteristics and outcomes for inpatient stays with and without OR procedures in 2014. The unit of analysis is the inpatient stay; stays that listed an OR procedure in any procedure field are compared with those that did not involve any OR procedures.

Table 1. Utilization and outcomes for inpatient hospital stays with and without operating room (OR) procedures, 2014

Characteristic or outcome	Stays with one or more OR procedures	Stays without any OR procedures
Number of stays	10,115,800	25,243,000
All hospital stays, %	28.6	71.4
Rate of stays per 100,000 population	3,172.5	7,916.7
Aggregate costs, $ billions	187.1	199.1
Aggregate costs, %	48.4	51.6
Mean cost per stay, $	18,500	7,900
Mean length of stay, days	5.1	4.4
Mean cost per day, $	4,800	2,100
Admitted from emergency department, %	27.7	58.7
Discharge status, %		
Discharged to self-care (routine discharge) or home health care	83.0	80.3
Transferred to short-term hospital	0.8	2.5
Transferred to other type of facility, including long-term care	14.8	13.5
Died in hospital	1.2	2.2
Other[a]	0.2	1.5

Notes: Number of stays, mean cost per stay, and mean cost per day are rounded to the nearest hundred.

[a] Other discharges include alive/destination unknown, against medical advice, and missing.

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS), 2014

- **On average, inpatient stays involving OR procedures were longer and more than twice as expensive as stays without OR procedures.**

  In 2014, inpatient stays involving OR procedures averaged 5.1 days in length with an average cost of $18,500, compared with 4.4 days and $7,900 for stays without OR procedures.

- **Compared with inpatient stays without OR procedures, a lower percentage of stays involving OR procedures began in the emergency department or ended with in-hospital death.**

  In 2014, only 27.7 percent of inpatient stays involving OR procedures were admitted from the emergency department, compared with nearly 60 percent of stays without OR procedures.

  The percentage of stays that resulted in in-hospital death was lower among stays that involved OR procedures than stays without OR procedures (1.2 vs. 2.2 percent). Similarly, the percentage of stays transferred to a short-term hospital was lower among stays that involved OR procedures than those that did not (0.8 vs. 2.5 percent).

Table 2 presents select patient characteristics for inpatient stays with and without OR procedures in 2014.

Table 2. Distribution of inpatient stays with and without operating room (OR) procedures, by patient characteristic, 2014

Characteristic	Stays with one or more OR procedures		Stays without any OR procedures	
	Number	%	Number	%
All stays	10,115,800	100.0	25,243,000	100.0
Sex				
Male	4,776,200	47.2	10,319,500	40.9
Female	5,337,900	52.8	14,917,700	59.1
Age, years				
<1[a]	1,136,400	11.2	3,111,400	12.3
1–17	272,100	2.7	1,075,200	4.3
18–44	2,568,100	25.4	6,146,800	24.4
45–64	2,844,000	28.1	5,865,300	23.2
65–84	2,851,200	28.2	6,638,900	26.3
85+	441,100	4.4	2,396,600	9.5
Expected primary payer				
Medicare	3,505,400	34.7	10,289,700	40.8
Medicaid	1,903,500	18.8	6,090,000	24.1
Private insurance	3,970,900	39.3	6,862,100	27.2
Uninsured	375,200	3.7	1,275,200	5.1
Community-level income				
Low (lowest quartile)	2,610,300	25.8	7,634,300	30.2
Not low (upper 3 quartiles)	7,505,500	74.2	17,608,600	69.8
Location of patient residence				
Large central metropolitan	2,861,800	28.3	7,839,700	31.1
Large fringe metropolitan (suburbs)	2,501,800	24.7	5,914,200	23.4
Medium and small metropolitan	3,045,100	30.1	7,344,100	29.1
Micropolitan and noncore (rural)	1,670,300	16.5	4,014,400	15.9

Notes: Number of stays is rounded to the nearest hundred. Percentage is based on unrounded data values. Unspecified, missing, and "other" categories are not reported.

[a] The vast majority of inpatient stays with OR procedures among infants involved male circumcision.

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS), 2014

- **Females accounted for more than half of inpatient stays with and without OR procedures.**

  In 2014, 52.8 percent of hospital stays involving OR procedures were among females, and 47.2 percent of OR-related stays were among males. Females constituted an even larger proportion of inpatient stays that did not involve an OR procedure—59.1 percent.

