ORIGINAL RESEARCH

# Causes and Predictors of Readmission in Patients With Atrial Fibrillation Undergoing Catheter Ablation: A National Population-Based Cohort Study

Shilpkumar Arora, MD, MPH;* Sopan Lahewala, MD;* Byomesh Tripathi, MD;* Varshil Mehta, MD; Varun Kumar, MD; Divya Chandramohan, MD; Alejandro Lemor, MD; Mihir Dave, MD; Nileshkumar Patel, MD; Nilay V. Patel, MD; Ghanshyam Palamaner Subash Shantha, MD; Juan Viles-Gonzalez, MD; Abhishek Deshmukh, MD

***Background*—**Reducing readmission after catheter ablation (CA) in atrial fibrillation (AF) is important.

***Methods and Results*—**We utilized National Readmission Data (NRD) 2010–2014. AF was identified by *International Classification of Diseases, Ninth Edition, Clinical Modification (ICD-9-CM)* diagnostic code 427.31 in the primary field, while first CA of AF was identified via *ICD-9*-procedure code 37.34. Any admission within 30 or 90 days of index admission was considered a readmission. Cox proportional hazard regression was used to adjust for confounders. The primary outcomes were 30- and 90-day readmissions and the secondary outcome was AF recurrence. In total, 1 128 372 patients with AF were identified from January 1, 2010 to September 30, 2014. Of which 37 360 (3.3%) underwent CA. Patients aged ≥65 years and female sex were less likely to receive CA for AF. Overall, 10.9% and 16.5% of CA patients were readmitted within 30 and 90 days post-CA, respectively. Most common causes of readmissions were arrhythmia (AF, atrial flutter), heart failure, pulmonary causes (pneumonia, chronic obstructive pulmonary disease) and bleeding complications (gastrointestinal bleed, intracranial hemorrhage). Patients with diabetes mellitus, heart failure, coronary artery disease (CAD), chronic pulmonary and kidney disease, prior stroke/transient ischemic attack (TIA), female sex, length of stay ≥2 and disposition to the facility were prone to higher 30- and 90-day readmissions post-CA. Predictors of increase in AF recurrence post-CA were female sex, diabetes mellitus, chronic pulmonary disease, and length of stay ≥2. Trends of 90-day readmission and AF recurrence were found to improve over the study period.

***Conclusions*—**We identified several demographic and clinical factors associated with the use of CA in AF, and short-term outcomes of the same, which could potentially help in the patient selection and improve outcomes. **(*J Am Heart Assoc*. 2018;7: e009294. DOI: 10.1161/JAHA.118.009294.)**

**Key Words:** atrial fibrillation • catheter ablation • causes • readmission

Atrial fibrillation (AF) is the most common clinically significant cardiac arrhythmia and affects almost 2.3 million people in the US population.[1] Catheter ablation (CA) of AF is one of the most effective rhythm control strategies for AF patients in anti-arrhythmic drug (AAD) resistant AF.[2] Despite the use of different ablation strategies and different sources of energy (cryoenergy versus radiofrequency), the success rate of single procedures has ranged between 20% and 60%. During the first 90 days, which is considered the "blanking period," readmissions are common.[3]

*From the Mt. Sinai St. Luke's Roosevelt Hospital Center, New York, NY (S.A., B.T., V.M., V.K., D.C., A.L.); RWJ Barnabas Health/ Jersey City Medical Center, Jersey City, NJ (S.L.); Icahn School of Medicine at Mount Sinai, New York, NY (M.D.); University of Miami/Miller School of Medicine, Miami, FL (N.P.); University of Kansas Medical Center, Kansas City, KS (N.V.P.); University of Iowa Hospitals and Clinics, Iowa City, IA (G.P.S.S.); Tulane University School of Medicine, New Orleans, LA (J.V.-G.); Mayo Clinic, Rochester, MN (A.D.).*

Accompanying Tables S1 through S8 and Figures S1 through S3 are available at http://jaha.ahajournals.org/content/7/12/e009294/DC1/embed/inline-supplementary-material-1.pdf

*Dr Arora, Dr Lahewala, and Dr Tripathi contributed equally to this work.

**Correspondence to:** Abhishek Deshmukh, MD, Department of Cardiovascular Diseases, Mayo Clinic, 200 1st St SW, Rochester, MN 55902. E-mails: deshmukh.abhishek@mayo.edu, abhishek_mbbs@yahoo.com

Received March 26, 2018; accepted May 7, 2018.

## Clinical Perspective

### What Is New?

- We examined readmissions after atrial fibrillation ablations from the national readmissions database and noted that readmission rate of 10.9% and 16.5% within the first 30 and 90 days.
- Female sex, increased length of stay during index hospitalization, and increased comorbidity burden were the principal predictors of increase in readmission rates.
- Patients with private insurance and ablations performed in hospitals with high volume correlated to minimal readmission rates.

### What Are the Clinical Implications?

- Readmission may be an appropriate quality measure for atrial fibrillation ablation.
- Targeted interventions that focus on the immediate postoperative period and high-risk patients could result in further reduction in procedural morbidity and reduce readmissions.

However, after CA, apart from the recurrence of atrial arrhythmias, there are many other causes which are responsible for high readmission rates, but the data available on them are limited. Our study aims to evaluate 1) baseline characteristics of AF cohort undergoing CA, 2) specific admission diagnoses, predictors, and trends of 30- and 90-day readmission in CA of AF patients, and 3) predictors and trends of AF recurrence in 90 days after CA of AF patients.

# Methods

## Data Source

The study was derived from the Healthcare Cost and Utilization Project's (HCUP) National Readmission Database (NRD) of 2010–2014, sponsored by the Agency for Healthcare Research and Quality. The NRD is one of the largest publicly available all-payer inpatient care databases in the United States, which includes data on ≈15 million discharges in year 2014, estimating roughly 35 million discharges from 22 states with reliable, verified linkage numbers. NRD represents 49.3% of total US hospitalizations. Patients were tracked during the same year using the variable "NRD_visitlink," and time between 2 admissions was calculated by subtracting variable "NRD_DaysToEvent". Time to readmission was calculated by subtracting the length of stay (LOS) of index admissions to time between 2 admissions. Sampling weights provided by the sponsor were used to produce national estimates. The details regarding the NRD data are available online.[4]

## Data Selection

We queried NRD database using the *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) diagnosis code for AF (427.31) in the primary field. Catheter ablation was identified by *ICD-9* procedural code 37.34 in either primary or secondary field. Patients having a secondary diagnosis of atrial flutter, paroxysmal supraventricular tachycardia, atrioventricular (AV) nodal tachycardia, Wolff-Parkinson-White syndrome, paroxysmal ventricular tachycardia and ventricular premature complexes were excluded. Also, to avoid inclusions of patients undergoing AV junction ablation, we excluded patients with diagnostic or procedural codes indicating prior or current implantation of a pacemaker or implantable cardioverter defibrillator. Also, cases with open surgical ablations during the hospitalization were excluded. Furthermore, patients aged <18 years, with missing data for age, sex, or mortality were excluded. Patients with multiple CA for AF, only first admission of all was included as index admission. Index admissions from October, November, and December were excluded as NRD did not follow patients over the years, therefore, 90 days follow up would not be available for these index admissions. We identified in total 1 128 372 (AF) and 37 360 (CA in AF) index admissions (Table S1). Similar methods were used previously.[5,6] Patients who were readmitted to any hospital within 30 and 90 days within the same calendar year were further evaluated.

