

STATISTICAL BRIEF #236

February 2018

Inpatient Stays Involving Atrial Fibrillation, 1998–2014

*Elisabeth Kato, M.D., M.R.P., Quyen Ngo-Metzger, M.D., M.P.H.,
Kathryn R. Fingar, Ph.D., M.P.H., Kimberly W. McDermott, Ph.D.,
and Anne Elixhauser, Ph.D.*

Introduction

Atrial fibrillation, an abnormal heart rhythm or “arrhythmia” in which the upper chambers of the heart contract irregularly and inefficiently, affects 2.7–6.1 million Americans and is the most common type of heart arrhythmia.¹ Atrial fibrillation occurs when underlying heart disease (such as ischemic heart disease, valvular heart disease, cardiomyopathy, or heart failure) damages the tissue of the atria and disrupts its ability to contract regularly. Symptoms include palpitations (fluttering sensation in the chest), dizziness, shortness of breath, syncope (fainting), and fatigue. However not all people with atrial fibrillation have symptoms, and some may be unaware that they have an arrhythmia.

Atrial fibrillation is strongly associated with increasing age (affecting 0.2 percent of people under 55 years of age but 10 percent of those over 85 years old),² obesity, and diabetes.³ These risk factors are becoming increasingly relevant in the United States, where the population is aging,⁴ the obesity epidemic is growing,⁵ and the prevalence of diabetes is rising.⁶ Other risk factors include hypertension, previous cardiothoracic surgery, smoking, prior stroke, sleep apnea, alcohol and drug use, and hyperthyroidism.

¹ Centers for Disease Control and Prevention. Atrial Fibrillation Fact Sheet. Updated August 22, 2017. www.cdc.gov/dhdsdp/data_statistics/fact_sheets/fs_atrial_fibrillation.htm. Accessed September 28, 2017.

² Go AS, Hylek EM, Phillips KA, Chang Y, Henault LE, Selby JV, et al. Prevalence of diagnosed atrial fibrillation in adults: national implications for rhythm management and stroke prevention: the AnTicoagulation and Risk Factors in Atrial Fibrillation (ATRIA) Study. *JAMA*. 2001;285(18):2370–5.

³ Centers for Disease Control and Prevention, 2017. Op. cit.

⁴ Ortman JM, Velkoff VA, Hogan H. An Aging Nation: The Older Population in the United States. May 2014. U.S. Census Bureau. www.census.gov/prod/2014pubs/p25-1140.pdf. Accessed November 20, 2017.

⁵ Ogden CL, Carroll MD, Fryar CD, Flegal KM. Prevalence of Obesity Among Adults and Youth: United States, 2011–2014. NCHS Data Brief #219. November 2015. Centers for Disease Control and Prevention. www.cdc.gov/nchs/data/databriefs/db219.pdf. Accessed November 20, 2017.

⁶ Centers for Disease Control and Prevention, Division of Diabetes Translation. Long-term Trends in Diabetes. April 2017. www.cdc.gov/diabetes/statistics/slides/long_term_trends.pdf. Accessed November 20, 2017.

Highlights

- Inpatient stays with atrial fibrillation increased 34.7 percent from 1998 through 2014, but the increase in recent years reflects an aging population. The age-adjusted rate increased by 20.7 percent between 1998 and 2006 (1,170 vs. 1,411 per 100,000 adults) but was largely stable after 2006.
- Although the rate of stays with atrial fibrillation stabilized for inpatients aged 65+ years after 2006, it has continued to climb for younger adults (up 21.9 percent for patients aged 45–64 years and up 10.1 percent for those aged 18–44 years.)
- In 2014, the rate of inpatient stays with atrial fibrillation was highest among adults aged 85 years or older (16,309 per 100,000 adults) and patients who lived in areas with community-level income in the two lowest quartiles (1,662–1,681 per 100,000 adults) and rural areas (2,053 per 100,000 adults).
- In 1998, one in five stays with ischemic stroke also included a diagnosis of atrial fibrillation. By 2014, that number had increased to one in four stays.
- Among every adult age group, atrial fibrillation-associated stroke constituted a greater share of stroke cases in 2014 than in 1998. For example, in 2014, nearly half of stays (46.2 percent) with ischemic stroke among adults aged 85+ years involved atrial fibrillation, compared with 31.1 percent in 1998.

The prevalence of atrial fibrillation has been increasing over the past few decades and is expected to continue to increase in coming years. This may be due to the increasing prevalence of some risk factors for atrial fibrillation (e.g., older age, obesity, and diabetes), although the prevalence of other risk factors is declining.⁷

Atrial fibrillation tends to progress over time, causing worsening symptoms and exacerbating heart failure. Atrial fibrillation also is an important cause of ischemic stroke. Without anticoagulation treatment, patients with atrial fibrillation have an approximately five-fold increased risk of stroke, and the strokes tend to be severe. Approximately one-third of patients with atrial fibrillation who experience a stroke die within the year, and up to 30 percent of survivors are permanently disabled.⁸ However for approximately 20 percent of patients who have a stroke associated with atrial fibrillation, the stroke is the first sign that they have atrial fibrillation.^{9,10,11}

Treatment of atrial fibrillation has two components: managing the arrhythmia and preventing stroke. The arrhythmia can be managed through either controlling the heart rate to minimize symptoms (usually through medication) or putting the heart back into a normal rhythm. Methods for restoring normal rhythm include electrical or pharmacologic cardioversion and surgical or catheter ablation. There is some evidence that selected patients may be able to reverse atrial fibrillation through lifestyle changes that address the underlying causes of atrial fibrillation.¹² For patients with atrial fibrillation whose stroke risk is high, the risk can be reduced through anticoagulation medications: originally warfarin, but more recently nonvitamin K antagonist oral anticoagulation drugs have become available. For nonpharmacologic approaches, a left atrial appendage closure device can also be used.¹³

Atrial fibrillation places a substantial burden on the U.S. health care system. A study of Medicare patients found that patients with atrial fibrillation were much more likely to be hospitalized (37.5 percent vs. 17.5 percent) and much more likely to die during hospitalization (2.1 percent vs. 0.1 percent) than were similar patients without atrial fibrillation.¹⁴ Hospital costs were \$8,705 higher for patients with atrial fibrillation than for those without.¹⁵ This pattern of higher hospitalization costs has also been documented for younger patients with atrial fibrillation.¹⁶

This Healthcare Cost and Utilization Project (HCUP) Statistical Brief presents data on inpatient stays involving atrial fibrillation among adults from 1998 through 2014. First, age-related trends in inpatient stays involving atrial fibrillation are examined. Second, sociodemographic and clinical characteristics of inpatient stays involving atrial fibrillation among adults are presented. Common diagnoses and procedures for these stays are shown. Additionally, hospital stays involving atrial fibrillation as a co-occurring condition alongside ischemic stroke are examined within subgroups of patients. Differences of 10 percent or greater are noted in the text.