- **In 2014, the youngest and the oldest age groups accounted for the fewest hospital stays involving OR procedures.**

  Although age distributions were similar among stays with and without OR procedures, the youngest and oldest age groups accounted for a smaller proportion of stays with OR procedures than stays without OR procedures (11.2 vs. 12.3 percent for patients younger than 1 year, 2.7 vs. 4.3 percent for patients aged 1–17 years, and 4.4 vs. 9.5 percent for patients aged 85 years and older). Conversely,

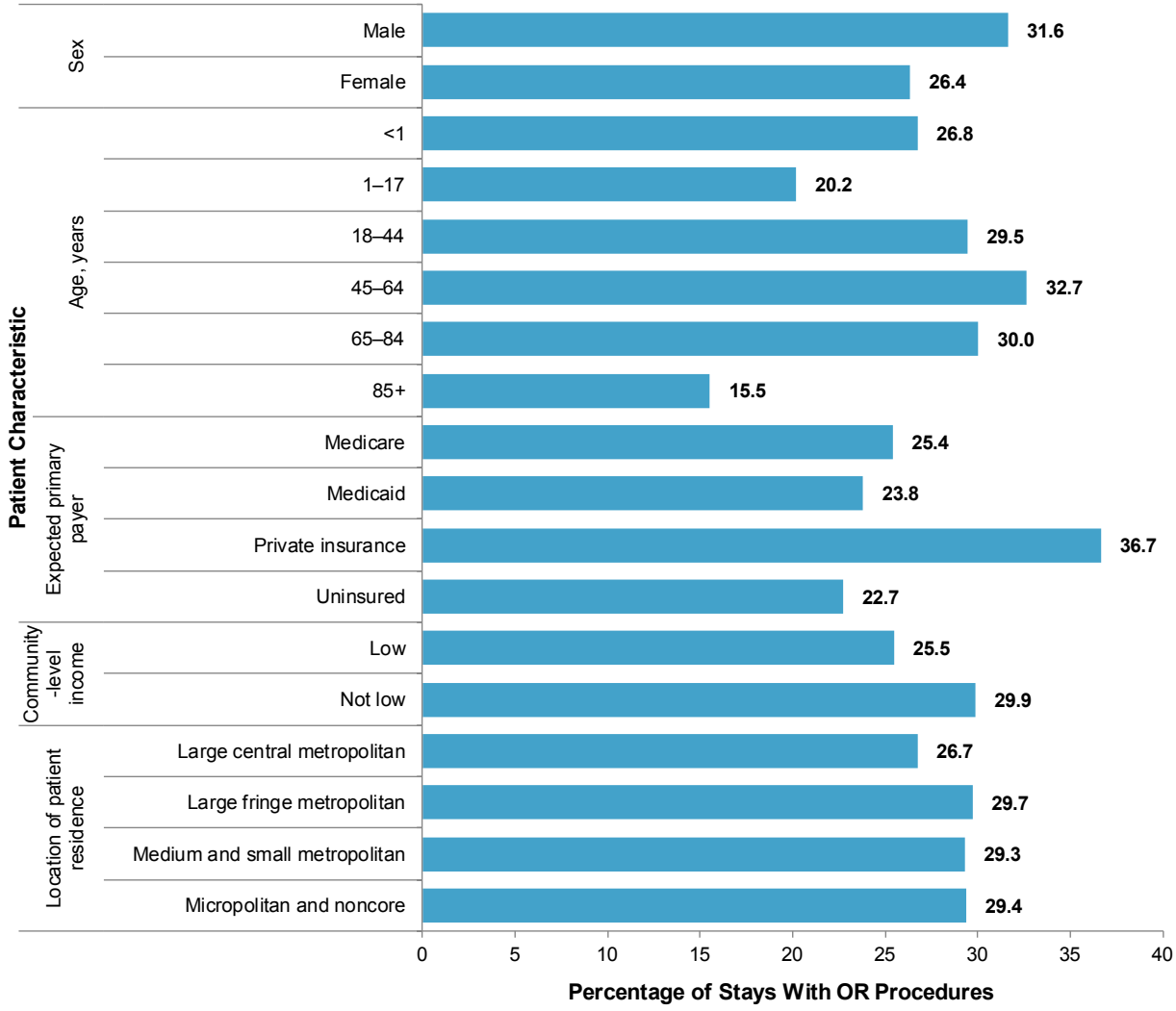
patients aged 45–64 years accounted for a larger proportion of stays with OR procedures (28.1 percent) than stays without OR procedures (23.2 percent).

- **Private insurance and Medicare were the most common expected primary payers for inpatient stays with OR procedures in 2014.**

  Among inpatient stays involving OR procedures, the most common payers were private insurance (39.3 percent of stays with OR procedures) and Medicare (34.7 percent). For stays that did not involve OR procedures, Medicare was the most common payer (40.8 percent of stays) and privately insured stays made up only 27.2 percent.