## Outcomes

Primary outcomes of our study were 30- and 90-day readmissions and the secondary outcome was AF recurrence which was defined as readmission with a primary diagnosis of AF or repeat AF ablation during readmission. Causes (admitting diagnosis) of readmission were identified by using *ICD-9-CM* codes in primary diagnosis filed during readmission observation. We identified 553 different *ICD-9 CM* diagnosis codes and combined the ones with similar diagnoses to make clinically important groups (Table S2). Numbers were verified by M.D. and V.K. independently.

## Definition of Variables

NRD variables were used to identify patients' demographic characteristics including age, sex, hospital characteristics (bed size and teaching status), patient-specific characteristics including median household income category for patient's zip code, primary payer, admission type, admission day, and discharge disposition.[7] Discharge to skilled nursing facility and intermediate care facility were classified as the disposition to facility. Comorbidities such as obesity, hypertension, diabetes mellitus, chronic obstructive pulmonary disease (COPD), alcohol abuse, vascular disease history, and anemia

were identified by variables provided in NRD, which uses *ICD-9-CM* diagnoses and the diagnosis-related group in effect on the discharge date. These comorbidities were likely to have originated before the hospital stay and not directly related to the primary diagnosis or main reason for admission.[8] Other comorbidities were identified by *ICD-9-CM* codes in secondary diagnosis field which included heart failure, coronary artery disease (CAD), chronic kidney disease, prior coronary artery bypass graft, hyperthyroidism, mitral valve disease, prior stroke/transient ischemic attack (TIA) etc (Table S3).

Deyo modification of Charlson Comorbidity Index, which contains 17 comorbid conditions with differential weights, was used to define the severity of comorbid conditions. This score ranges from 0 to 33, with higher scores corresponding to a larger burden of comorbid conditions (Table S4).[9] Annual hospital volume of procedure was calculated by using unique hospital identification provided by NRD. We also evaluated LOS provided by NRD. Cost of hospitalization was calculated by merging cost to charge ratio provided by HCUP to the main data set and after adjusting for inflation.[10]

## Statistical Analysis

SAS 9.4 (SAS Institute Inc, Cary, NC) was utilized for analyses. Wilcoxon rank sum test was used for differences between continuous variables, as data were nonparametric, while chi-square test was used for the differences between categorical variables. We assessed each outcome using Kaplan–Meier curve before running multivariate model (Figures S1 through S3). Multivariate predictors of 30-day readmission, 90-day readmission and AF recurrence were evaluated using Cox proportional hazard regression with hospital identification as clustering effect. For 30 and 90-day readmission, we first assessed all available known risk factors for AF, known risk factors for stroke/TIA in AF patients and other patient/hospital specific variables mentioned in Table 1. In multivariate analysis, we only included variables with a statistically significant difference in readmission using the univariate method. We also ran the hierarchical multivariate regression with hospital identification as clustering effect with all same variables mentioned above to assess predictors of CA amongst AF patients (Table S5).

For AF recurrence, we investigated risk factors for AF and patient/hospital specific variables mentioned in Table S6. For multivariate regression (Cox-proportional regression), we only included variables with a statically significant difference in AF recurrence using the univariate method. Included variables were age, sex, Charlson/Deyo Comorbidity Index, hypertension, diabetes mellitus, chronic obstructive pulmonary disease, chronic kidney disease (CKD) stage 3 or more, hyperthyroidism, alcoholism, anemia, median household income, hospital volume, admission type, disposition, LOS for index admission stay (Table S6). 30-day readmission, 90-day readmission and AF recurrence models were run on patients who survived index admission. The patient who died during readmission was considered censored observations for AF recurrence model. The *P*-value of $<0.05$ was considered significant. Cochrane Armitage test was used to assess *P*-value for trends of categorical variables such as in-hospital mortality and simple linear regression were used to assess *P*-value for trends of continuous variables such as LOS and cost of care. The study was exempt from institutional review board approval, and the requirement for informed consent was waived because database uses previously collected deidentified data.

# Results

## Cohort Characteristics

As described in Table 1 and Table S5, our analysis included 1 128 372 index admissions for AF (68.8% aged ≥65 years and 52.9% females). Of which 37 360 (3.3%) underwent CA for AF. Overall, patients aged ≥65 years (52.5% versus 69.3%, *P*<0.001) (odds ratio [OR]: 0.82, 95% confidence interval [CI]: 0.76–0.89, *P*<0.001) and females (35.8% versus 53.5%, *P*<0.001) (OR: 0.76, 95% CI: 0.73–0.78, *P*<0.001) were less likely to receive CA for AF. Patients with higher median household income (75th–100th percentile) (30.9% versus 21.3%, *P*<0.001) (OR: 1.92, 95% CI: 1.82–2.02, *P*<0.001), private insurance (42.3% versus 21.5%, *P*<0.001) (OR: 1.11, 95% CI: 1.05–1.17, *P*<0.001) compared with Medicare were more likely to undergo CA for AF. Patients with comorbidities such as hypertension, diabetes mellitus, heart failure, CAD, chronic pulmonary disease, CKD stage 3 or more, hypothyroidism, mitral valve disease, prior stroke/TIA and anemia were less likely to receive CA for AF. Large hospitals and teaching hospitals were more likely to perform CA for AF (Table 1).

## Predictors of All Cause Readmission

Of the 37 360 patients who underwent CA, 3802 (10.9%) and 6164 (16.5%) patients required readmission in 30 and 90 days post-CA, respectively. Patients with diabetes mellitus (25.6% versus 17.7%, *P*<0.001) (hazard ratio [HR]: 1.10, 95% CI: 1.03–1.19, *P*=0.01), heart failure (26.4% versus 13.8%, *P*<0.001) (HR: 1.17, 95% CI: 1.08–1.26, *P*<0.001), CAD (33.7% versus 23.5%, *P*<0.001) (HR: 1.18, 95% CI: 1.11–1.25, *P*<0.001), chronic pulmonary disease (21.3% versus 12.8%, *P*<0.001) (HR: 1.17, 95% CI: 1.09–1.26, *P*<0.001), CKD stage 3 or more (6.9% versus 2.6%, *P*<0.001) (HR: 1.26, 95% CI: 1.12–1.41, *P*<0.001), prior stroke/TIA (8.5% versus 6.3%, *P*<0.001) (HR: 1.10, 95% CI: 1.00–1.21, *P*=0.041), anemia (10% versus 4.3%, *P*<0.001) (HR: 1.27, 95% CI: 1.16–1.39,