⁷ Mozaffarian D, Benjamin EJ, Go AS, Arnett DK, Blaha MJ, Cushman M, et al. Heart disease and stroke statistics—2015 update: a report from the American Heart Association. *Circulation*. 2015;131:e29–e322.

⁸ Menke J, Luthje L, Kastrup A, Larsen J. Thromboembolism in atrial fibrillation. *American Journal of Cardiology*. 2010;105(4):502–10.

⁹ Wolf PA, Kannel WB, McGee DL, Meeks SL, Bharucha NE, McNamara PM. Duration of atrial fibrillation and imminence of stroke: the Framingham study. *Stroke*. 1983;14(5):664–7.

¹⁰ Lin HJ, Wolf PA, Benjamin EJ, Belanger AJ, D'Agostino RB. Newly diagnosed atrial fibrillation and acute stroke: the Framingham Study. *Stroke*. 1995;26(9):1527–30.

¹¹ Hannon N, Sheehan O, Kelly L, Marnane M, Merwick A, Moore A, et al. Stroke associated with atrial fibrillation—incidence and early outcomes in the north Dublin population stroke study. *Cerebrovascular Disease*. 2010;29(1):43–9.

¹² Pathak RK, Elliott A, Middeldorp ME, Meredith M, Mehta AB, Mahajan R, et al. Impact of CARDIOrespiratory FITness on arrhythmia recurrence in obese individuals with atrial fibrillation: the CARDIO-FIT Study. *Journal of the American College of Cardiology*. 2015;66(9):985–96.

¹³ Akin I, Nienaber CA. Left atrial appendage occlusion: a better alternative to anticoagulation?. *World Journal of Cardiology*. 2017 Feb 26;9(2):139–46.

¹⁴ Kim MH, Johnston SS, Chu BC, Dalal MR, Schulman KL. Estimation of total incremental health care costs in patients with atrial fibrillation in the United States. *Circulation: Cardiovascular Quality and Outcomes*. 2011;4:313–20.

¹⁵ *Ibid*.

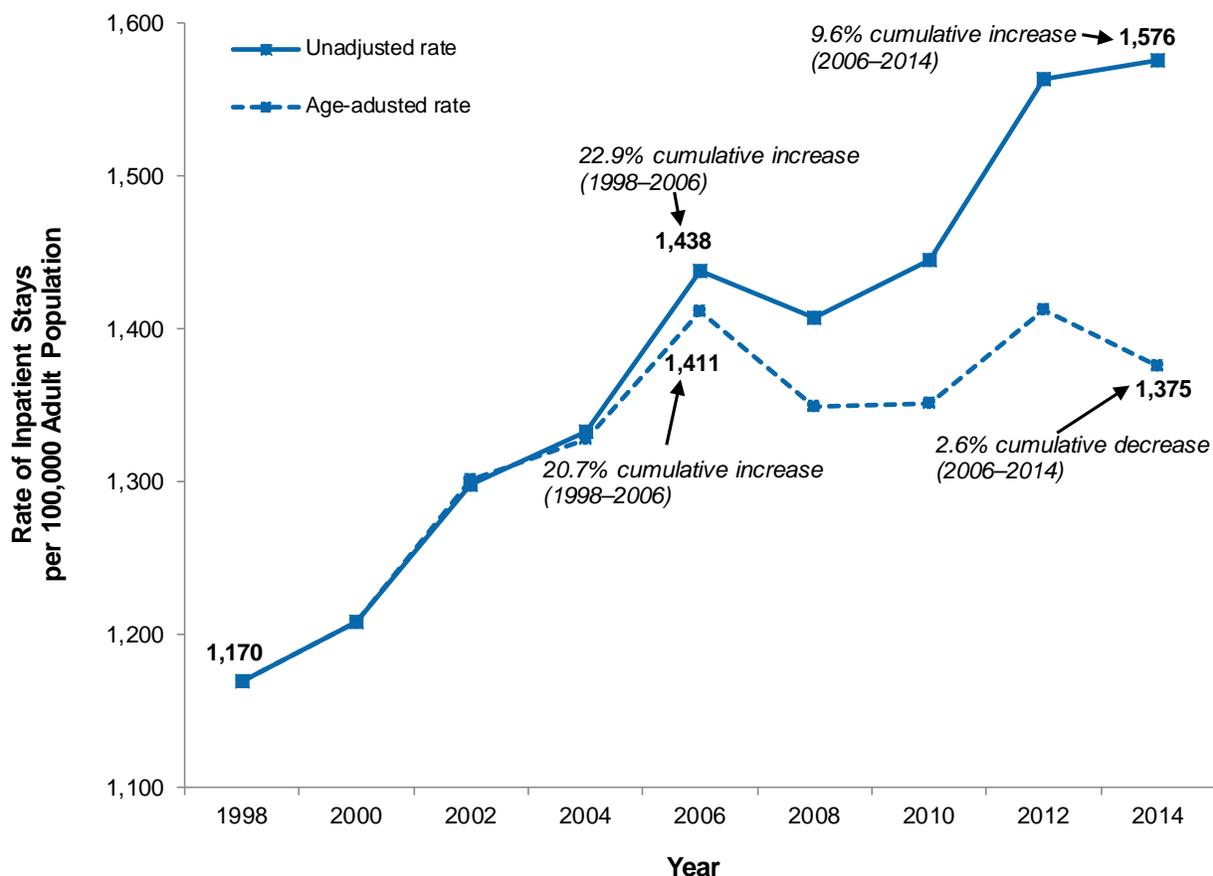
¹⁶ Wang G, Joo H, Tong X, George M. Hospital costs associated with atrial fibrillation for patients with ischemic stroke aged 18–64 years in the United States. *Stroke*. 2015;46:1314–20.

