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Acute Renal Failure Hospitalizations, 2005–2014

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Introduction

Acute renal failure or acute kidney injury is defined as an abrupt decrease in kidney function to the point that the body accumulates waste products and becomes unable to maintain electrolyte, acid-base, and water balance.[1] It can occur when there is impaired blood flow to the kidneys, damage to the kidneys, or urine blockage in the kidneys.[2] It is an increasingly common complication among patients hospitalized for acute illness.[3] It has been associated with increased long-term risk of poor outcomes, including reduced health-related quality of life, increased incidence of chronic kidney disease, accelerated progression to end-stage renal disease, and mortality.[3,4,5] These poor outcomes result in greater utilization of health care resources and increased health care costs.[3,4]

In 2014, acute renal failure was in the top 20 most frequent primary reasons for hospitalization.[6] Among the most common reasons for inpatient stays, acute renal failure had the largest increase in the population rate of stays (346 percent) between 1997 and 2011.[7] In 2013, acute renal failure was one of the 20 most expensive conditions billed to Medicare.[8]

This Healthcare Cost and Utilization Project (HCUP) Statistical Brief presents data on hospital inpatient stays with a diagnosis of acute renal failure from 2005 to 2014. The 10-year trend in stays involving acute renal failure diagnosis is provided. We also

Highlights

- In 2014, hospital stays with a principal diagnosis of acute renal failure accounted for 1.4 percent of all hospitalizations; 10.5 percent of all hospitalizations had an all-listed diagnosis of acute renal failure.
- The rate of inpatient stays with a secondary diagnosis of acute renal failure increased nearly threefold from 2005 to 2014 (from 350.2 to 1,011.5 stays per 100,000 population).
- Medicare accounted for 69.4 percent of the 504,600 stays with a principal diagnosis of acute renal failure and 68.6 percent of the $4.6 billion in aggregate costs associated with those stays in 2014.
- Between 2005 and 2014, the rate of stays with a principal diagnosis of acute renal failure increased the most among patients aged 18–44 and 45–64 years, as well as among those living in the lowest income areas. Patients living in the South and Midwest had the highest rate of stays for acute renal failure in 2005 and 2014.
- Septicemia was the most frequent principal diagnosis and blood transfusion was the most common procedure among stays with an all-listed acute renal failure diagnosis in 2014.
- Overall, the average cost of hospital stays involving acute renal failure was nearly double the cost of stays without renal failure.