Figure 2 shows the percentage of inpatient stays that involved OR procedures for select patient subgroups in 2014. Whereas Table 2 shows the distribution of all stays with OR procedures, this figure simply reports the percentage of each patient subgroup that underwent one or more OR procedures.

Figure 2. Percentage of inpatient stays that involved operating room (OR) procedures, by patient characteristic, 2014



Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS), 2014

- **OR procedures were more common during inpatient stays among males than during stays among females.**

  In 2014, 31.6 percent of inpatient stays among males and 26.4 percent of stays among females involved OR procedures.

- **In 2014, nearly one-third of inpatient stays for patients aged 18–84 years involved OR procedures.**

  OR procedures were involved in 29.5 percent of stays for patients aged 18–44 years, 32.7 percent of stays for patients aged 45–64 years, and 30.0 percent of stays for patients aged 65–84 years.

  OR procedures were less common among the youngest and oldest age groups. Only 26.8 percent of inpatient stays for patients younger than 1 year and 20.2 percent of stays for patients aged 1–17 years involved OR procedures. Among inpatients aged 85 years and older, only 15.5 percent of stays involved OR procedures.

- **OR procedures were more common among inpatient stays covered by private insurance than among stays covered by other payers.**

  More than one-third (36.7 percent) of inpatient stays covered by private insurance involved OR procedures, compared with only 25.4 percent of stays for Medicare patients, 23.8 percent of stays for Medicaid patients, and 22.7 percent of stays for uninsured patients.

- **OR procedures were less common among inpatient stays for patients in the lowest income quartile and for patients living in large central metropolitan areas.**

  OR procedures were involved in 25.5 percent of hospital stays for patients in the lowest income quartile compared with 29.9 percent of stays for patients in the upper three income quartiles.

  Approximately 27 percent of inpatient stays for patients living in large central metropolitan areas involved OR procedures, compared with 29 to 30 percent of stays for patients living in less populated areas.

Most frequent and costly types of operating room procedures, 2014

Table 3 presents the number and rate of inpatient stays for the 20 most common all-listed operating room procedures in 2014. Only one occurrence of a procedure type is counted per hospitalization because multiple codes may be used for related procedures performed during a single operation. For example, multiple codes for spinal fusion may appear on the record when multiple vertebrae were fused, but only one procedure is counted in the spinal fusion procedure category total. The unit of analysis for Table 3 is the number of procedures (unlike Table 1, which shows the number of inpatient stays with one or more procedures).

Table 3. Most frequent all-listed operating room (OR) procedures, 2014

Rank	All-listed OR procedure type	Number of OR procedures	Percent of all OR procedures	Rate per 100,000 population
All-listed OR procedures		14,198,900	100.0	4,453.1
1	Cesarean section	1,242,800	8.8	389.8
2	Circumcision	1,075,100	7.6	337.2
3	Arthroplasty of knee	752,900	5.3	236.1
4	Hip replacement, total and partial	522,800	3.7	164.0
5	Percutaneous coronary angioplasty (PTCA)	465,400	3.3	146.0
6	Spinal fusion	463,200	3.3	145.3
7	Laminectomy, excision of intervertebral disc	438,200	3.1	137.4
8	Cholecystectomy and common duct exploration	372,600	2.6	116.9
9	Colorectal resection	302,400	2.5	94.8
10	Treatment, fracture or dislocation of hip and femur	289,800	2.0	90.9
11	Ligation of fallopian tubes	254,500	1.8	79.8
12	Appendectomy	238,800	1.7	74.9
13	Hysterectomy, abdominal and vaginal	237,500	1.7	74.5
14	Coronary artery bypass graft (CABG)	201,600	1.4	63.2
15	Oophorectomy, unilateral and bilateral	182,400	1.3	57.2
16	Treatment, fracture or dislocation of lower extremity (other than hip or femur)	181,900	1.3	57.0
17	Debridement of wound, infection or burn	160,400	1.1	50.3
18	Amputation of lower extremity	146,500	1.0	46.0
19	Heart valve procedures	143,600	1.0	45.0
20	Incision and excision of central nervous system (CNS)	120,800	0.9	37.9
Top 20 OR procedures		**7,793,400**	**54.9**	**2,444.2**

Notes: Number of procedures is rounded to the nearest hundred. Percentage is based on unrounded data values. Procedures are grouped using the Agency for Healthcare Research and Quality (AHRQ) Clinical Classifications Software (CCS). CCS categories identified as "Other" and procedure categories that are nonspecific or likely to be adjuncts to other procedures were not reported. Procedure totals include only one occurrence of a CCS category per hospitalization because multiple codes may be used for related procedures performed during a single operation. The overall number of procedures represents the sum of all CCS category totals. Although some procedures are specific to male or female populations (e.g., Cesarean section and circumcision), the population denominator used to calculate rate includes both sexes.