Findings

Age-related trends in inpatient stays involving atrial fibrillation, 1998–2014

Figure 1 displays trends in the unadjusted and age-adjusted population rates of inpatient stays involving any diagnosis (all-listed, principal or secondary) of atrial fibrillation from 1998 through 2014 per 100,000 adults aged 18 years or older.

Figure 1. Population rates of inpatient stays involving atrial fibrillation among adults, unadjusted and adjusted for age, 1998–2014



Notes: Rates are based on all-listed diagnosis of atrial fibrillation. Age adjustment was performed using direct standardization with the 1998 age distribution as the reference population.

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), 1998–2014

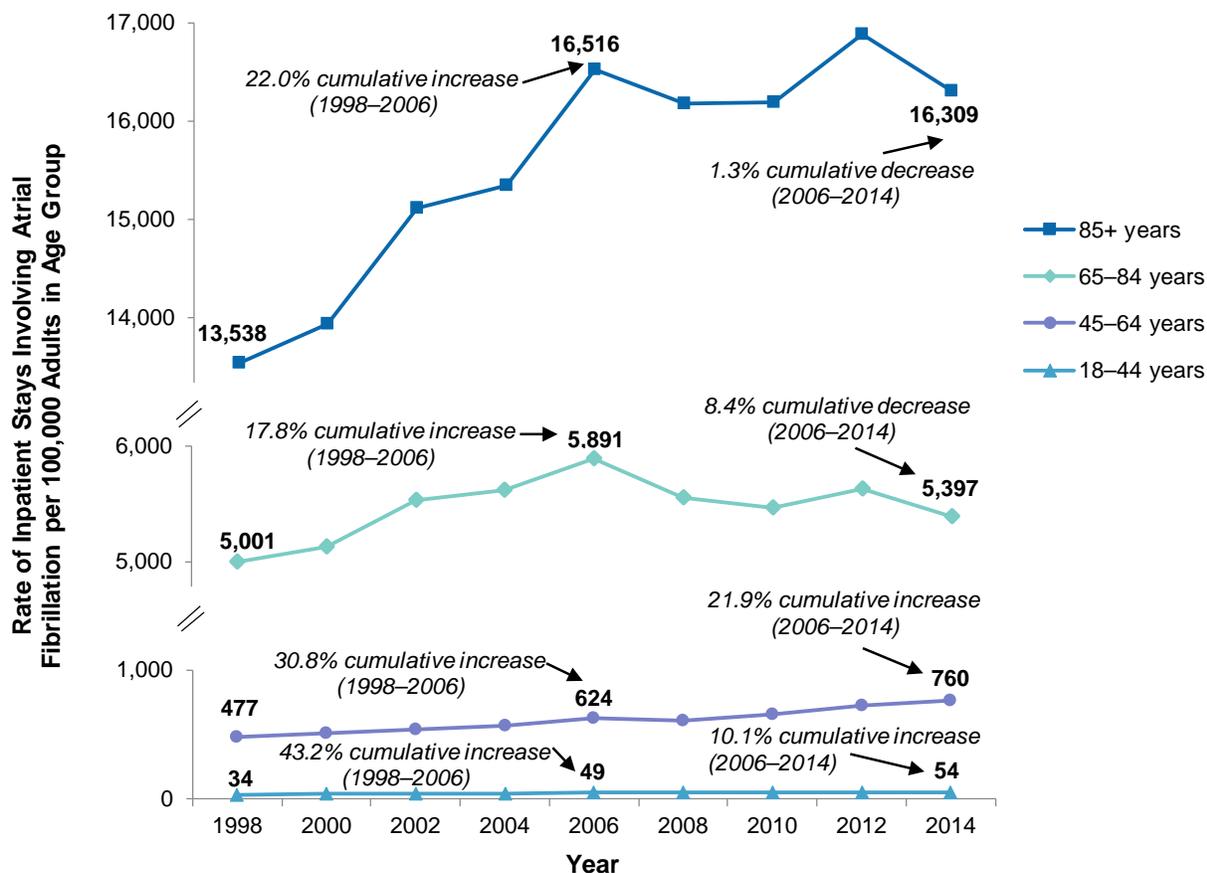
- **Inpatient stays with atrial fibrillation increased steadily from 1998 through 2014, although the age-adjusted rate remained largely stable after 2006.**

The unadjusted rate of inpatient stays involving atrial fibrillation increased 34.7 percent between 1998 and 2014, from 1,170 to 1,576 per 100,000 adults. However, the age-adjusted rate of inpatient stays involving atrial fibrillation (which controls for the aging population) increased by only 17.6 percent between 1998 and 2014. Specifically, the age-adjusted rate increased 20.7 percent between 1998 and 2006 (from 1,170 to 1,411 per 100,000 adults) and after that remained relatively stable, fluctuating between 1,349 and 1,412 per 100,000 adults between 2006 and 2014.

In comparison, the unadjusted rates of inpatient stays for three other cardiovascular disease categories—coronary atherosclerosis, acute myocardial infarction, and acute cerebrovascular disease—decreased by 7.8 percent, 18.3 percent, and 16.6 percent, respectively, from 1998 through 2014 (data not shown).

Figure 2 displays trends in the population rate of inpatient stays involving all-listed diagnosis of atrial fibrillation from 1998 through 2014 per 100,000 adults aged 18 years or older, by age group.

Figure 2. Population rate of inpatient stays involving atrial fibrillation among adults, by age group, with cumulative changes from 1998 to 2006 and from 2006 to 2014



Notes: Rates are based on all-listed diagnosis of atrial fibrillation. Cumulative changes are calculated using nonrounded rates.

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), 1998–2014

- **The population rate of inpatient stays involving atrial fibrillation was 3 times higher for adults aged 85 years or older compared with adults aged 65–84 years.**

Overall, the population rate of inpatient stays with atrial fibrillation was higher with increasing patient age. For example, the rate was 16,309 per 100,000 adults aged 85 years or older in 2014—more than 3 times higher than the rate for adults in the next oldest age group at 5,397 per 100,000 adults aged 65–84 years.