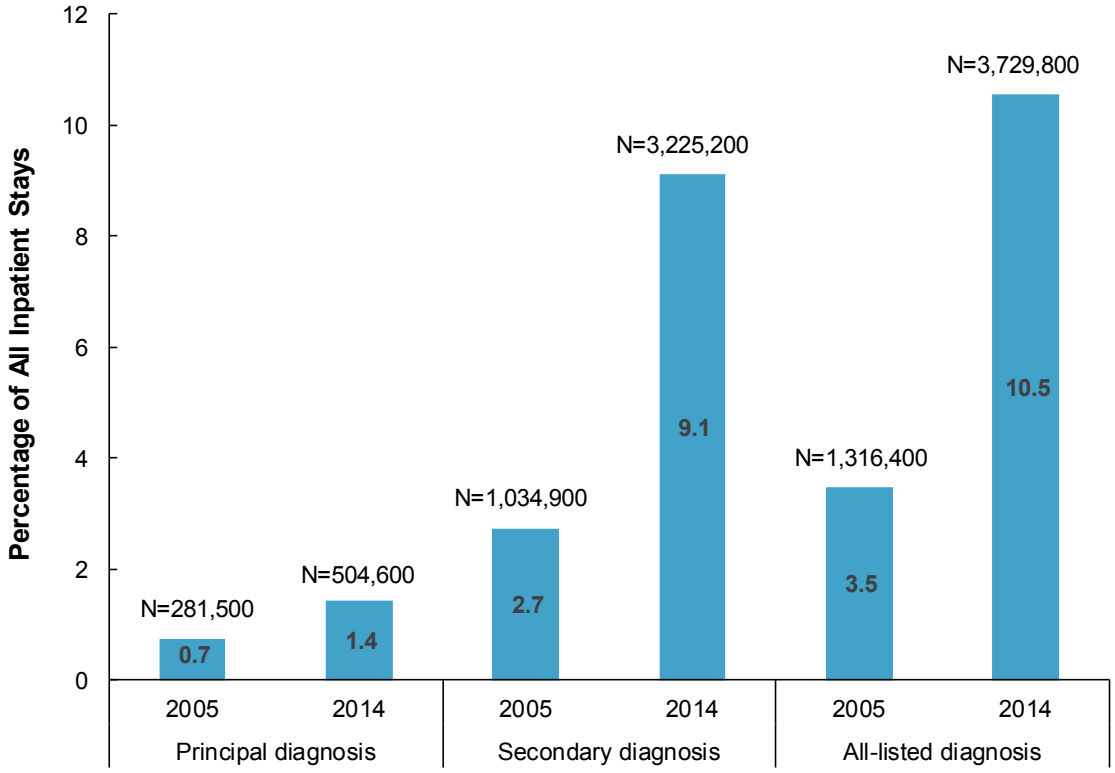
[1] Makris K, Spanou L. Acute kidney injury: definition, pathophysiology and clinical phenotypes. Clinical Biochemist Reviews. 2016;37(2):85–98.
[2] Mayo Clinic. Diseases and conditions: acute kidney failure. www.mayoclinic.org/diseases-conditions/kidney-failure/basics/causes/con-20024029. Accessed July 31, 2017.
[3] Koza Y. Acute kidney injury: current concepts and new insights. Journal of Injury and Violence Research. 2016;8(1):58–62.
[4] Rewa O, Bagshaw SM. Acute kidney injury: epidemiology, outcomes and economics. Nature Reviews Nephrology. 2014;10:193–207.
[5] Mehta RL, Cerdá J, Burdmann EA, Tonelli M, Garcia-Garcia G, Jha V, et al. International Society of Nephrology's 0by25 initiative for acute kidney injury (zero preventable deaths by 2025): a human rights case for nephrology. The Lancet. 2015;385(9987):2616–2643.
[6] HCUPnet. Healthcare Cost and Utilization Project (HCUP). 2014. Agency for Healthcare Research and Quality, Rockville, MD. www.hcupnet.ahrq.gov/. Accessed August 8, 2017.
[7] Pfuntner A, Wier LM, Stocks C. Most Frequent Conditions in U.S. Hospitals, 2011. HCUP Statistical Brief #162. September 2013. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/reports/statbriefs/sb162.pdf.
[8] Torio CM, Moore BJ. National Inpatient Hospital Costs: The Most Expensive Conditions by Payer, 2013. HCUP Statistical Brief #204. May 2016. Agency for Healthcare Research and Quality, Rockville, MD.

present rates of stays with a diagnosis of acute renal failure per 100,000 population by patient characteristics in both 2005 and 2014. The distribution of stays and costs by payer in 2014 are presented. We present statistics for the most frequent principal diagnoses and all-listed procedures during stays with an all-listed diagnosis of acute renal failure. Finally, we compare the mean cost per stay by principal diagnosis for stays with and without an all-listed acute renal failure diagnosis.

Findings

Trends in inpatient stays for acute renal failure, 2005–2014
Figure 1 presents the number of inpatient stays with a diagnosis of acute renal failure and the percentage of all inpatient stays in 2005 and 2014.

Figure 1. Number and percentage of inpatient stays with a diagnosis of acute renal failure, 2005 and 2014



Notes: Diagnoses were identified using the Clinical Classifications Software (CCS). Number of stays are rounded to the nearest 100.