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), HCUPnet (www.hcupnet.ahrq.gov/)

- **More than 14 million OR procedures were performed during inpatient hospital stays in 2014—a rate of 4,453.1 OR procedures per 100,000 population.**

  Overall, the highest rates were for one of two childbirth- and infant-related procedures—Cesarean section (389.8 per 100,000 population) and male circumcision (337.2 per 100,000 population).

- **The 20 most common OR procedures accounted for more than half of all OR procedures.**

  Six musculoskeletal procedures—knee arthroplasty, hip replacement, spinal fusion, treatment of hip and femur fracture or dislocation, treatment of fracture or dislocation of other lower extremity, and amputation of lower extremity—constituted 16.6 percent of all OR procedures.

  Four obstetric/gynecologic procedures—Cesarean section, ligation of fallopian tubes, hysterectomy, and oophorectomy—together made up 13.5 percent of all OR procedures, whereas male circumcision alone constituted 7.6 percent of all OR procedures.

  Three digestive procedures—cholecystectomy, colorectal resection, and appendectomy—together accounted for 6.4 percent of all OR procedures. Three cardiovascular procedures—percutaneous coronary angioplasty, coronary artery bypass graft, and heart valve procedures—accounted for 5.7 percent.

Table 4 presents the five most common operating room procedures by age group in 2014.

Table 4. Top five most frequent all-listed operating room (OR) procedures by age group, 2014

Rank	OR Procedure	Number of OR procedures	Percent of OR procedures in this age group
Age <1 year		**1,186,700**	**100.0**
1	Circumcision	1,071,200	90.3
2	Inguinal and femoral hernia repair	4,600	0.4
3	Insertion, replacement, or removal of extracranial ventricular shunt	3,400	0.3
4	Colorectal resection	3,000	0.3
5	Small bowel resection	2,800	0.2
Ages 1–17 years		**384,100**	**100.0**
1	Appendectomy	54,400	14.2
2	Cesarean section	13,000	3.4
3	Spinal fusion	12,500	3.2
4	Treatment, fracture or dislocation of hip and femur	12,400	3.2
5	Tonsillectomy and/or adenoidectomy	10,500	2.7
Ages 18–44 years		**3,585,700**	**100.0**
1	Cesarean section	1,225,500	34.2
2	Ligation of fallopian tubes	253,600	7.1
3	Cholecystectomy and common duct exploration	122,800	3.4
4	Hysterectomy, abdominal and vaginal	89,700	2.5
5	Appendectomy	88,800	2.5
Ages 45–64 years		**4,382,700**	**100.0**
1	Arthroplasty of knee	314,800	7.2
2	Spinal fusion	216,500	4.9
3	Percutaneous coronary angioplasty (PTCA)	207,500	4.7
4	Laminectomy, excision of intervertebral disc	199,200	4.5
5	Hip replacement, total and partial	188,000	4.3
Ages 65–84 years		**4,094,500**	**100.0**
1	Arthroplasty of knee	402,500	9.8
2	Hip replacement, total and partial	253,700	6.2
3	Percutaneous coronary angioplasty (PTCA)	205,200	5.0
4	Spinal fusion	155,900	3.8
5	Laminectomy, excision of intervertebral disc	149,000	3.6
Age 85+ years		**561,700**	**100.0**
1	Treatment, fracture or dislocation of hip and femur	85,800	15.3
2	Hip replacement, total and partial	61,700	11.0
3	Percutaneous coronary angioplasty (PTCA)	26,700	4.8
4	Colorectal resection	18,700	3.3
5	Arthroplasty of knee	18,200	3.2

Notes: The number of procedures is rounded to the nearest hundred. Percentage is based on unrounded data values. Procedures are grouped using the Agency for Healthcare Research and Quality (AHRQ) Clinical Classifications Software (CCS). CCS categories identified as "Other" and procedure categories that are nonspecific or likely to be adjuncts to other procedures were not reported. Procedure totals include only one occurrence of a CCS category per hospitalization because multiple codes may be used for related procedures performed during a single operation. The overall number of procedures for each age group represents the sum of all CCS category totals for that age group.