- **Between 1998 and 2006, the rate of stays with atrial fibrillation increased. However, after 2006, the rate stabilized for adults aged 65 years or older, yet continued to climb for younger adults.**

The rate of inpatient stays involving atrial fibrillation generally increased steadily from 1998 through 2014 among younger adults—increasing by 57.7 percent from 34 to 54 per 100,000 adults aged 18–44 years and increasing by 59.5 percent from 477 to 760 per 100,000 adults aged 45–64 years. Among older adults there was a much smaller cumulative change in rate across the 16-year time period. The rate remained relatively stable among adults aged 65–84 years (at 5,001 per 100,000 in 1998 and 5,397 per 100,000 in 2014) and increased 20.5 percent among adults aged 85 years and older (from 13,538 to 16,309 per 100,000).

The largest increase in rate among younger adults occurred between 1998 and 2006, increasing by 43.2 percent among adults aged 18–44 years and by 30.8 percent among adults aged 45–64 years. In comparison, the percentage increase in rate was smaller for older adults from 1998 through 2006—increasing by only 17.8 percent for adults aged 65–84 years (from 5,001 to 5,891 per 100,000) and by 22.0 percent for adults aged 85 years and older (from 13,538 to 16,516 per 100,000).

Although the rates of inpatient stays involving atrial fibrillation in the two older age groups remained relatively stable or decreased from 2006 through 2014, the rates increased for the two younger age groups. From 2006 to 2014, for patients aged 45–64 years, the rate of stays for atrial fibrillation increased by 21.9 percent and for those aged 18–44 years, the rate of stays increased by 10.1 percent.

Characteristics, common diagnoses, and common procedures associated with adult inpatient stays involving atrial fibrillation, 2014

Table 1 presents the number and rate of inpatient stays among adults aged 18 years or older with all-listed diagnosis of atrial fibrillation by select patient and hospital characteristics in 2014.

Table 1. Characteristics of adult inpatient stays with atrial fibrillation, 2014

Characteristic	Number	Rate per 100,000 adult population	Characteristic	Number	Rate per 100,000 adult population
Total	3,865,447	1,590	Community-level income, quartile		
Age group, years			First (poorest)	986,156	1,662
18–44	62,130	54	Second	1,074,315	1,681
45–64	635,265	757	Third	912,185	1,526
65–84	2,163,051	5,520	Fourth (wealthiest)	823,466	1,370
85+	1,005,001	16,830	Location of patient residence		
Sex			Large metropolitan	1,979,942	1,485
Male	1,985,726	1,679	Small metropolitan	1,179,376	1,595
Female	1,879,361	1,505	Micropolitan	394,854	1,866
Race/ethnicity			Rural	301,065	2,053
White	3,026,277	1,903	Hospital region		
Black	307,765	1,080	Northeast	794,615	1,807
Hispanic	195,195	524	Midwest	952,399	1,840
Asian/Pacific Islander	66,425	523	South	1,453,682	1,601
Other	88,015	1,542	West	664,750	1,175

Note: Number and rate are based on all-listed diagnosis of atrial fibrillation.

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

- **The rate of inpatient stays involving atrial fibrillation was highest for males, Whites, and patients residing in the Northeast and Midwest.**

The rate of stays involving atrial fibrillation was higher for males than for females (1,679 vs. 1,505 per 100,000 population) and higher for Whites than for any other race/ethnicity (1,903 per 100,000 population for Whites vs. 523–1,542 per 100,000 population for all other races/ethnicities).

The rate of stays for atrial fibrillation was highest in the Northeast and Midwest (1,807 and 1,840 per 100,000 population, respectively), followed by the South (1,601) and West (1,175).

- **The rate of inpatient stays involving atrial fibrillation increased with age, rurality, and lower community-level income.**

In 2014, the population rate of stays involving atrial fibrillation was more than 3 times as high among adults aged 85 years or older compared with adults aged 65–84 years (16,830 vs. 5,520 per 100,000 population).

Patients who resided in the poorest areas (quartiles 1 and 2) had the highest rates of stays involving atrial fibrillation (1,662 and 1,681 per 100,000 population), followed by those in income quartile 3 (1,526 per 100,000) and those from the wealthiest areas (quartile 4, 1,370 per 100,000).

Patients who resided in rural areas had a higher rate of stays involving atrial fibrillation (2,053 per 100,000 population) compared with those from micropolitan areas (1,866 per 100,000) and small and large metropolitan areas (1,595 and 1,485 per 100,000 population, respectively).

Table 2 presents the top 10 most common diagnoses among stays involving atrial fibrillation, subdivided into stays with atrial fibrillation as the principal reason for the stay versus a secondary diagnosis.

Table 2. Common diagnoses among adult inpatient stays involving atrial fibrillation, 2014

Diagnosis ^a	Rank	Number	%
Secondary diagnosis among stays with a principal diagnosis of atrial fibrillation		398,890	100.0
Coronary atherosclerosis and other heart disease	1	249,190	62.5
Congestive heart failure	2	231,855	58.1
Essential hypertension	3	227,290	57.0
Disorders of lipid metabolism	4	204,345	51.2
Screening and history of mental health and substance abuse	5	124,005	31.1
Cardiac dysrhythmias	6	118,355	29.7
Fluid and electrolyte disorders	7	114,665	28.7
Heart valve disorders	8	106,565	26.7
Diabetes mellitus without complication	9	94,510	23.7
Esophageal disorders	10	83,780	21.0
Principal diagnosis among stays with a secondary diagnosis of atrial fibrillation		3,466,556	100.0
Congestive heart failure	1	378,325	10.9
Septicemia	2	295,170	8.5
Pneumonia	3	157,010	4.5
Acute cerebrovascular disease	4	138,980	4.0
Acute myocardial infarction	5	108,185	3.1
Chronic obstructive pulmonary disease	6	99,070	2.9
Cardiac dysrhythmias	7	96,625	2.8
Acute and unspecified renal failure	8	93,945	2.7
Complication of device; implant or graft	9	83,430	2.4
Respiratory failure; insufficiency; arrest	10	82,775	2.4

Notes: Diagnoses are grouped according to AHRQ's Clinical Classifications Software (CCS). Categories for residual codes and "other" categories that group a heterogeneous set of codes are not shown.