**Table 1.** Baseline Characteristics of Atrial Fibrillation Patients With and Without Ablation

| | Atrial Fibrillation | | | |
|---|---|---|---|---|
| | Without Ablation | With Ablation | Overall | *P* Value |
| Index admission | 1 091 012 (96.7%) | 37 360 (3.3%) | 1 128 372 | |
| Patient level variables | | | | |
| Age (median, IQR) y | 73 (62–82) | 65 (57–72) | 72 (62–82) | <0.001 |
| Age groups, % | | | | <0.001 |
| 18 to 49 y | 7.9 | 10.2 | 8.0 | |
| 50 to 64 y | 22.7 | 37.3 | 23.2 | |
| 65 to 79 y | 38.2 | 45.3 | 38.5 | |
| ≥80 y | 31.1 | 7.2 | 30.3 | |
| Sex, % | | | | <0.001 |
| Male | 46.5 | 64.2 | 47.1 | |
| Female | 53.5 | 35.8 | 52.9 | |
| Charlson comorbidity index, %* | | | | <0.001 |
| 0 | 36.4 | 57.9 | 37.1 | |
| 1 | 28.4 | 24.8 | 28.3 | |
| ≥2 | 35.2 | 17.4 | 34.6 | |
| Comorbidities, % | | | | |
| Obesity† | 14.8 | 15.3 | 14.8 | 0.015 |
| Obstructive sleep apnea‡ | 7.9 | 14.2 | 8.2 | <0.001 |
| Hypertension† | 69.5 | 62.8 | 69.3 | <0.001 |
| Diabetes mellitus† | 25.2 | 19.0 | 25.0 | <0.001 |
| Heart failure‖ | 29.3 | 15.9 | 28.8 | <0.001 |
| Coronary artery disease§ | 32.0 | 25.2 | 31.8 | <0.001 |
| Chronic pulmonary disease† | 21.7 | 14.2 | 21.5 | <0.001 |
| Chronic kidney disease¶ (stage 3 or more) | 7.9 | 3.3 | 7.8 | <0.001 |
| Prior coronary artery bypass graft# | 6.9 | 5.3 | 6.8 | <0.001 |
| Hyperthyroidism** | 1.7 | 0.8 | 1.7 | <0.001 |
| Alcohol abuse† | 4.7 | 1.1 | 4.5 | <0.001 |
| Mitral valve disease†† | 8.8 | 7.9 | 8.7 | <0.001 |
| Prior stroke/transient ischemic attack‡‡ | 9.1 | 6.6 | 9.0 | <0.001 |
| Vascular disease history† | 6.7 | 4.6 | 6.6 | <0.001 |
| Anemia† | 12.7 | 5.2 | 12.4 | <0.001 |
| Median household income category for patient's zip code, %§§ | | | | <0.001 |
| 0 to 25th percentile | 27.6 | 18.4 | 27.3 | |
| 26 to 50th percentile | 26.0 | 22.4 | 25.8 | |
| 51 to 75th percentile | 23.7 | 26.5 | 23.8 | |
| 76 to 100th percentile | 21.3 | 30.9 | 21.6 | |
| Primary payer, % | | | | <0.001 |
| Medicare | 68.1 | 52.0 | 67.6 | |
| Medicaid | 4.34 | 2.68 | 4.29 | |
| Private including health maintenance organization | 21.5 | 42.3 | 22.2 | |
| Self-pay/no charge/other | 5.8 | 3.0 | 5.7 | |

Continued

**Table 1.** Continued

| | Atrial Fibrillation | | Overall | *P* Value |
|---|---|---|---|---|
| | Without Ablation | With Ablation | | |
| Hospital characteristics | | | | |
| Hospital bed size, %‖ | | | | <0.001 |
| Small | 14.5 | 3.5 | 14.1 | |
| Medium | 24.3 | 17.7 | 24.1 | |
| Large | 61.2 | 78.9 | 61.8 | |
| Hospital teaching status, %¶ | | | | <0.001 |
| Non-teaching | 56.5 | 25.1 | 55.4 | |
| Teaching | 43.5 | 74.9 | 44.6 | |
| Admission type, % | | | | <0.001 |
| Non-elective | 90.3 | 29.9 | 88.3 | |
| Elective | 9.6 | 70.1 | 11.6 | |
| Admission day, % | | | | <0.001 |
| Weekdays | 78.7 | 96.2 | 79.2 | |
| Weekend | 21.3 | 3.8 | 20.8 | |
| Disposition, % | | | | <0.001 |
| Home | 87.0 | 97.9 | 87.4 | |
| Facility | 11.0 | 1.8 | 10.7 | |
| In hospital mortality, % | 1.0 | 0.1 | 1.0 | <0.001 |
| Length of stay (median, IQR) days | 2 (1–4) | 1 (1–3) | 2 (1–4) | <0.001 |
| Cost of hospitalization (median, IQR)¶ | 5114 (3272–8404) | 6043 (3824–9874 | 5335 (3391–8792) | <0.001 |

α, β, ∞, ®, Ω, μ, ©: comorbidities were identified by appropriate *ICD-9-CM* diagnosis codes in secondary diagnosis field (Table S3).
*ICD-9-CM* indicates *International Classification of Diseases, Ninth Edition, Clinical Modification*.
*Charlson/Deyo Comorbidity Index (CCI) was calculated as per Deyo classification.
†Variables are AHRQ comorbidity measures.
‡Heart failure is identified by *ICD-9* codes in secondary diagnosis field and it includes systolic, diastolic and combined heart failure.
§Represents a quartile classification of the estimated median household income of residents within the patients' zip code, derived from zip code-demographic data obtained from Claritas. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations. Because these estimates are updated annually, the value ranges vary by year. https://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nrdnote.jsp.
‖The bed size cutoff points divided into small, medium, and large have been done so that approximately one third of the hospitals in a given region, location, and teaching status combination would fall within each bed size category. https://www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nrdnote.jsp.
¶A hospital is considered to be a teaching hospital if it has an American Medical Association-approved residency program, is a member of the Council of Teaching Hospitals or has a ratio of full-time equivalent interns and residents to beds of 0.25 or higher. https://www.hcup-us.ahrq.gov/db/vars/hosp_ur_teach/nrdnote.jsp.

*P*<0.001), female sex (43.6% versus 34.3%, *P*<0.001) (HR: 1.20, 95% CI: 1.13–1.26, *P*<0.001), discharge to facility after index hospitalization (4.5% versus 1.3%, *P*<0.001) (HR: 1.25, 95% CI: 1.10–1.43, *P*<0.001), and index hospitalization LOS ≥2 days were associated with increased 90-day readmissions. Patients with private insurance (29.6% versus 44.8%, *P*<0.001) (HR: 0.69, 95% CI: 0.64–0.76, *P*<0.001) compared with Medicare were associated with lower readmissions (Tables 2 and 3). Similar results were observed with 30-day readmission (Tables 2 and 3). Higher hospital volume was associated with reduced 90-day readmission (HR: 0.99, 95% CI: 0.99–0.99, *P*=0.046) but could not reach to statistical significance with 30 days follow up (Tables 2 and 3). In separate analysis of an entire population of AF, we found that CA was associated with decreased 90-day readmission compared with no CA. Similar results were not observed at 30 days (Table 3, Table S7). Subgroup analysis of 90-day readmission for CA patients (Table S8), showed similar results in most subgroups except in older patients (aged ≥80 years), patients with obesity, CKD stage 3 or more, hyperthyroidism, and alcoholism.