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), HCUPnet (www.hcupnet.ahrq.gov/)

- **Childbirth- and delivery-related procedures and appendectomies were the most common OR procedures among younger patients in 2014.**

  Of all OR procedures performed on patients younger than 1 year, 90.3 percent were male circumcisions. Other procedures among infants demonstrate how infrequently this age group undergoes surgery.

  Appendectomy was the most common OR procedure among patients aged 1–17 years, accounting for 14.2 percent of OR procedures for this age group. Orthopedic procedures and tonsillectomy were also in the top five procedures for children and adolescents. Cesarean section accounted for about 13,000 procedures among adolescents (teen pregnancy).

- **Among the top five procedures for 18–44-year-olds, three are performed only on females.**

  Cesarean section was the most common procedure among 18–44-year-olds, accounting for more than one-third of OR procedures in this age group. Two gynecologic procedures were also among the top five OR procedures for this age group. Among all patients aged 18–44 years, fallopian tube ligation accounted for 7.1 percent and hysterectomy accounted for 2.5 percent of all OR procedures. Cholecystectomy and appendectomy are the only top five procedures in this age group that are performed for both males and females.

- **Musculoskeletal and cardiovascular procedures were most common among older patients in 2014.**

  Knee arthroplasty was the most common OR procedure among older patients, accounting for 7.2 percent of OR procedures among patients aged 45–64 years, 9.8 percent of procedures among patients aged 65–84 years, and 3.2 percent of procedures among patients aged 85 years and older.

  Hip replacement was also one of the top five OR procedures among these three older age groups, accounting for 4–11 percent of OR procedures for patients aged 45 years and older.

  Percutaneous coronary angioplasty was the third most common OR procedure among the three oldest age groups, accounting for approximately 5 percent of OR procedures for patients aged 45 years and older.

Table 5 presents the 20 OR procedures with the highest aggregate costs for the entire hospital stay during which the procedure was the first-listed procedure on the record. Procedures are ranked by aggregate hospital costs. Rankings are based on first-listed procedure to avoid double-counting costs of inpatient stays involving more than one type of OR procedure. (The unit of analysis is the inpatient stay. Numbers of stays vary from all-listed analyses presented earlier because of the focus on first-listed procedures.) Aggregate costs, mean cost per stay, and number of stays are provided.

Table 5. Most costly inpatient stays by first-listed operating room (OR) procedure, 2014

Rank	First-listed OR procedure type	Aggregate costs for stays with a first-listed OR procedure, $ billions	Percent of aggregate costs for all stays with a first-listed OR procedure	Mean cost per stay, $ thousands	Number of inpatient stays
First-listed OR procedures		**163.8**	**100.0**	**17.8**	**9,204,100**
1	Spinal fusion	12.0	7.3	28.9	413,200
2	Arthroplasty of knee	11.8	7.2	16.3	723,100
3	Hip replacement, total and partial	8.3	5.1	17.1	487,600
4	Percutaneous coronary angioplasty (PTCA)	8.1	4.9	21.5	377,500
5	Cesarean section	7.0	4.3	6.1	1,142,700
6	Coronary artery bypass graft (CABG)	6.7	4.1	41.9	160,200
7	Heart valve procedures	5.8	3.5	52.0	111,100
8	Colorectal resection	5.6	3.4	23.7	234,700
9	Treatment, fracture or dislocation of hip and femur	4.3	2.6	17.3	246,100
10	Cholecystectomy and common duct exploration	4.0	2.4	13.3	300,200
11	Incision and excision of central nervous system (CNS)	3.5	2.1	34.6	100,400
12	Insertion, revision, replacement, removal of cardiac pacemaker or cardioverter/defibrillator	2.8	1.7	35.0	79,000
13	Amputation of lower extremity	2.5	1.5	20.8	119,200
14	Treatment, fracture or dislocation of lower extremity (other than hip or femur)	2.4	1.4	16.5	142,400
15	Laminectomy, excision of intervertebral disc	2.3	1.4	14.9	151,700
16	Hysterectomy, abdominal and vaginal	1.9	1.2	10.3	185,000
17	Appendectomy	1.9	1.2	10.7	177,600
18	Circumcision	1.8	1.1	2.0	887,600
19	Debridement of wound, infection or burn	1.7	1.1	17.5	98,400
20	Small bowel resection	1.7	1.1	34.3	50,300
20 most costly first-listed OR procedures		**96.0**	**58.6**	**—**	**6,188,000**

Notes: Number of stays is rounded to the nearest hundred. Percentage is based on unrounded data values. Procedures are grouped using the Agency for Healthcare Research and Quality (AHRQ) Clinical Classifications Software (CCS). CCS categories identified as "Other" are not reported.