^a The diagnoses shown correspond to all-listed secondary diagnoses among stays with a principal diagnosis of atrial fibrillation, or the principal co-occurring diagnosis among stays with a secondary diagnosis of atrial fibrillation.

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

- **Atrial fibrillation was more often listed as a secondary than as a principal diagnosis.**

In 2014 among 3,865,447 inpatient stays with any diagnosis of atrial fibrillation, 398,890 stays had atrial fibrillation listed as the principal reason for the inpatient stay (10.3 percent). The remaining stays were for another principal reason, and atrial fibrillation was listed as a co-occurring condition.

- **Among inpatient stays with a principal diagnosis of atrial fibrillation, more than half had co-occurring cardiovascular conditions or disorders of lipid metabolism.**

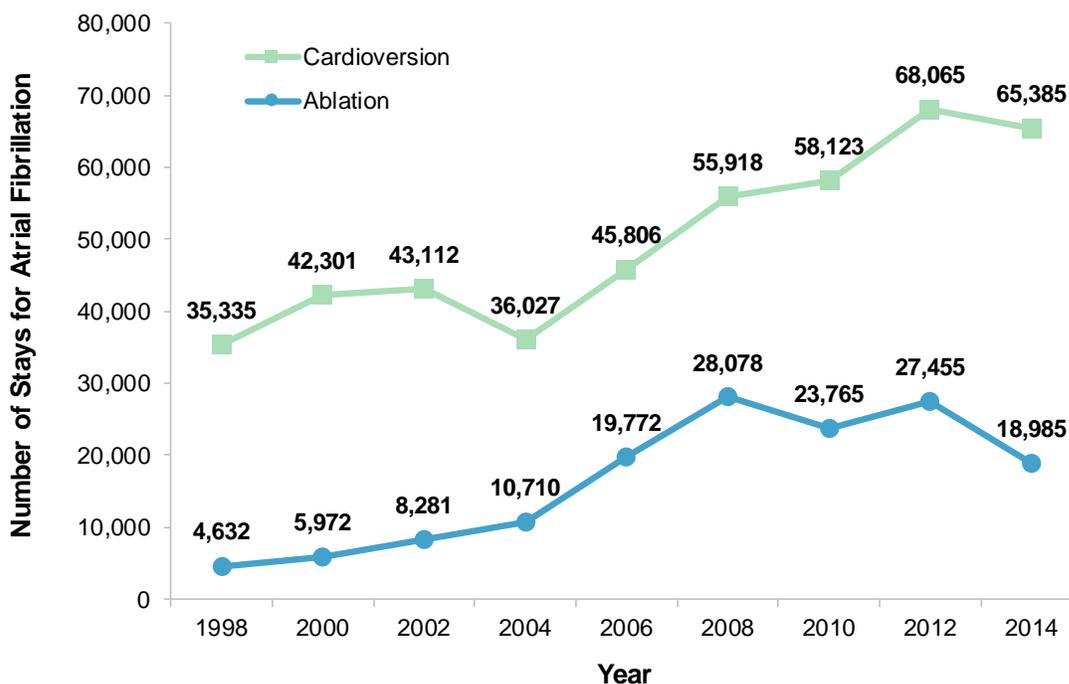
In 2014 among stays with a principal diagnosis of atrial fibrillation, over half also involved coronary atherosclerosis (62.5 percent), congestive heart failure (58.1 percent), essential hypertension (57.0 percent), or disorders of lipid metabolism (51.2 percent). Nearly one-third of stays involved screening and history of mental health and substance abuse (31.1 percent).

- **For stays with a secondary diagnosis of atrial fibrillation, the most common principal reasons for hospitalization were congestive heart failure, septicemia, and pneumonia.**

Among inpatient stays with a secondary diagnosis of atrial fibrillation, 10.9 percent of stays were principally for congestive heart failure, 8.5 percent were for septicemia, 4.5 percent were for pneumonia, and 4.0 percent were for acute cerebrovascular disease.

Figure 3 presents the total number of stays with cardioversion and ablation procedures among inpatient stays with a principal diagnosis of atrial fibrillation from 1998 through 2014. Both procedures can be done on an outpatient basis; thus, these figures do not represent a complete count of procedures. In addition, it is likely that the use of these procedures in outpatient settings increased over the 1998–2014 study period. There is no national source of outpatient procedure data for this time period for comparison.

Figure 3. Number of cardioversion and ablation procedures among adult inpatient stays with a principal diagnosis of atrial fibrillation, 1998–2014



Notes: Data are based on all-listed procedures. Thus, if cardioversion and ablation were both indicated on the record, the stay was counted in both categories. Among stays with a secondary diagnosis of atrial fibrillation, cardioversion and ablation each constituted less than 2 percent of stays and are therefore not shown.

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), 1998–2014

- **Overall in 2014, there was one cardioversion or ablation procedure for every five inpatient stays with a principal diagnosis of atrial fibrillation.**

In 2014, of the 398,890 stays with a principal diagnosis of atrial fibrillation, 65,385 involved cardioversion and 18,985 involved ablation. This equates to 16.4 cardioversions and 4.8 ablations per 100 stays with a principal diagnosis of atrial fibrillation.