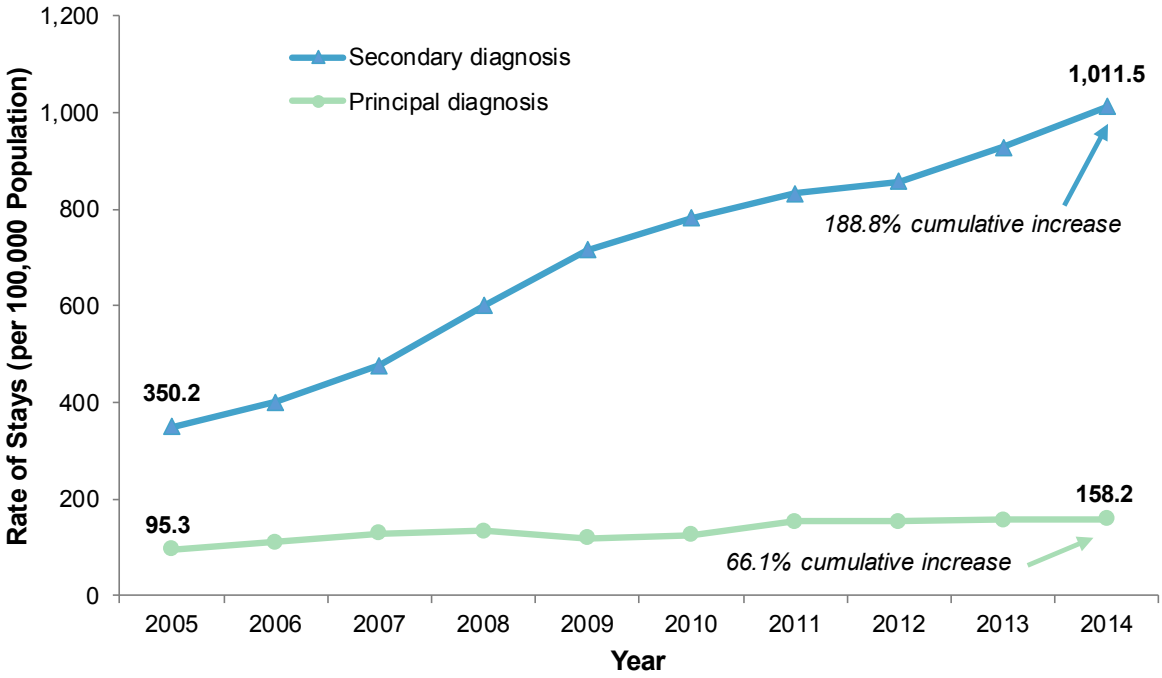
Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), National (Nationwide) Inpatient Sample (NIS), 2005 and 2014

- **From 2005 to 2014, stays involving acute renal failure increased as a percentage of all hospital stays.**

  The number of hospital stays involving a principal diagnosis of acute renal failure increased by a factor of 1.8 from 2005 to 2014, from 281,500 to 504,600 stays. Similarly, the number of stays with acute renal failure listed as a secondary diagnosis increased 3.1 times, from 1.0 million to 3.2 million stays. Overall, the percentage of all hospital stays that involved any diagnosis of acute renal failure (principal or secondary) increased from 3.5 percent of stays in 2005 to 10.5 percent of stays in 2014.

Figure 2 presents the rate of inpatient stays with a diagnosis of acute renal failure per 100,000 population from 2005 through 2014, thus accounting for changes in the size of the U.S. population.

Figure 2. Population rate of inpatient stays with a diagnosis of acute renal failure, 2005–2014



Note: Diagnoses were identified using the Clinical Classifications Software (CCS).

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), National (Nationwide) Inpatient Sample (NIS), 2005–2014

- **From 2005 to 2014, the population rate of inpatient stays with a diagnosis of acute renal failure increased 188.8 percent for secondary diagnoses and 66.1 percent for principal diagnoses.**

  The rate of inpatient stays with a secondary diagnosis of acute renal failure increased 188.8 percent, nearly tripling from 2005 to 2014 (from 350.2 to 1,011.5 stays per 100,000 population). During the same period, the rate of inpatient stays with a principal diagnosis of acute renal failure increased 66.1 percent, from 95.3 stays per 100,000 population in 2005 to 158.2 stays per 100,000 population in 2014.

Characteristics of hospital inpatient stays with acute renal failure, 2005 and 2014
Table 1 presents the rate of inpatient stays with either a principal diagnosis or an all-listed diagnosis of acute renal failure by select patient characteristics in both 2005 and 2014, along with the percent change in the rate of stays between those years. All-listed diagnoses include records with a principal diagnosis of acute renal failure as well as those in which acute renal failure is listed as a secondary diagnosis.

Table 1. Rate of inpatient stays with an acute renal failure diagnosis per 100,000 population, by select characteristics, 2005 and 2014

Characteristic	Principal diagnosis			All-listed diagnoses		
	2005	2014	Percent change	2005	2014	Percent change
Age group, years						
<1	3.8	4.7	22.8	123.3	159.2	29.1
0–17	2.6	2.9	8.2	13.1	22.1	68.8
18–44	19.6	33.2	69.6	94.2	263.5	179.7
45–64	91.9	164.4	78.9	448.6	1,269.7	183.0
65–84	430.8	580.5	34.7	2,002.2	4,238.6	111.7
85+	1,121.8	1,525.4	36.0	4,870.4	10,449.9	114.6
Sex						
Male	97.8	162.6	66.2	475.0	1,270.3	167.4
Female	92.7	154.0	66.0	416.8	1,072.0	157.2
Community-level income						
Low (first quartile)	111.6	207.5	86.0	516.5	1,469.2	184.4
Not low (upper three quartiles)	87.4	138.8	58.9	410.0	1,047.7	155.5
Region						
Northeast	99.9	156.9	57.0	474.2	1,176.3	148.1
Midwest	96.0	172.0	79.1	440.7	1,270.5	188.3
South	109.5	182.2	66.4	493.1	1,276.0	158.8
West	68.2	108.6	59.3	351.5	904.9	157.4