## Admitting Diagnoses of Readmission

Out of 3802 and 6164 readmissions (over 30 and 90 days, respectively) cardiac causes (58.4% and 59.1%, respectively) were the most prevalent cause of readmission, of which arrhythmia (32.6% and 35.2%) was the most common

**Table 2.** Baseline Characteristics of Catheter Ablation in Atrial Fibrillation Patients With or Without Readmission

| | Catheter Ablation of Atrial Fibrillation Patients | | | | | |
|---|---|---|---|---|---|---|
| | No Readmission | 30-Day Readmission | 90-Day Readmission | Overall | *P* Value | *P* Value |
| Index admission | 31 196 (89.1%) | 3802 (10.9%) | 6164 (16.5%) | 37 360 | 30-day readmission vs no readmission | 90-day readmission vs no readmission |
| Patient level variables | | | | | | |
| Age (median, IQR) y | 65 (57–71) | 68 (60–74) | 68 (60–74) | 65 (57–72) | <0.001 | <0.001 |
| Age groups (%) | | | | | <0.001 | <0.001 |
| 18 to 49 y | 3363 (10.8%) | 286 (7.5%) | 449 (7.3%) | 3811 (10.2%) | | |
| 50 to 64 y | 12 082 (38.7%) | 1168 (30.7%) | 1837 (29.8%) | 13 917 (37.3%) | | |
| 65 to 79 y | 13 842 (44.4%) | 1843 (48.5%) | 3085 (50.1%) | 16 928 (45.3%) | | |
| ≥80 y | 1909 (6.1%) | 504 (13.3%) | 793 (12.9%) | 2705 (7.2%) | | |
| Sex (%) | | | | | <0.001 | <0.001 |
| Male | 20 505 (65.7%) | 2107 (55.4%) | 3477 (56.4%) | 23 981 (64.2%) | | |
| Female | 10 691 (34.3%) | 1695 (44.6%) | 2687 (43.6%) | 13 379 (35.8%) | | |
| Charlson Comorbidity Index (%)* | | | | | <0.001 | <0.001 |
| 0 | 18 986 (60.9%) | 1613 (42.4%) | 2626 (42.6%) | 21 613 (57.9%) | | |
| 1 | 7528 (24.1%) | 1109 (29.2%0 | 1724 (28.0%) | 9250 (24.8) | | |
| ≥2 | 4683 (15.0%) | 1081 (28.4%0 | 1813 (29.4%) | 6497 (17.4%) | | |
| Comorbidities (%) | | | | | | |
| Obesity† | 4636 (14.9%) | 667 (17.6%0 | 1071 (17.4%) | 5705 (15.3%) | <0.001 | <0.001 |
| Obstructive sleep apnea$^{\alpha}$ | 4502 (14.4%) | 522 (13.7) | 814 (13.2) | 5316 (14.2%) | 0.254 | 0.012 |
| Hypertension† | 19 357 (62.1%) | 2515 (66.2%) | 4099 (66.5%) | 23 458 (62.8%) | <0.001 | <0.001 |
| Diabetes mellitus† | 5512 (17.7%) | 969 (25.5%) | 1579 (25.6%) | 7091 (19.0%) | <0.001 | <0.001 |
| Heart failure‡ | 4293 (13.8%) | 1010 (26.6%) | 1626 (26.4%) | 5922 (15.9%) | <0.001 | <0.001 |
| Coronary artery disease$^{\beta}$ | 7328 (23.5%) | 1255 (33.0%) | 2078 (33.7%) | 9404 (25.2%) | <0.001 | <0.001 |
| Chronic pulmonary disease† | 3996 (12.8%) | 823 (21.6%) | 1315 (21.3%) | 5313 (14.2%) | <0.001 | <0.001 |
| Chronic kidney disease$^{\infty}$ (stage 3 or more) | 802 (2.6%) | 249 (6.5%) | 425 (6.9%) | 1225 (3.3%) | <0.001 | <0.001 |
| Prior coronary artery bypass graft® | 1522 (4.9%) | 240 (6.3%) | 445 (7.2%) | 1969 (5.3%) | <0.001 | <0.001 |
| Hyperthyroidism$^{\Omega}$ | 237 (0.8%) | 31 (0.8%) | 53 (0.9%) | 291 (0.8%) | 0.759 | 0.439 |
| Alcohol abuse† | 346 (1.1%) | 35 (0.9%) | 63 (1.0%) | 407 (1.1%) | 0.310 | 0.531 |
| Mitral valve disease$^{\mu}$ | 2343 (7.5%) | 387 (10.2%) | 591 (9.6%) | 2933 (7.9%) | <0.001 | <0.001 |
| Prior stroke/transient ischemic attack© | 1950 (6.3%) | 338 (8.9%) | 526 (8.5%) | 2473 (6.6%) | <0.001 | <0.001 |
| Vascular disease history† | 1295 (4.2%) | 253 (6.7%) | 420 (6.8%) | 1715 (4.6%) | <0.001 | <0.001 |
| Anemia† | 1338 (4.3%) | 378 (10.0%) | 616 (10.0%) | 1954 (5.2%) | <0.001 | <0.001 |
| Median household income category for patient's zip code (%)§ | | | | | <0.001 | <0.001 |
| 0 to 25th percentile | 5553 (17.8%) | 858 (22.6%) | 1328 (21.6%) | 6882 (18.4%) | | |
| 26 to 50th percentile | 6888 (22.1%) | 921 (24.2%) | 1492 (24.2%) | 8380 (22.4%) | | |
| 51 to 75th percentile | 8307 (26.6%) | 990 (26.0%) | 1592 (25.8%) | 9900 (26.5%) | | |
| 76 to 100th percentile | 9889 (31.7%) | 971 (25.5%) | 1638 (26.6%) | 11 529 (30.9%) | | |