- **Among stays with a principal diagnosis of atrial fibrillation, the number of stays that involved cardioversion generally increased from 1998 through 2014.**

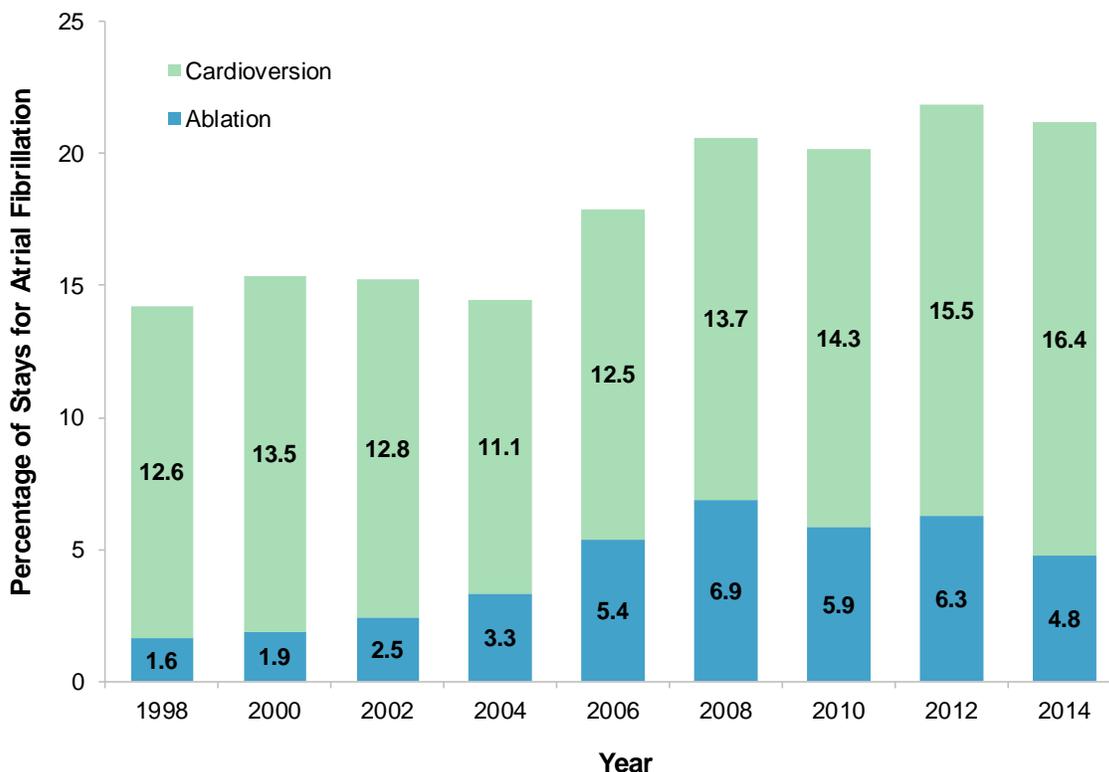
Apart from a few short periods of decline, from 1998 through 2014 the number of stays with a principal diagnosis of atrial fibrillation that involved cardioversion generally increased steadily from 35,335 to 65,385—an 85.0 percent increase.

- **In 2014, the number of inpatient stays with a principal diagnosis of atrial fibrillation that involved ablation was 4 times higher than the number in 1998.**

From 1998 through 2008, the number of stays with a principal diagnosis of atrial fibrillation that involved ablation increased from 4,632 to 28,078 and then decreased to 18,985 in 2014.

Figure 4 displays the percentage of stays involving cardioversion and ablation, out of all inpatient stays with a principal diagnosis of atrial fibrillation in 2010 and 2014. There is no national source of outpatient procedure data for this time period for comparison.

Figure 4. Percentage of stays involving cardioversion and ablation procedures among adult inpatient stays with a principal diagnosis of atrial fibrillation, 1998–2014



Note: Data are based on all-listed procedures. Thus, if cardioversion and ablation were both indicated on the record, the stay was counted in both categories.

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), 1998–2014

- **In 2014, 16.4 percent of stays with a principal diagnosis of atrial fibrillation involved cardioversion, reaching a 16-year high.**

From 1998 through 2014, the proportion of stays with a principal diagnosis of atrial fibrillation that involved a cardioversion procedure increased from 12.6 to 16.4 percent.

- **The percentage of stays with a principal diagnosis of atrial fibrillation involving ablation increased from 1998 to 2008 and then declined.**

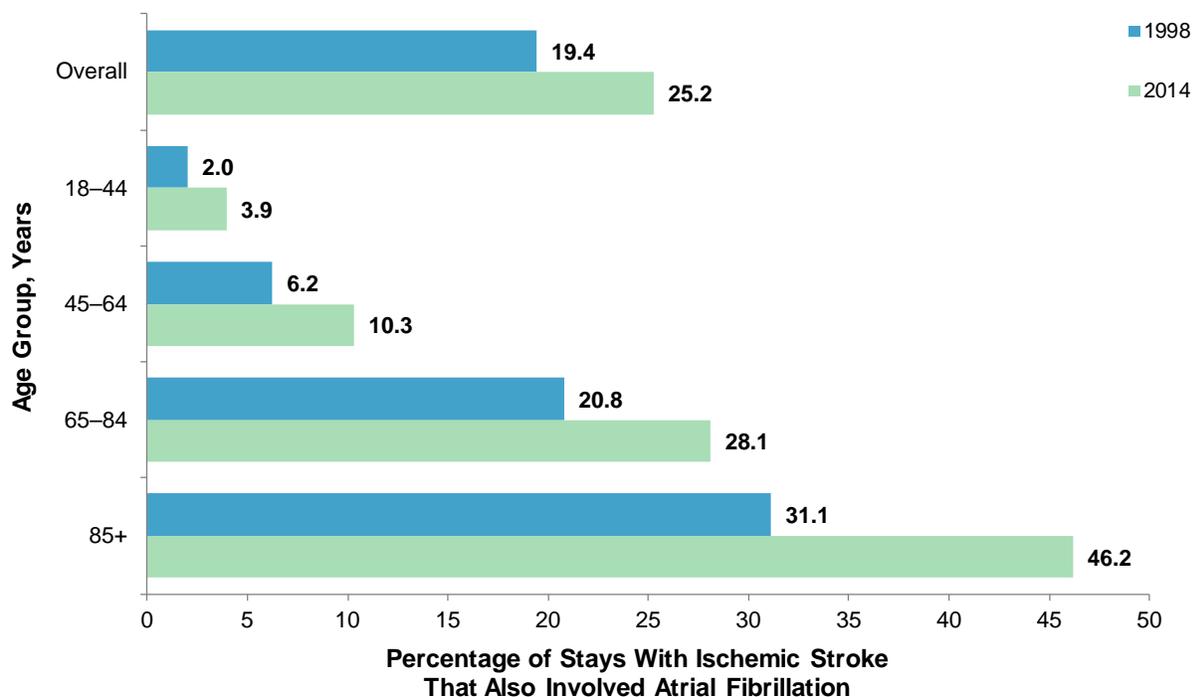
From 1998 through 2008, the percentage of stays with ablation, out of all stays with a principal diagnosis of atrial fibrillation, increased from 1.6 to 6.9 percent. By 2014, this percentage had decreased to 4.8 percent.