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), HCUPnet (www.hcupnet.ahrq.gov/)

- **Inpatient stays for the 20 most costly OR procedures accounted for nearly 60 percent of aggregate costs for all inpatient stays with a first-listed OR procedure.**

  In 2014, there were 9,204,100 inpatient stays with a first-listed OR procedure. The aggregate costs for these stays totaled $163.8 billion. Stays for the 20 most costly OR procedures accounted for 58.6 percent of this total, or $96.0 billion.

- **Inpatient stays for six musculoskeletal procedures accounted for one-quarter of aggregate costs for all stays with a first-listed OR procedure.**

  Six musculoskeletal procedures combined accounted for $41.2 billion in hospital costs, or 25 percent of aggregate costs for stays with a first-listed OR procedure: spinal fusion (7.3 percent of aggregate costs), knee arthroplasty (7.2 percent), hip replacement (5.1 percent), treatment of hip and femur fracture or dislocation (2.6 percent), amputation of lower extremity (1.5 percent), and treatment of fracture or dislocation of other lower extremity (1.4 percent).

  Costs associated with four cardiovascular procedures— percutaneous coronary angioplasty, coronary artery bypass graft, heart valve procedures, and procedures related to pacemakers/defibrillators—constituted about 14 percent of aggregate costs for inpatient stays with a first-listed OR procedure, or $23.4 billion in aggregate hospital costs.

  Four digestive procedures—colorectal resection, cholecystectomy, appendectomy, and small bowel resection—together accounted for roughly 8 percent of aggregate costs associated with a first-listed OR procedure, or $13.2 billion in aggregate costs.

- **Although they were not among the 20 most common all-listed OR procedures, procedures related to pacemakers/defibrillators and small bowel resection were among the 20 most expensive OR procedures in 2014.**

  Procedures related to pacemakers/defibrillators and small bowel resection were less common than other costly procedures. Still, these procedures were associated with high aggregate costs because of their relatively high mean costs per stay—$35,000 for procedures related to pacemakers/defibrillators and $34,300 for small bowel resection. Among the 20 most expensive OR procedures overall, the only procedures with higher or equivalent average hospital costs were heart valve procedures (mean cost, $52,000), coronary artery bypass graft ($41,900), and incision and excision of the central nervous system ($34,600).

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) 2014 National Inpatient Sample (NIS). Some of the statistics were generated from HCUPnet, a free, online query system that provides users with *immediate access* to the largest set of publicly available, all-payer national, regional, and State-level hospital care databases from HCUP.[8] Supplemental sources included population denominator data for use with HCUP databases, derived from information available from the U.S. Census Bureau.[9]

Definitions

Procedures, ICD-9-CM, Clinical Classifications Software (CCS), diagnosis-related groups (DRGs)
All-listed procedures include all procedures performed during the hospital stay, whether for definitive treatment or for diagnostic or exploratory purposes. The *first-listed procedure* is the procedure that is listed first on the discharge record. Inpatient data define this as the *principal procedure*—the procedure that is performed for definitive treatment rather than for diagnostic or exploratory purposes (i.e., the procedure that was necessary to take care of a complication).

ICD-9-CM is the International Classification of Diseases, Ninth Revision, Clinical Modification, which assigns numeric codes to procedures. There are approximately 4,000 ICD-9-CM procedure codes.

CCS categorizes ICD-9-CM procedure codes into a manageable number of clinically meaningful categories.[10] This clinical grouper makes it easier to quickly understand patterns of procedure use. CCS categories identified as Other typically are not reported; these categories include miscellaneous, otherwise unclassifiable procedures that may be difficult to interpret as a group. In this report, procedure categories that are nonspecific or likely to be adjuncts to other procedures (e.g., excision, lysis peritoneal adhesions; partial bone excision; intraoperative cholangiogram) are not included in the listings of specific procedure rankings. Only one occurrence of a CCS category is counted per hospitalization because multiple codes may be used for related procedures performed during a single operation. For example, multiple codes for spinal fusion may appear on the record when multiple vertebrae were fused, but only one code is counted in the spinal fusion CCS category total.

Major operating room (OR) procedures were defined using procedure classes, which categorize each ICD-9-CM procedure code as either major therapeutic, major diagnostic, minor therapeutic, or minor diagnostic.[11] If at least one major diagnostic or major therapeutic procedure was on a hospital record, the hospital stay was classified as involving a major OR procedure. Major OR procedures are considered to be valid OR procedures based on diagnosis-related groups (DRGs). This classification scheme relies upon physician panels that classify ICD-9-CM procedure codes according to whether the procedure would be performed in a hospital operating room in most hospitals.