Continued

**Table 2.** Continued

| | Catheter Ablation of Atrial Fibrillation Patients | | | | | |
|---|---|---|---|---|---|---|
| | No Readmission | 30-Day Readmission | 90-Day Readmission | Overall | *P* Value | *P* Value |
| Primary payer (%) | | | | | <0.001 | <0.001 |
| Medicare | 15 439 (49.5%) | 2434 (64.0%) | 3978 (64.5%) | 19 416 (51.9%) | | |
| Medicaid | 795 (2.6%) | 126 (3.3%) | 205 (3.3%) | 1001 (2.7%) | | |
| Private including health maintenance organization | 13 979 (44.8%) | 1137 (29.9%) | 1823 (29.6%) | 15 800 (42.3%) | | |
| Self-pay/no charge/other | 976 (3.1%) | 105 (2.8%) | 155 (2.5%) | 1132 (3.0%) | | |
| Hospital characteristics | | | | | | |
| Hospital bed size (%)‖ | | | | | 0.012 | 0.249 |
| Small | 1061 (3.4%) | 122 (3.2%) | 235 (3.8%) | 1296 (3.5%) | | |
| Medium | 5522 (17.7%) | 603 (15.9%) | 1081 (17.5%) | 6605 (17.7%) | | |
| Large | 24 614 (78.9%) | 3077 (80.9%) | 4847 (78.6%) | 29 458 (78.9%) | | |
| Hospital teaching status (%)¶ | | | | | 0.009 | 0.003 |
| Non-teaching | 7740 (24.8%) | 10 108 (26.8%) | 1638 (26.6%) | 9377 (25.1%) | | |
| Teaching | 23 456 (75.2%) | 2784 (73.2%) | 4526 (73.4%) | 27 983 (74.9%) | | |
| Hospital volume (median, IQR) | 41 (24–109) | 52 (18–83) | 53 (18–90) | 47 (22–106) | <0.001 | <0.001 |
| Admission type (%) | | | | | <0.001 | <0.001 |
| Non-elective | 8813 (28.3%) | 1426 (37.5) | 2353 (38.2%) | 11 163 (29.9%) | | |
| Elective | 22 383 (71.8%) | 2376 (62.5) | 3805 (61.7%) | 26 182 (70.1%) | | |
| Admission day (%) | | | | | <0.001 | <0.001 |
| Weekdays | 30 160 (96.7%) | 3566 (93.8%) | 5774 (93.7%) | 35 933 (96.2%) | | |
| Weekend | 1036 (3.3%) | 236 (6.2%) | 390 (6.3%) | 1427 (3.8%) | | |
| Disposition (%) | | | | | <0.001 | <0.001 |
| Home | 30 706 (98.4%) | 3626 (95.4%) | 5882 (95.4%) | 36 587 (97.9%) | | |
| Facility | 412 (1.3%) | 173 (4.6%) | 278 (4.5%) | 687 (1.8%) | | |
| In-hospital mortality (%) | 53 (0.2%) | 0 (0.0%) | 0 (0.0%) | 52 (0.1%) | | |
| Length of stay (median, IQR) days | 1 (1–2) | 2 (1–4) | 2 (1–4) | 1 (1–3) | <0.001 | <0.001 |
| Cost of hospitalization (median, IQR)¶ | 23 581 (17 282–30 209) | 22 799 (15 836–31 167) | 22 318 (15 235–30 315 | 23 414 (17 004–30 220) | <0.001 | <0.001 |

α, β, ∞, ®, Ω, μ, ©: comorbidities were identified by appropriate *ICD-9-CM* diagnosis codes in secondary diagnosis field (Table S3).
*ICD-9-CM* indicates *International Classification of Diseases, Ninth Edition, Clinical Modification*.
*Charlson/Deyo Comorbidity Index (CCI) was calculated as per Deyo classification.
†Variables are AHRQ comorbidity measures.
‡Heart failure is identified by *ICD-9* codes in secondary diagnosis field and it includes systolic, diastolic and combined heart failure.
§Represents a quartile classification of the estimated median household income of residents within the patients' zip code, derived from zip code-demographic data obtained from Claritas. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations. Because these estimates are updated annually, the value ranges vary by year. https://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nrdnote.jsp.
‖The bed size cutoff points divided into small, medium, and large have been done so that approximately one third of the hospitals in a given region, location, and teaching status combination would fall within each bed size category. https://www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nrdnote.jsp.
¶A hospital is considered to be a teaching hospital if it has an American Medical Association-approved residency program is a member of the Council of Teaching Hospitals or has a ratio of full-time equivalent interns and residents to beds of 0.25 or higher. https://www.hcup-us.ahrq.gov/db/vars/hosp_ur_teach/nrdnote.jsp.

including (AF [22.7% and 24.8%] and atrial flutter [4.8% and 5.1%]) followed by heart failure (13.8% and 12.6%), pericardial complications (2.6% and 2.1%) and ischemic heart disease (1.9% and 2.3%). While pulmonary causes (primarily pneumonia [3.4% and 2.7%] followed by COPD [2.1% and 2.2%]) were responsible for 8.4% 30-day readmission and 8.3% 90-day readmission, whereas bleeding complications consisted of gastrointestinal bleed (1.5% and 1.7%), intracranial hemorrhage (0.6%) and other bleed (3.4% and 2.7%) made the third most prevalent cause of readmission. Other

**Table 3.** Predictors of 30 and 90-Day (All Cause) Readmission in Catheter Ablation of AF Patients

| | 30-Day Readmission* | | | | 90-Day Readmission | | | |
|---|---|---|---|---|---|---|---|---|
| Patient Level Variables | HR | LL | UL | *P* Value | HR | LL | UL | *P* Value |
| Age (continuous variable)† | 1.01 | 1.01 | 1.01 | <0.001 | 1.01 | 1.01 | 1.01 | <0.001 |
| Age groups | | | | | | | | |
| 18 to 49 y | Referent | Referent | Referent | | Referent | Referent | Referent | |
| 50 to 64 y | 1.00 | 0.88 | 1.14 | 0.996 | 1.00 | 0.90 | 1.12 | 0.922 |
| 65 to 79 y | 0.90 | 0.77 | 1.05 | 0.175 | 0.98 | 0.87 | 1.11 | 0.752 |
| ≥80 y | 1.14 | 0.95 | 1.37 | 0.166 | 1.17 | 1.01 | 1.35 | 0.034 |
| Female | 1.22 | 1.14 | 1.31 | <0.001 | 1.20 | 1.13 | 1.26 | <0.001 |
| Charlson Comorbidity Index‡ | | | | | | | | |
| 0 | Referent | Referent | Referent | | Referent | Referent | Referent | |
| 1 | 1.24 | 1.12 | 1.37 | <0.001 | 1.22 | 1.12 | 1.32 | <0.001 |
| ≥2 | 1.16 | 1.00 | 1.35 | 0.049 | 1.26 | 1.12 | 1.42 | <0.001 |
| Comorbidities | | | | | | | | |
| Obesity§ | 1.11 | 1.02 | 1.21 | 0.018 | 1.12 | 1.04 | 1.20 | 0.002 |
| Hypertension§ | 0.94 | 0.87 | 1.00 | 0.067 | 0.94 | 0.89 | 1.00 | 0.034 |
| Diabetes mellitus§ | 1.13 | 1.03 | 1.25 | 0.010 | 1.10 | 1.03 | 1.19 | 0.009 |
| Heart failure‖ | 1.19 | 1.08 | 1.32 | <0.001 | 1.17 | 1.08 | 1.26 | <0.001 |
| Coronary artery disease¶ | 1.17 | 1.08 | 1.27 | <0.001 | 1.18 | 1.11 | 1.25 | <0.001 |
| Chronic pulmonary disease§ | 1.22 | 1.10 | 1.34 | <0.001 | 1.17 | 1.09 | 1.26 | <0.001 |
| Chronic kidney disease∞ (stage 3 or more) | 1.28 | 1.10 | 1.48 | 0.001 | 1.26 | 1.12 | 1.41 | <0.001 |
| Prior coronary artery bypass graft® | 0.86 | 0.75 | 0.99 | 0.037 | 0.95 | 0.85 | 1.05 | 0.327 |
| Mitral valve disease$^{\mu}$ | 1.13 | 1.01 | 1.26 | 0.028 | 1.07 | 0.99 | 1.17 | 0.105 |
| Prior stroke/Transient ischemic attack© | 1.14 | 1.02 | 1.28 | 0.026 | 1.10 | 1.00 | 1.21 | 0.041 |
| Vascular disease history§ | 1.08 | 0.95 | 1.24 | 0.237 | 1.08 | 0.98 | 1.20 | 0.123 |
| Anemia§ | 1.28 | 1.14 | 1.43 | <0.001 | 1.27 | 1.16 | 1.39 | <0.001 |
| Median household income category for patient's zip code¶ | | | | | | | | |
| 0 to 25$^{th}$ percentile | Referent | Referent | Referent | | Referent | Referent | Referent | |
| 26 to 50$^{th}$ percentile | 0.93 | 0.85 | 1.03 | 0.149 | 0.97 | 0.90 | 1.04 | 0.357 |
| 51 to 75$^{th}$ percentile | 0.94 | 0.86 | 1.03 | 0.205 | 0.97 | 0.90 | 1.04 | 0.341 |
| 76 to 100$^{th}$ percentile | 0.88 | 0.80 | 0.97 | 0.009 | 0.94 | 0.87 | 1.01 | 0.092 |
| Primary payer | | | | | | | | |
| Medicare | Referent | Referent | Referent | | Referent | Referent | Referent | |
| Medicaid | 0.96 | 0.78 | 1.17 | 0.655 | 1.02 | 0.88 | 1.20 | 0.748 |
| Private including health maintenance organization | 0.67 | 0.60 | 0.74 | <0.001 | 0.69 | 0.64 | 0.76 | <0.001 |
| Self-pay/no charge/other | 0.73 | 0.59 | 0.91 | 0.004 | 0.74 | 0.62 | 0.88 | <0.001 |
| Hospital characteristics of index admission | | | | | | | | |
| Teaching hospitals# | 0.97 | 0.90 | 1.04 | 0.382 | 0.96 | 0.91 | 1.02 | 0.174 |
| Hospital volume (per 1 increase) | 1.00 | 0.99 | 1.00 | 0.131 | 0.99 | 0.99 | 0.99 | 0.046 |
| Admission characteristics of index admission | | | | | | | | |
| Elective admission | 0.95 | 0.88 | 1.02 | 0.156 | 0.91 | 0.86 | 0.96 | <0.001 |
| Weekend admission | 1.06 | 0.92 | 1.21 | 0.435 | 1.08 | 0.97 | 1.21 | 0.157 |