Atrial fibrillation as a co-occurring condition among ischemic stroke-related stays, 2014

Inpatient stays involving ischemic stroke with atrial fibrillation, as compared with strokes of other etiologies, have become increasingly common. Analysis of these data shows that in 1998, stays for ischemic stroke involving etiologies other than atrial fibrillation were over 4 times more common than stays for ischemic stroke with atrial fibrillation (data not shown). Yet in 2014, stays for ischemic stroke involving etiologies other than atrial fibrillation were only 3 times more common than stays for ischemic stroke with atrial fibrillation (data not shown).

Figure 5 presents the percentage of stays with an all-listed diagnosis of ischemic stroke for which atrial fibrillation was a co-occurring condition, overall and by age group, in 1998 versus 2014.

Figure 5. Percentage of adult inpatient stays with ischemic stroke that also involved atrial fibrillation, overall and by age group, 1998 and 2014



Note: Percentages are based on all-listed diagnoses of atrial fibrillation and ischemic stroke.

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), 1998 and 2014

- **In 1998, one in five inpatient stays with ischemic stroke involved atrial fibrillation. By 2014, that number had increased to one in four stays.**

Among inpatient stays with ischemic stroke, those involving atrial fibrillation increased from 19.4 percent in 1998 to 25.2 percent in 2014.

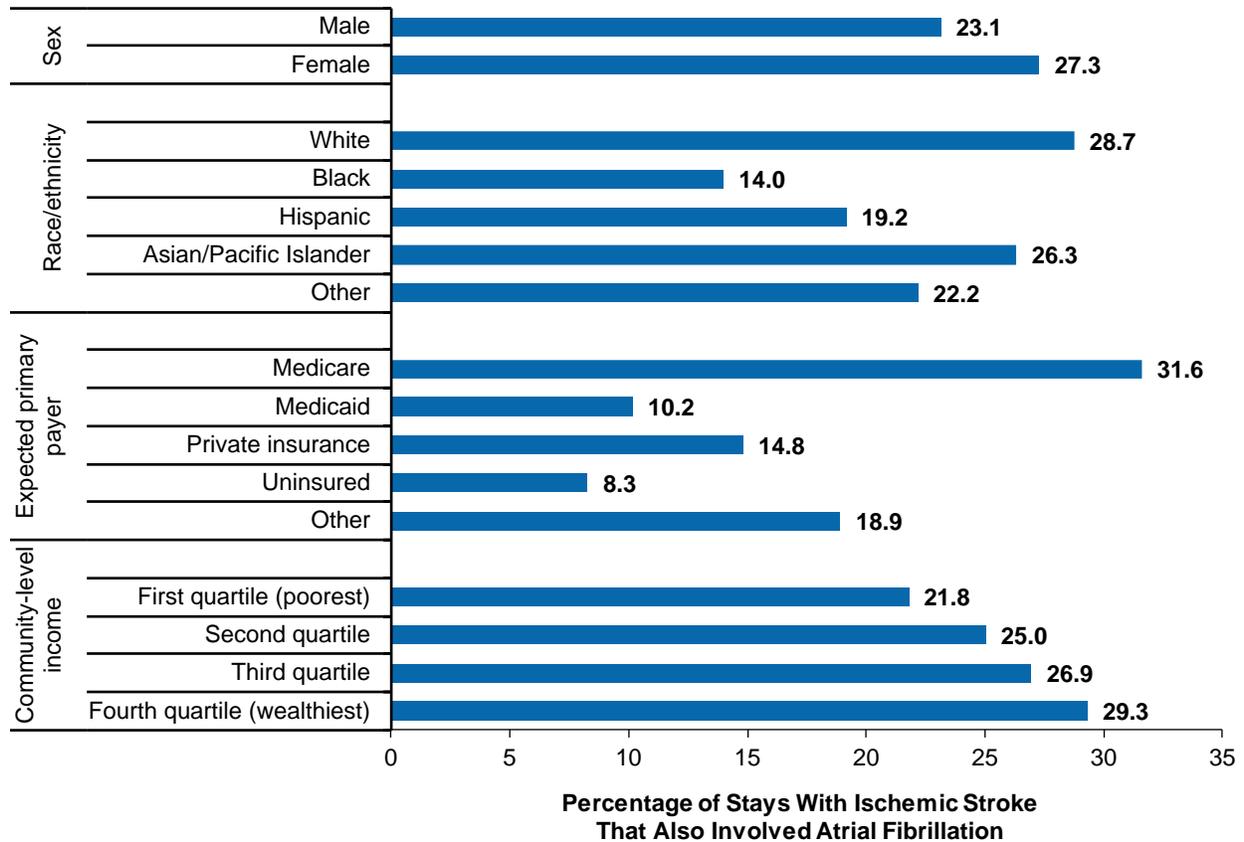
The percentage of stays with both diagnoses increased across all age groups from 1998 to 2014, with the largest increase occurring in the two youngest age groups. Specifically, the percentage of stays with ischemic stroke that also involved atrial fibrillation nearly doubled for patients aged 18–44 years (from 2.0 to 3.9 percent of stays) and increased by approximately two-thirds for patients aged 45–64 years (from 6.2 to 10.3 percent).

- **In 2014, nearly half of ischemic stroke stays for patients aged 85 years and older involved atrial fibrillation.**

In both 1998 and 2014, the percentage of inpatient stay involving both ischemic stroke and atrial fibrillation increased with patient age. Patients aged 65 years and older had the highest percentage of stays with ischemic stroke and atrial fibrillation. For patients aged 65–84 years, atrial fibrillation was involved in 20.8 percent of ischemic stroke stays in 1998 and 28.1 percent of ischemic stroke stays in 2014. For patients aged 85 years and older, the percentage of stays with ischemic stroke that also involved atrial fibrillation was 31.1 percent in 1998 and 46.2 percent in 2014.