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), National (Nationwide) Inpatient Sample (NIS), 2005 and 2014

- **Patients aged 85 years and older had the highest rate of stays with acute renal failure, but those aged 18–44 and 45–64 years had the fastest increase in rate.**

  The rate of inpatient stays with acute renal failure was consistently highest among patients aged 85 years or older, for both principal and all-listed diagnoses in both 2005 and 2014. For example, there were over 10,000 stays among patients aged 85 years or older with an all-listed acute renal failure diagnosis per 100,000 population in 2014. This means that there was one hospital stay involving acute renal failure for every 10 people aged 85 years or older.

  Although the rate of stays increased for all age groups, the largest increases were seen among patients aged 18–44 years (69.6 percent increase in principal diagnosis and 179.7 percent increase in all-listed diagnoses) and those aged 45–64 years (78.9 percent increase in principal diagnosis and 183.0 percent increase in all-listed diagnoses). In other words, among 18–65-year-olds, hospital stays involving an all-listed diagnosis of renal failure nearly tripled over this 10-year time period.

- **Males had a higher rate of stays with all-listed acute renal failure diagnoses than females but had a similar increase in rate.**

  The rate of stays with an all-listed diagnosis of acute renal failure was higher among males than among females (e.g., 2014: 1270.3 vs. 1072.0 stays per 100,000 population). However, the percentage increase from 2005 to 2014 was similar for both sexes. Moreover, the rate of stays with a principal diagnosis of acute renal failure in 2005 and 2014 and the 10-year percentage increase was similar for males and females.

- **Patients living in low income areas had a higher rate of stays with acute renal failure, and their rate increased faster than that of patients living in higher income areas.**

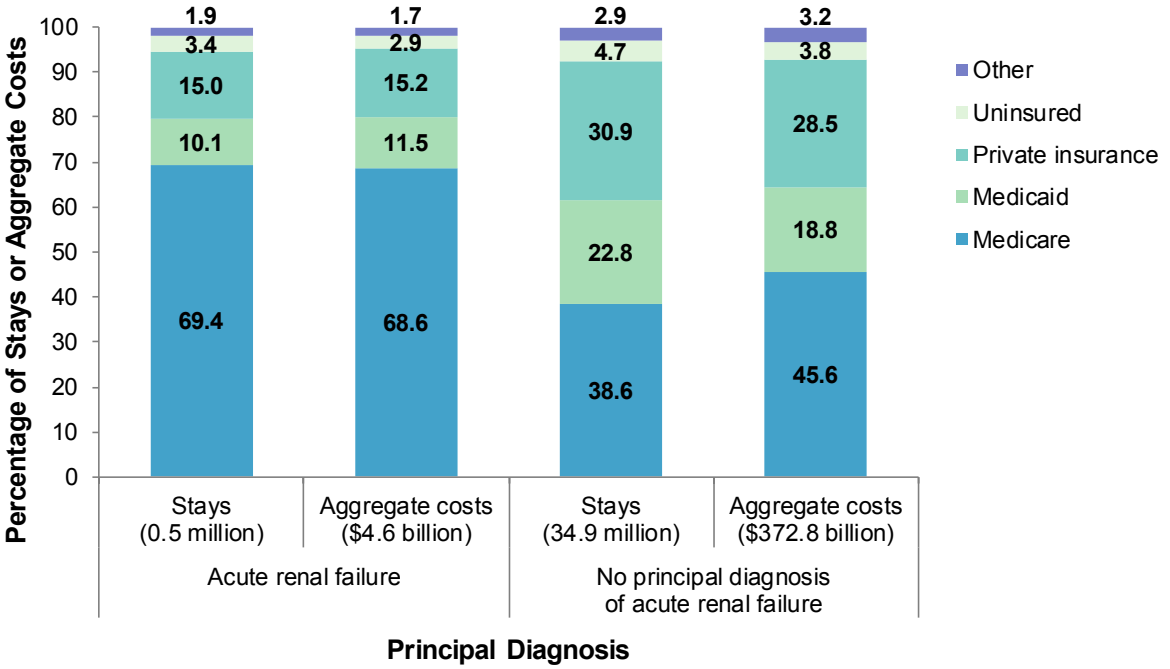
  In both 2005 and 2014, the rate of inpatient stays with a principal diagnosis of acute renal failure was higher among patients living in low income ZIP Codes (i.e., the lowest income quartile) compared with those living in higher income areas (e.g., 2014: 207.5 vs. 138.8 stays per 100,000 population). Across the 10 years, the rate of stays with acute renal failure as a principal diagnosis increased faster among patients living in lower income than in higher income areas (86.0 vs. 58.9 percent). The same pattern occurred for inpatient stays with an all-listed diagnosis of acute renal failure.