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[8] Agency for Healthcare Research and Quality. HCUPnet Web site. www.hcupnet.ahrq.gov/. Accessed January 31, 2017.
[9] Barrett M, McCarty J, Coffey R, Levit K. Population Denominator Data for Use with the HCUP Databases (Updated with 2015 Population Data). HCUP Methods Series Report #2016-04. September 29, 2016. U.S. Agency for Healthcare Research and Quality. www.hcup-us.ahrq.gov/reports/methods/2016-04.pdf. Accessed January 31, 2017.
[10] Agency for Healthcare Research and Quality. HCUP Clinical Classifications Software (CCS) for ICD-9-CM. Healthcare Cost and Utilization Project (HCUP). Rockville, MD: Agency for Healthcare Research and Quality. Updated October 2016. www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp. Accessed January 31, 2017.
[11] HCUP Procedure Classes. Healthcare Cost and Utilization Project (HCUP). U.S. Agency for Healthcare Research and Quality. Rockville, MD. Updated September 2015. www.hcup-us.ahrq.gov/toolssoftware/procedure/procedure.jsp. Accessed September 26, 2017.

Types of hospitals included in the HCUP National (Nationwide) Inpatient Sample
The National (Nationwide) Inpatient Sample (NIS) is based on 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). The NIS includes obstetrics and gynecology, otolaryngology, orthopedic, cancer, pediatric, public, and academic medical hospitals. Excluded are long-term care facilities such as rehabilitation, psychiatric, and alcoholism and chemical dependency hospitals. Beginning in 2012, long-term acute care hospitals are also excluded. 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 will be included in the NIS.

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.

Costs and charges
Total hospital charges were converted to costs using HCUP Cost-to-Charge Ratios based on hospital accounting reports from the Centers for Medicare & Medicaid Services (CMS).[12] *Costs* reflect the actual expenses incurred in the production of hospital services, such as wages, supplies, and utility costs; *charges* represent the amount a hospital billed for the case. For each hospital, a hospital-wide cost-to-charge ratio is used. Hospital charges reflect the amount the hospital billed for the entire hospital stay and do not include professional (physician) fees. For the purposes of this Statistical Brief, costs are reported to the nearest hundred.

As reported in this Statistical Brief, mean cost per day represents the weighted average of cost per day at the discharge level, which is calculated as total cost of stay divided by length of stay. When length of stay was 0 days (same-day discharge), cost per day was set equal to total cost of stay.

How HCUP estimates of costs differ from National Health Expenditure Accounts
There are a number of differences between the costs cited in this Statistical Brief and spending as measured in the National Health Expenditure Accounts (NHEA), which are produced annually by CMS.[13] The largest source of difference comes from the HCUP coverage of inpatient treatment only in contrast to the NHEA inclusion of outpatient costs associated with emergency departments and other hospital-based outpatient clinics and departments as well. The outpatient portion of hospitals' activities has been growing steadily and may exceed half of all hospital revenue in recent years. On the basis of the American Hospital Association Annual Survey, 2012 outpatient gross revenues (or charges) were about 44 percent of total hospital gross revenues.[14]

Smaller sources of differences come from the inclusion in the NHEA of hospitals that are excluded from HCUP. These include Federal hospitals (Department of Defense, Veterans Administration, Indian Health Services, and Department of Justice [prison] hospitals) as well as psychiatric, substance abuse, and long-term care hospitals. A third source of difference lies in the HCUP reliance on billed charges from hospitals to payers, adjusted to provide estimates of costs using hospital-wide cost-to-charge ratios, in contrast to the NHEA measurement of spending or revenue. HCUP costs estimate the amount of money required to produce hospital services, including expenses for wages, salaries, and benefits paid to staff as well as utilities, maintenance, and other similar expenses required to run a hospital. NHEA spending or revenue measures the amount of income received by the hospital for treatment and other services provided, including payments by insurers, patients, or government programs. The difference between revenues and costs include profit for for-profit hospitals or surpluses for nonprofit hospitals.