Continued

**Table 3.** Continued

| Patient Level Variables | 30-Day Readmission* | | | | 90-Day Readmission | | | |
|---|---|---|---|---|---|---|---|---|
| | HR | LL | UL | *P* Value | HR | LL | UL | *P* Value |
| Discharge characteristics of index admission | | | | | | | | |
| Disposition to facility | 1.30 | 1.10 | 1.53 | 0.002 | 1.25 | 1.10 | 1.43 | <0.001 |
| Length of stay, days | | | | | | | | |
| 1 | Referent | Referent | Referent | | Referent | Referent | Referent | |
| 2 to 3 | 1.39 | 1.28 | 1.50 | <0.001 | 1.22 | 1.15 | 1.30 | <0.001 |
| >3 | 1.75 | 1.59 | 1.92 | <0.001 | 1.56 | 1.45 | 1.68 | <0.001 |
| In separate analysis with entire AF population | | | | | | | | |
| Catheter ablation of AF | 1.02 | 0.97 | 1.08 | 0.424 | 0.89 | 0.86 | 0.92 | <0.001 |

A, β, ∞, ®, Ω, μ, ©: comorbidities were identified by appropriate *ICD-9-CM* diagnosis codes in secondary diagnosis field (Table S3).
AF indicates atrial fibrillation; CI, confidence interval; HR, hazard ratio; *ICD-9-CM*, *International Classification of Diseases, Ninth Edition, Clinical Modification*; LL, lower limit; UL, upper limit.
*Patients who were readmitted after 30 days were excluded from 30-day analysis.
†Two separate multivariate models were conducted, first one with age as continuous variables and second with age as group variable.
‡Charlson/Deyo Comorbidity Index (CCI) was calculated as per Deyo classification.
§Variables are AHRQ comorbidity measures.
‖Heart failure is identified by *ICD-9* codes in secondary diagnosis field and it includes systolic, diastolic, and combined heart failure.
¶Represents a quartile classification of the estimated median household income of residents within the patients' zip code, derived from zip code-demographic data obtained from Claritas. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations. Because these estimates are updated annually, the value ranges vary by year. https://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nrdnote.jsp.
#A hospital is considered to be a teaching hospital if it has an American Medical Association-approved residency program, is a member of the Council of Teaching Hospitals or has a ratio of full-time equivalent interns and residents to beds of 0.25 or higher. https://www.hcup-us.ahrq.gov/db/vars/hosp_ur_teach/nrdnote.jsp.

important causes were infections (5% and 4.9%) (including sepsis [2.6% and 2.3%]) and stroke/TIA (1.7% and 1.6%) (Table 4).

## Predictors of AF Recurrence

One thousand nine hundred sixty-four patients (5.3%) out of 37 360 patients came back to hospital with primary diagnosis of AF or for the repeat AF ablation procedure (Table S6). Trends of AF recurrence suggest that half of overall AF recurrence takes place in the first 21 to 30 days post discharge (Figure 1). Predictors of increase in AF recurrence post-AF ablation were diabetes mellitus (HR: 1.30, 95% CI: 1.06–1.61, *P*=0.013), chronic pulmonary disease (HR: 1.29, 95% CI: 1.04–1.61, *P*=0.021), female sex (HR: 1.28, 95% CI: 1.11–1.46, *P*<0.001) and index hospitalization LOS ≥2 days (LOS 2–3 days: HR: 1.34, 95% CI: 1.15–1.56, *P*<0.001) (LOS >3 days: HR: 1.60, 95% CI: 1.32–1.95, *P*<0.001). While, a predictor of decreased AF recurrence was higher hospital volume (HR: 0.998, 95% CI: 0.997–0.999, *P*<0.001) (Table 5).

## Trends of Short-Term Outcomes

Rate of 30-day readmission and in-hospital mortality (data not shown in table) have not changed from year 2010 to 2014; while 90-day readmission rate (from 17% in 2010 to 15% in 2014, 0.55% reduction per year, *P*<0.001) and AF recurrence rate (from 6.5% in 2010 to 3.7%, 0.66% reduction per year, *P*<0.001) were improving over the years (Figure 2). Resource utilization including LOS (median, interquartile range) (from 1 [1–2] days in 2010 to 2 [1–3] days in 2014, 0.11-day increments per year, *P*<0.001) and cost of care (from $22 561 [16 129–28 141] in 2010 to $23 779 [16 861–30 845] in 2014, $621 increment per year, *P*<0.001) were increasing over the study period (data not shown in table).