- **Patients living in the Midwest and South had the highest rate of stays with acute renal failure, and patients living in the Midwest had the fastest rate of increase in the rate from 2005 to 2014.**

  The rate of stays for acute renal failure was higher in the Midwest and South than in the other regions (e.g., 2014 principal acute renal failure diagnoses: Northeast 156.9 per 100,000 population; Midwest, 172.0; South 182.2; West, 108.6). Between 2005 and 2014, the rate of stays with acute renal failure increased more in the Midwest than in the other regions (e.g., a 79.1 percent increase in the Midwest for acute renal failure as a principal diagnosis).

Figure 3 presents the distribution of stays and aggregate costs by expected primary payer among hospital inpatient stays with a principal diagnosis of acute renal failure compared with stays without a principal diagnosis for acute renal failure in 2014.

Figure 3. Distribution of stays and aggregate costs by expected payer for stays with and without a principal acute renal failure diagnosis, 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

- **In 2014, stays principally for acute renal failure accounted for 1.4 percent of all hospital inpatient stays and 1.2 percent of aggregate hospital costs.**

  A total of 0.5 million inpatient stays involved a principal diagnosis of acute renal failure in 2014 (1.4 percent of all hospital stays). These stays accounted for $4.6 billion in aggregate costs—1.2 percent of all hospital costs during 2014.

- **Medicare accounted for a greater proportion of stays and aggregate costs among stays for acute renal failure compared with stays without a principal diagnosis of acute renal failure.**

  Patients with primary Medicare coverage accounted for over two-thirds of the stays for acute renal failure (69.4 percent) and over two-thirds of the costs (68.6 percent) in 2014. Among all stays with a principal diagnosis of acute renal failure, 64.7 percent are among patients aged 65 years or older (data not shown). Medicare accounted for only 38.6 percent of hospital stays and 45.6 percent of aggregate hospital costs for stays without a principal diagnosis of acute renal failure.

  Private insurance was the second most common payer of stays for acute renal failure, accounting for 15.0 percent of stays and 15.2 percent of aggregate costs. Private insurance also accounted for the second largest proportion of stays without an acute renal failure principal diagnosis, but that proportion was much larger: 30.9 percent of stays and 28.5 percent of aggregate costs.

Most frequent diagnoses and procedures associated with acute renal failure inpatient stays, 2005 and 2014

Table 2 presents the principal diagnoses most frequently listed for hospital inpatient stays with an all-listed diagnosis of acute renal failure in 2005 and 2014. The percentage of total all-listed acute renal failure stays with each principal diagnosis and the average cost per stay are also presented for both years. Diagnoses are ordered by their ranking in 2014.

Table 2. Most frequent principal diagnoses for inpatient stays with an all-listed acute renal failure diagnosis, 2005 and 2014