Similar to the statistics provided previously by age group, Figure 6 presents the percentage of stays with an all-listed diagnosis of ischemic stroke for which atrial fibrillation was a co-occurring condition, by patient characteristics in 2014.

Figure 6. Percentage of adult inpatient stays with ischemic stroke that also involved atrial fibrillation, by patient characteristics, 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

- **Among all stays with ischemic stroke, the percentage of those with atrial fibrillation was highest among females, Whites, Asian/Pacific Islanders, those covered by Medicare, and patients who resided in wealthier areas.**

The percentage of stays involving atrial fibrillation among stays with ischemic stroke was highest for the following demographic groups:

- Females (27.3 percent) versus males (23.1 percent)
- Whites (28.7 percent) and Asian Pacific/Islanders (26.3 percent) compared with Blacks (14.0 percent), Hispanics (19.2 percent), and other ethnicities (22.2 percent)
- Patients covered by Medicare (31.6 percent), followed by those with other payers (18.9 percent), private insurance (14.8 percent), Medicaid (10.2 percent), and uninsured individuals (8.3 percent)
- Adults who resided in the wealthiest areas (quartile 4, 29.3 percent; quartile 3, 26.9 percent), followed by those who resided in quartile 2 (25.0 percent), and quartile 1 (21.8 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) 2014 National Inpatient Sample (NIS). Historical data were drawn from the 1998–2013 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 Bureau¹⁷ and Claritas, a vendor that compiles and adds value to census data.¹⁸

Definitions

Diagnoses, procedures, ICD-9-CM, 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. There are approximately 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.¹⁹ 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

Atrial fibrillation was defined using the following ICD-9-CM diagnosis code:

- 427.31: Atrial fibrillation

Ischemic stroke was defined using the following ICD-9-CM diagnosis codes:

- 433.01: Occlusion and stenosis of precerebral arteries, basilar artery, with cerebral infarction
- 433.11: Occlusion and stenosis of precerebral arteries, carotid artery, with cerebral infarction
- 433.21: Occlusion and stenosis of precerebral arteries, vertebral artery, with cerebral infarction

¹⁷ 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.

¹⁸ Claritas. Claritas Demographic Profile. www.claritas.com. Accessed June 23, 2017.

¹⁹ 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/toolsoftware/ccs/ccs.jsp. Accessed January 31, 2017.

- 433.31: Occlusion and stenosis of precerebral arteries, multiple and bilateral, with cerebral infarction
- 433.81: Occlusion and stenosis of precerebral arteries, other specified precerebral artery, with cerebral infarction
- 433.91: Occlusion and stenosis of precerebral arteries, unspecified precerebral artery, with cerebral infarction
- 434.01: Occlusion of cerebral arteries, cerebral thrombosis, with cerebral infarction
- 434.11: Occlusion of cerebral arteries, cerebral embolism, with cerebral infarction
- 434.91: Occlusion of cerebral arteries, cerebral artery occlusion, unspecified, with cerebral infarction
- 436: Acute, but ill-defined, cerebrovascular disease (valid from 1998 through September 30, 2004)

Cardioversion was defined using the following ICD-9-CM procedure codes:

- 99.61: Atrial cardioversion
- 99.62: Other electric countershock of heart
- 99.69: Other conversion of cardiac rhythm

Ablation was defined using the following ICD-9-CM procedure codes:

- 37.33: Excision or destruction of other lesion or tissue of heart, open approach
- 37.34: Excision or destruction of other lesion or tissue of heart, endovascular approach

The ICD-9-CM procedure code 37.37: Excision or destruction of other lesion or tissue of heart, thoracoscopic approach was not included in the definition of ablation because it was not available until 2010. Had it been included, this code would have constituted 5.6 percent of total ablations in 2014.

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.

Location of patients' residence

Place of residence is based on a simplified adaptation of the Urban Influence Codes (UIC) developed by the United States Department of Agriculture (USDA) Economic Research Service (ERS). The 12 categories of the UIC are combined into 4 broader categories that differentiate between large metropolitan (at least 1 million residents), small metropolitan (less than 1 million residents), micropolitan, and rural areas.

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.²⁰ The value ranges for the income quartiles vary by year. The income quartile is missing for patients who are homeless or foreign.

²⁰ Claritas. Claritas Demographic Profile. www.claritas.com. Accessed June 23, 2017.

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

Reporting of race and ethnicity

Data on Hispanic ethnicity are collected differently among the States and also can differ from the census methodology of collecting information on race (White, Black, Asian/Pacific Islander, American Indian/Alaska Native, Other (including mixed race)) separately from ethnicity (Hispanic, non-Hispanic). State data organizations often collect Hispanic ethnicity as one of several categories that include race. Therefore, for multistate analyses, HCUP creates the combined categorization of race and ethnicity for data from States that report ethnicity separately. When a State data organization collects Hispanic ethnicity separately from race, HCUP uses Hispanic ethnicity to override any other race category to create a Hispanic category for the uniformly coded race/ethnicity data element, while also retaining the original race and ethnicity data. This Statistical Brief reports race/ethnicity for the following categories: Hispanic, non-Hispanic White, non-Hispanic Black, Asian/Pacific Islander, and Other.

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.

For More Information

For other information on cardiovascular diseases refer to the HCUP Statistical Briefs located at www.hcup-us.ahrq.gov/reports/statbriefs/sb_heart.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.

Suggested Citation

Kato E (AHRQ), Ngo-Metzger Q (AHRQ), Fingar KR (IBM Watson Health), McDermott KW (IBM Watson Health), Elixhauser A (AHRQ). Inpatient Stays Involving Atrial Fibrillation, 1998–2014. HCUP Statistical Brief #236. February 2018. Agency for Healthcare Research and Quality, Rockville, MD. www.hcup-us.ahrq.gov/reports/statbriefs/sb236-Atrial-Fibrillation-Hospital-Stays-Trends.pdf.

Acknowledgments

The authors would like to acknowledge the contributions of Minya Sheng of IBM Watson Health.

* * *

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:

Sharon B. Arnold, Ph.D., Acting Director
Center for Delivery, Organization, and Markets
Agency for Healthcare Research and Quality
5600 Fishers Lane
Rockville, MD 20857

This Statistical Brief was posted online on February 2, 2018.