## Discussion

Herein, we report the largest all-player data in the United States from a nationwide readmission database on the causes and predictors of all-cause readmission, and several short-term outcomes in patients with AF undergoing catheter ablation. The important findings of our study were: 1) readmission rate of 10.9% and 16.5% was noted within first 30 and 90 days of discharge from index admission, respectively for CA of AF; 2) female sex, increased LOS of index hospitalization, disposition to facility, and comorbidities (diabetes mellitus, heart failure, CAD, chronic pulmonary disease, CKD, prior stroke/TIA and anemia) were the predictors of increased readmissions whereas private insurance coverage, high hospital volume for the catheter ablation, and non-urgent admission correlated to improved 90-day readmission; 3) most common causes of readmission were cardiac, where AF recurrence was the most common followed

**Table 4.** Admitting Diagnosis of Readmitted Patients Amongst CA of AF

| | 30-Day Readmission | 90-Day Readmission |
|---|---|---|
| Causes of readmission after CA of AF | | |
| Total readmissions | 3803 | 6164 |
| Cardiac causes | 58.4%* | 59.1%* |
| Heart failure† | 13.8% | 12.6% |
| Arrhythmia | 32.6% | 35.2% |
| Atrial fibrillation | 22.7% | 24.8% |
| Atrial flutter | 4.8% | 5.1% |
| Heart block excluding 1st degree block | 0.2% | 0.1% |
| Sinoatrial node dysfunction | 1.51% | 1.64% |
| Paroxysmal ventricular tachycardia | 0.67% | 0.68% |
| Paroxysmal supraventricular tachycardia | 0.47% | 0.52% |
| Others‡ | 2.26% | 2.35% |
| Ischemic heart disease | 1.9% | 2.3% |
| Heart valve disease | 0.4% | 0.7% |
| Hypertension | 0.3% | 0.3% |
| Hypotension/dizziness/syncope | 1.7% | 1.4% |
| Pericardial complications | 2.6% | 2.1% |
| Other cardiac complication | 5.2% | 4.5% |
| Vascular causes/complications | 3.0%* | 2.2%* |
| Infections | 5.0%* | 4.9%* |
| Sepsis | 2.6% | 2.3% |
| Pulmonary causes/complications | 8.4%* | 8.3%* |
| Chronic obstructive pulmonary diseases | 2.1% | 2.2% |
| Pneumonia | 3.4% | 2.7% |
| Other respiratory causes/complications | 2.9% | 3.4% |
| Gastrointestinal causes/complication | 3.8%* | 4.3%* |
| Neurological complications | 2.7%* | 2.8%* |
| Ischemic stroke/Transient ischemic attack | 1.7% | 1.6% |
| Other neurological causes/complications | 1.0% | 1.2% |
| Kidney or urinary causes/complications | 4.5%* | 3.7%* |
| Electrolyte imbalance | 0.6% | 0.8% |
| Acute/acute on chronic kidney failure | 1.6% | 1.5% |
| Other kidney/urinary tract etiology/complication | 2.4% | 1.4% |
| Hematology | 1.0%* | 0.5%* |
| Anemia | 0.7% | 0.3% |
| Others | 0.3% | 0.3% |
| Trauma/fracture/poisoning | 1.0%* | 1.2%* |
| Endocrine causes | 0.5%* | 0.6%* |
| Diabetes mellitus | 0.3% | 0.4% |
| Others | 0.2% | 0.2% |
| Malignancy | 0.9%* | 1.2%* |
| Bleeding complications | 5.4%* | 5.0%* |

Continued

**Table 4.** Continued

| | 30-Day Readmission | 90-Day Readmission |
|---|---|---|
| Gastrointestinal bleed | 1.5% | 1.7% |
| Intracranial bleed | 0.6% | 0.6% |
| Intracranial bleed without trauma | 0.4% | 0.4% |
| Intracranial bleed with trauma | 0.1% | 0.2% |
| Other bleeding complications | 3.4% | 2.7% |
| Psychiatry causes | 0.6%* | 0.7%* |
| Pulmonary embolism (PE)/deep venous thrombosis (DVT) | 1.3%* | 1.1%* |
| Others[§] | 3.6%* | 4.5%* |

AF indicates atrial fibrillation; CA, catheter ablation.
*Overall percentage for respective system.
[†]Heart failure includes systolic, diastolic, and combined heart failure.
[‡]Other arrhythmia includes: anomalous atrioventricular excitation, long QT syndrome, other specified conduction disorders, conduction disorder, unspecified, paroxysmal tachycardia, unspecified, supraventricular premature beats, other premature beats, other specified cardiac dysrhythmias, cardiac dysrhythmia, unspecified, first degree atrioventricular block, ventricular fibrillation, cardiac arrest.
[§]Skin, subcutaneous, joints, non-specific laboratory findings, non-specific symptoms.

by heart failure; and 4) female sex, diabetes mellitus, chronic pulmonary disease, and higher LOS during index hospitalization were the predictors of increased AF recurrence requiring hospitalization.

The strength of our study is the large sample size representing real-world data. This is in contrast to a large number of previous studies on post-CA of AF readmission, which have been restricted by their comparatively small sample size[11] or selective population cohorts.[5,6,12] We noted a higher 90-day readmission rate (16.5%) in our study compared with data published by Noseworthy et al[13] (13.4%). This difference in readmission rate is likely explained