CCS principal diagnosis category	2005			2014			Percent change in number of stays
	Rank	Number of stays	Total acute renal failure stays, %	Rank	Number of stays	Total acute renal failure stays, %	
Septicemia	2	126,600	9.6	1	590,800	15.8	366.7
Acute and unspecified renal failure	1	281,500	21.4	2	504,600	13.5	79.3
Congestive heart failure; nonhypertensive	3	91,200	6.9	3	230,700	6.2	153.0
Diabetes mellitus with complications	7	32,000	2.4	4	129,400	3.5	304.4
Pneumonia	4	56,900	4.3	5	113,600	3.0	99.6
Acute myocardial infarction	5	54,200	4.1	6	105,300	2.8	94.3
Complication of device; implant or graft	8	27,200	2.1	7	90,800	2.4	233.8
Respiratory failure; insufficiency; arrest	6	42,400	3.2	8	88,200	2.4	108.0
Urinary tract infections	—	—	—	9	77,100	2.1	n/a
Cardiac dysrhythmias	—	—	—	10	76,500	2.1	n/a
Fluid and electrolyte disorders	9	26,100	2.0	—	—	—	n/a
Coronary atherosclerosis and other heart disease	10	24,300	1.8	—	—	—	n/a
Total in top 10	—	762,400	57.9	—	2,007,000	53.8	163.2
Total for all stays	—	1,316,400	100.0	—	3,729,800	100.0	183.3

Abbreviations: CCS, Clinical Classifications Software; n/a, not applicable

Notes: Diagnoses were identified using the Clinical Classifications Software (CCS). Number of stays are rounded to the nearest 100.

Source: Agency for Healthcare Research and Quality (AHRQ), Center for Delivery, Organization, and Markets, Healthcare Cost and Utilization Project (HCUP), National (Nationwide) Inpatient Sample (NIS), 2005 and 2014

- **Septicemia was the most frequent principal diagnosis for stays with an all-listed acute renal failure diagnosis in 2014.**

  Acute renal failure was a secondary diagnosis for 590,800 hospital stays with a principal diagnosis of septicemia in 2014, an increase of 366.7 percent from 2005 (126,600 stays). Septicemia moved from the second-ranked to first-ranked principal diagnosis associated with stays involving acute renal failure.

  For 504,600 stays with any mention of acute renal failure, acute renal failure appeared as the most frequent principal diagnosis in 2014—the second ranked condition for this population. Of the 3.7 million stays with an all-listed diagnosis of acute renal failure in 2014, acute renal failure was the principal diagnosis for 13.5 percent (504,600 stays) in 2014.

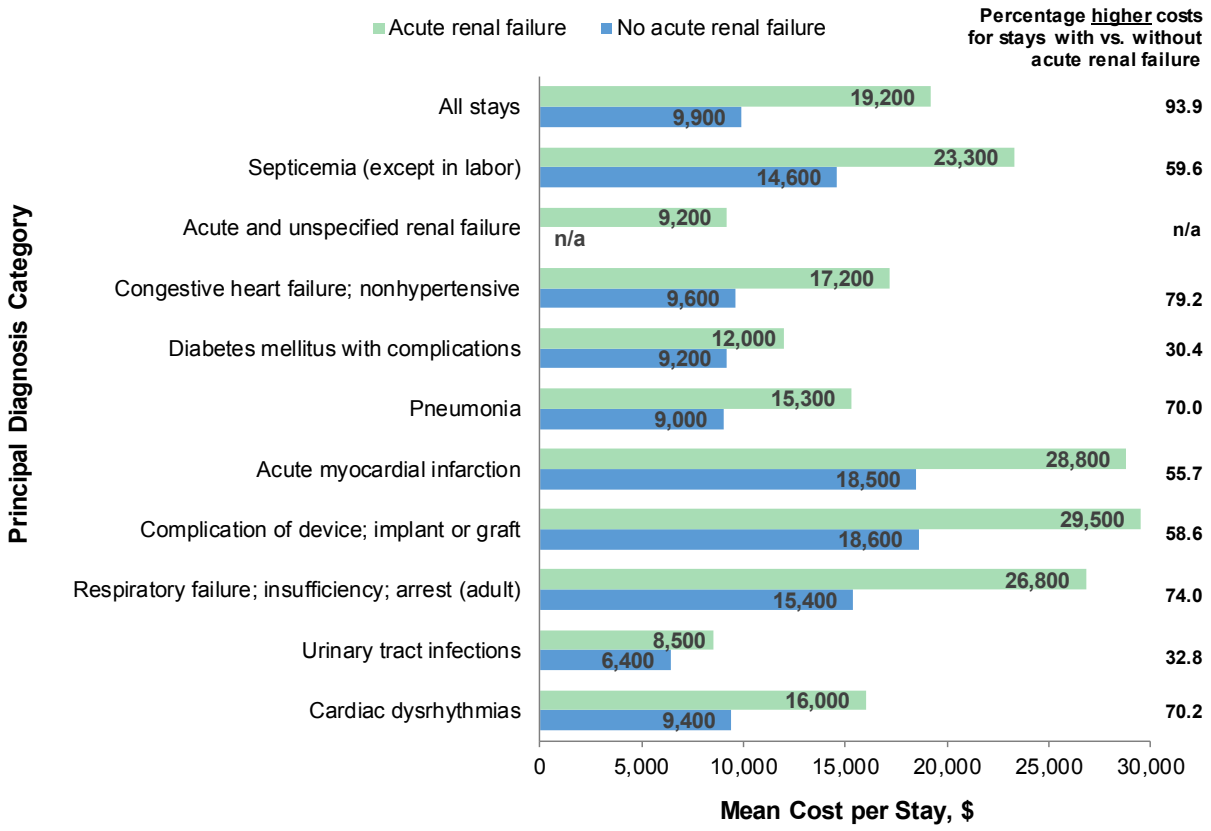
  Congestive heart failure was the third most common principal diagnosis among stays with a secondary diagnosis of acute renal failure, accounting for 230,700 stays.