[12] Agency for Healthcare Research and Quality. HCUP Cost-to-Charge Ratio (CCR) Files. Healthcare Cost and Utilization Project (HCUP). 2001–2014. Rockville, MD: Agency for Healthcare Research and Quality. Updated November 2016. www.hcup-us.ahrq.gov/db/state/costtocharge.jsp. Accessed January 31, 2017.
[13] For additional information about the NHEA, see Centers for Medicare & Medicaid Services (CMS). National Health Expenditure Data. CMS Web site May 2014. www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/index.html?redirect=/NationalHealthExpendData/. Accessed January 31, 2017.
[14] American Hospital Association. TrendWatch Chartbook, 2014. Table 4.2. Distribution of Inpatient vs. Outpatient Revenues, 1992–2012. www.aha.org/research/reports/tw/chartbook/2014/table4-2.pdf. Accessed January 31, 2017.

Location of patients' residence
Place of residence is based on the urban-rural classification scheme for U.S. counties developed by the National Center for Health Statistics (NCHS):

- Large Central Metropolitan: includes metropolitan areas with 1 million or more residents
- Large Fringe Metropolitan: includes counties of metropolitan areas with 1 million or more residents
- Medium and Small Metropolitan: includes areas with 50,000 to 999,999 residents
- Micropolitan and Noncore: includes nonmetropolitan counties (i.e., counties with no town greater than 50,000 residents).

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 the total U.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.[15] The value ranges for the income quartiles vary by year. Patients in the first quartile are designated as having *low* income, and patients in the upper three quartiles are designated as having *not low* income. The income quartile is missing for patients who are homeless or foreign.

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.

Admission source or point of origin
Admission source (now known as the patient's point of origin) indicates where the patient was located prior to admission to the hospital. Emergency admission indicates that the patient was admitted to the hospital through the emergency department.

Discharge status
Discharge status reflects the disposition of the patient at discharge from the hospital and includes the following five categories: discharged to self-care (routine discharge to home) or home health care; transferred to a short-term hospital; transferred to other type of facility (including skilled nursing facility, intermediate care, and another type of facility such as a nursing home); died in hospital, and other (including alive/destination unknown, against medical advice (AMA), and missing).

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

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 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 NIS

The HCUP National (Nationwide) Inpatient Sample (NIS) is a nationwide database of hospital inpatient stays. The NIS is nationally representative of all community hospitals (i.e., short-term, non-Federal, nonrehabilitation hospitals). The NIS includes all payers. It is drawn from a sampling frame that contains hospitals comprising more than 95 percent of all discharges in the United States. The vast size of the NIS allows the study of topics at the national and regional levels for specific subgroups of patients. In addition, NIS data are standardized across years to facilitate ease of use. Over time, the sampling frame for the NIS has changed; thus, the number of States contributing to the NIS varies from year to year. The NIS is intended for national estimates only; no State-level estimates can be produced.

The 2012 NIS was redesigned to optimize national estimates. The redesign incorporates two critical changes:

- Revisions to the sample design—starting with 2012, the NIS is now a *sample of discharge records from all HCUP-participating hospitals*, rather than a sample of hospitals from which all discharges were retained (as is the case for NIS years before 2012).

- Revisions to how hospitals are defined—the NIS now uses the *definition of hospitals and discharges supplied by the statewide data organizations* that contribute to HCUP, rather than the definitions used by the American Hospital Association (AHA) Annual Survey of Hospitals.

The new sampling strategy is expected to result in more precise estimates than those that resulted from the previous NIS design by reducing sampling error: for many estimates, confidence intervals under the new design are about half the length of confidence intervals under the previous design. The change in sample design for 2012 necessitates recomputation of prior years' NIS data to enable analyses of trends that use the same definitions of discharges and hospitals.

About HCUPnet

HCUPnet (www.hcupnet.ahrq.gov/) is an online query system that offers instant access to the largest set of all-payer health care databases that are publicly available. HCUPnet has an easy step-by-step query system that creates tables and graphs of national and regional statistics as well as data trends for community hospitals in the United States. HCUPnet generates statistics using data from HCUP's National (Nationwide) Inpatient Sample (NIS), the Kids' Inpatient Database (KID), the Nationwide Emergency Department Sample (NEDS), the Nationwide Readmissions Database (NRD), the State Inpatient Databases (SID), and the State Emergency Department Databases (SEDD).

For More Information

For other information on procedures and treatments**,** refer to the HCUP Statistical Briefs located at www.hcup-us.ahrq.gov/reports/statbriefs/sb_procedures.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 National (Nationwide) Inpatient Sample (NIS), please refer to the following database documentation:

Agency for Healthcare Research and Quality. Overview of the National (Nationwide) Inpatient Sample (NIS). Healthcare Cost and Utilization Project (HCUP). Rockville, MD: Agency for Healthcare Research and Quality. Updated December 2016. www.hcup-us.ahrq.gov/nisoverview.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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