- **Among patients with an all-listed diagnosis of acute renal failure in 2014, the top 10 principal diagnoses accounted for over half of the 3.7 million stays.**

  The top 10 most frequent principal diagnoses among patients with acute renal failure accounted for over half of all stays with acute renal failure (57.9 percent in 2005 and 53.8 percent in 2014). The principal diagnoses in the top 10 included both acute and chronic conditions, for example, four heart conditions (congestive heart failure, acute myocardial infarction, dysrhythmias, and coronary atherosclerosis) and two infections (pneumonia and urinary tract infections).

Figure 4 presents the relative costs of hospital stays with acute renal failure compared with stays without renal failure in 2014. The conditions examined here are the top 10 conditions for which acute renal failure appears on the list of diagnoses (taken from Table 2).

Figure 4. Mean costs per hospital stay for stays with and without an all-listed acute renal failure diagnosis, by principal diagnosis, 2014



Abbreviation: n/a, not applicable

Notes: Diagnoses were identified using the Clinical Classifications Software (CCS). Mean cost per stay is rounded to the nearest $100.

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

- **Mean hospital costs per stay were higher in 2014 when the stay included a diagnosis of acute renal failure.**

  Overall in 2014, the average cost for a hospital stay that involved a diagnosis of acute renal failure ($19,200) was nearly twice as high as for stays that did not involve acute renal failure ($9,900).

  Across principal diagnoses, the average cost for stays was consistently higher when acute renal failure was a secondary diagnosis than for stays without any mention of acute renal failure (range: 30.4 to 79.2 percent higher).

  Among stays with acute renal failure as a principal diagnosis, the average hospital cost was $9,200.

- **In 2014, complication of device, implant or graft and acute myocardial infarction were among the most costly stays involving a secondary acute renal failure diagnosis.**

  In 2014, the average cost for a stay with a principal diagnosis of complication of device, implant or graft was $29,500 when acute renal failure was also present but only $18,600 without acute renal failure. The average cost for a stay with a principal diagnosis of acute myocardial infarction stays

was $28,800 with acute renal failure and $18,500 without. This pattern was consistent across all conditions.

Table 3 presents all-listed procedures that occurred most frequently during hospital inpatient stays with any acute renal failure diagnosis in 2014. The percentage of all-listed acute renal failure stays with a procedure is also presented. For comparison, the table also shows the percentage of inpatient stays with these procedures among all patients.

Table 3. Most frequent all-listed procedures for inpatient stays with an acute renal failure diagnosis, 2014

CCS all-listed procedure category	Rank	Number of stays	Total acute renal failure stays with this procedure, %	All stays with this procedure, %
Blood transfusion	1	586,100	26.0	6.4
Respiratory intubation and mechanical ventilation	2	556,700	24.7	5.0
Upper gastrointestinal endoscopy; biopsy	3	212,100	9.4	3.1
Hemodialysis	4	186,800	8.3	2.3
Diagnostic ultrasound of heart (echocardiogram)	5	178,900	7.9	2.4
Diagnostic cardiac catheterization; coronary arteriography	6	167,700	7.4	3.1
Incision of pleura; thoracentesis; chest drainage	7	117,300	5.2	1.3
Enteral and parenteral nutrition	8	113,800	5.1	1.5
Diagnostic bronchoscopy and biopsy of bronchus	9	96,400	4.3	1.1
Abdominal paracentesis	10	89,100	4.0	0.8

Abbreviations: CCS, Clinical Classifications Software

Notes: Procedures are identified using the Clinical Classifications Software (CCS) based on all-listed procedures. Not all inpatient stays include a procedure. A single hospitalization could contribute to more than one row in the table if more than one procedure occurred during the inpatient stay. Number of stays are rounded to the nearest 100.

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

- **Blood transfusion was the most frequent procedure among stays with an all-listed acute renal failure diagnosis in 2014.**

  In 2014, more than one-quarter of hospital stays with acute renal failure involved blood transfusions, compared with 6.4 percent of all stays.

- **Respiratory intubation and mechanical ventilation, and upper gastrointestinal endoscopy were among the most frequent procedures performed during stays with an all-listed diagnosis of acute renal failure in 2014.**

  Nearly a quarter of inpatient stays involving acute renal failure involved mechanical ventilation in 2014 (compared with 5.0 percent of all stays), and 9.4 percent included upper gastrointestinal endoscopy (compared with 3.1 percent of all stays). For all remaining procedures on this top 10 list, acute renal failure patients had considerably higher rates than all stays.

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). Historical data were drawn from the 2005–2013 National (Nationwide) Inpatient Sample (NIS). Supplemental sources included population denominator data for use with HCUP databases, derived from information available from the U.S. Census Bureau[9] and Claritas, a vendor that compiles and adds values to data from the U.S. Census Bureau.[10]

Definitions

Diagnoses, procedures, ICD-9-CM, and Clinical Classifications Software (CCS)
The *principal diagnosis* is that condition established after study to be chiefly responsible for the patient's admission to the hospital. *Secondary diagnoses* are concomitant conditions that coexist at the time of admission or develop during the stay. *All-listed diagnoses* include the principal diagnosis plus these additional secondary conditions.

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 diagnoses and procedures. There are approximately 14,000 ICD-9-CM diagnosis codes and 4,000 ICD-9-CM procedure codes.

CCS categorizes ICD-9-CM diagnosis codes and procedure codes into a manageable number of clinically meaningful categories.[11] This clinical grouper makes it easier to quickly understand patterns of diagnoses and procedure use. CCS categories identified as Other typically are not reported; these categories include miscellaneous, otherwise unclassifiable diagnoses and procedures that may be difficult to interpret as a group.

Case definition
For this report, acute renal failure diagnoses were defined as CCS diagnosis category 157, acute and unspecified renal failure. Diagnoses of chronic renal failure were excluded. CCS 157 includes ICD-9-CM codes 584.5 (acute kidney failure with lesion of tubular necrosis), 584.6 (acute renal failure with lesion of renal cortical necrosis), 584.7 (acute renal failure with lesion of renal medullary [papillary] necrosis), 584.8 (acute renal failure with other specified pathological lesion in kidney), 584.9 (acute renal failure, unspecified), and 586 (renal failure, unspecified).

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[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 July 5, 2017.
[10] Claritas. Claritas Demographic Profile. www.claritas.com. Accessed June 23, 2017.
[11] 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.

The Centers for Medicare & Medicaid Services (CMS) implemented Medicare Severity Diagnosis Related Groups (MS-DRGs) in fiscal year 2008. The change to MS-DRGs included a major overhaul to the complications and comorbidity (CC) system to revise which ICD-9-CM codes qualified for CC and major CC status. We conducted several alternate analyses to examine whether this change in CMS rules affected the number of hospital inpatient stays with a secondary diagnosis of acute renal failure. There was no sudden increase in the number of acute kidney disease stays with the shift to MS-DRGs—the trend followed the same pattern of increase before and after 2008. We did not observe notable differences in the pattern of our results when the analysis focused only on discharges for patients aged 18–64 years. Medicare covers costs for end stage renal disease for patients of all ages, but acute kidney disease would not fall under Medicare reimbursement for patients aged 65 years or younger.

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.

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

[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.

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.

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] 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.

Region
Region is one of the four regions defined by the U.S. Census Bureau:

- Northeast: Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania
- Midwest: Ohio, Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, and Kansas
- South: Delaware, Maryland, District of Columbia, Virginia, West Virginia, North Carolina, South Carolina, Georgia, Florida, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Louisiana, Oklahoma, and Texas
- West: Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah, Nevada, Washington, Oregon, California, Alaska, and 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

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

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.

For More Information

For other information on urinary and renal conditions, refer to the HCUP Statistical Briefs located at www.hcup-us.ahrq.gov/reports/statbriefs/sb_urinary.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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