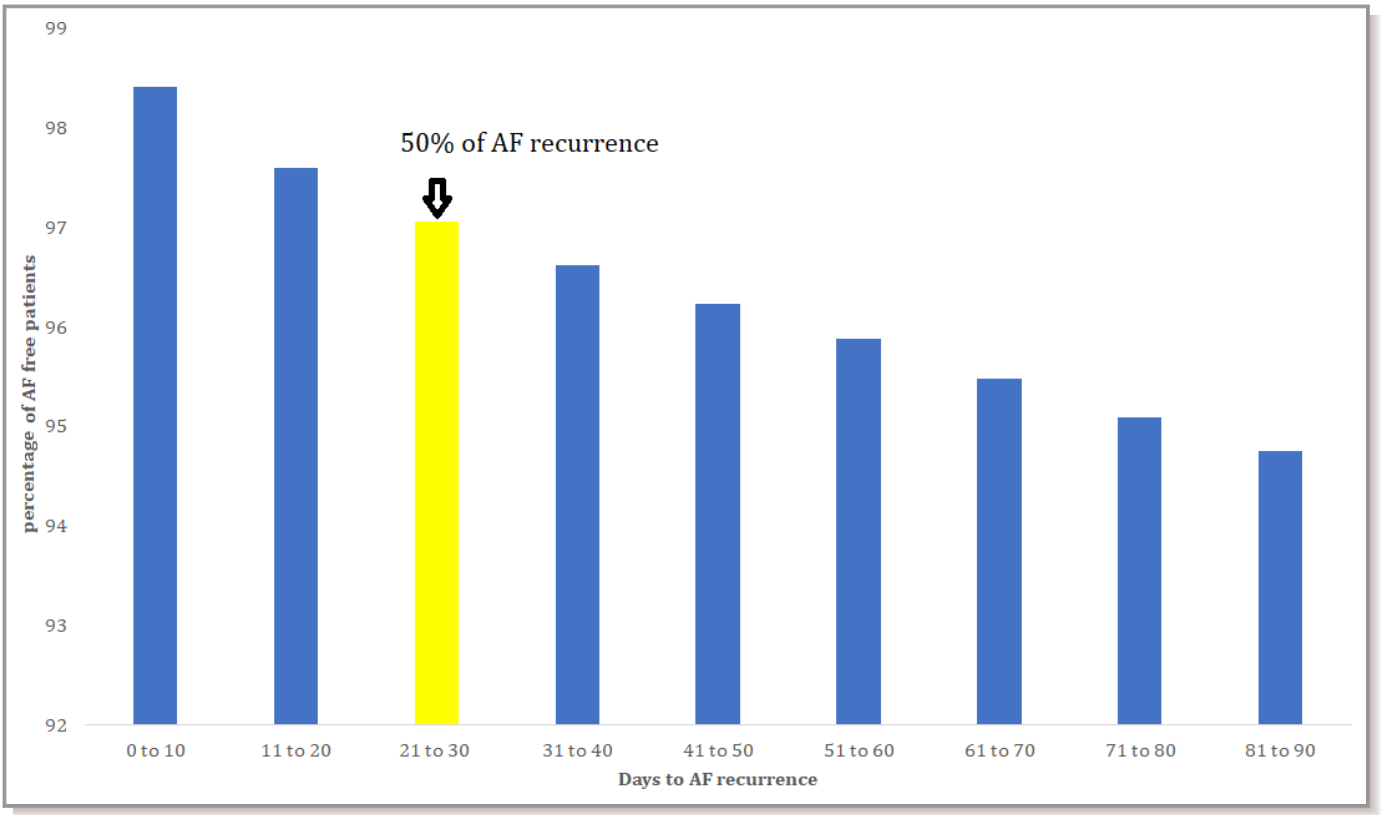


**Figure 1.** Trends of atrial fibrillation (AF) recurrence.

**Table 5.** Predictors of Atrial Fibrillation Recurrence Over 90 Days Post-Catheter Ablation of Atrial Fibrillation

| | Atrial Fibrillation Recurrence Post-Catheter Ablation | | | |
|---|---|---|---|---|
| Patient Level Variables | HR | LL | UL | *P* Value |
| Age (continuous variable)* | 1.00 | 0.99 | 1.01 | 0.493 |
| Age groups | | | | |
| 18 to 49 y | Referent | Referent | Referent | |
| 50 to 64 y | 1.14 | 0.87 | 1.48 | 0.351 |
| 65 to 79 y | 1.23 | 0.90 | 1.69 | 0.194 |
| ≥80 y | 1.08 | 0.72 | 1.62 | 0.707 |
| Female | 1.28 | 1.11 | 1.46 | <0.001 |
| Charlson Comorbidity Index† | | | | |
| 0 | Referent | Referent | Referent | |
| 1 | 1.01 | 0.83 | 1.24 | 0.901 |
| ≥2 | 0.96 | 0.73 | 1.27 | 0.787 |
| Comorbidities | | | | |
| Obesity‡ | 1.16 | 0.97 | 1.39 | 0.102 |
| Hypertension‡ | 1.01 | 0.87 | 1.16 | 0.964 |
| Diabetes mellitus‡ | 1.30 | 1.06 | 1.61 | 0.013 |
| Chronic pulmonary disease‡ | 1.29 | 1.04 | 1.61 | 0.021 |
| Chronic kidney disease∞ (stage 3 or more) | 0.90 | 0.58 | 1.39 | 0.645 |
| Hyperthyroidism$^{\Omega}$ | 0.45 | 0.15 | 1.40 | 0.169 |
| Alcohol abuse‡ | 0.31 | 0.10 | 0.96 | 0.042 |
| Anemia‡ | 1.23 | 0.94 | 1.60 | 0.134 |
| Median household income category for patient's zip code§ | | | | |
| 1. 0 to 25th percentile | Referent | Referent | Referent | |
| 2. 26 to 50th percentile | 1.11 | 0.91 | 1.35 | 0.320 |
| 3. 51 to 75th percentile | 0.99 | 0.81 | 1.20 | 0.906 |
| 4. 76 to 100th percentile | 0.90 | 0.74 | 1.10 | 0.292 |
| Primary payer | | | | |
| Medicare | Referent | Referent | Referent | |
| Medicaid | 1.39 | 0.94 | 2.04 | 0.098 |
| Private including health maintenance organization | 0.85 | 0.68 | 1.05 | 0.132 |
| Self-pay/no charge/other | 0.86 | 0.55 | 1.34 | 0.502 |
| Hospital characteristics of index admission | | | | |
| Hospital volume (per 1 increase) | 0.998 | 0.997 | 0.999 | <0.001 |
| Admission characteristics of index admission | | | | |
| Electives admission | 0.91 | 0.78 | 1.05 | 0.190 |
| Discharge characteristics of index admission | | | | |
| Disposition to facility | 0.69 | 0.38 | 1.28 | 0.241 |
| Length of stay, days | | | | |
| 1 | Referent | Referent | Referent | |

Continued

**Table 5.** Continued

| Patient Level Variables | Atrial Fibrillation Recurrence Post-Catheter Ablation | | | |
|---|---|---|---|---|
| | HR | LL | UL | *P* Value |
| 2 to 3 | 1.34 | 1.15 | 1.56 | <0.001 |
| >3 | 1.60 | 1.32 | 1.95 | <0.001 |

CI indicates confidence interval; HR, hazard ratio; LL, lower limit; UL, upper limit. α, β, ∞, ®, Ω, μ, ©: comorbidities were identified by appropriate *ICD-9-CM* diagnosis codes in secondary diagnosis field (Table S3).

*ICD-9-CM* indicates *International Classification of Diseases, Ninth Edition, Clinical Modification*.

*Two separate multivariate models were conducted, first one with age as continuous variables and second with age as group variable.

†Charlson/Deyo Comorbidity Index (CCI) was calculated as per Deyo classification.

‡Variables are AHRQ comorbidity measures.

§Represents a quartile classification of the estimated median household income of residents within the patients' zip code, derived from zip code-demographic data obtained from Claritas. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations. Because these estimates are updated annually, the value ranges vary by year. https://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nrdnote.jsp.

by the inclusion of only privately insured patients from Optum Labs Data Warehouse database by Noseworthy et al.[13] The key observation in our study was a significantly lower 30-day readmission rate (10.9%) in ablated AF patients compared with data published by Freeman et al[12] who reported a 30-day readmission rate ranging between 15.3% to 15.5% in patients admitted with principal diagnosis for AF during years 1999–2011. Similarly, Munir et al[14] noted a 30-day readmission rate of 15.1% using a patient database similar to the database in our study. A lower readmission rate observed in our study reflects the salutary effect of catheter ablation in AF patients. Moreover, our study also noted catheter ablation to be a significant predictor of reduced 90-day readmission among AF patients (Table 3 and Table S6) thus supporting the same observation. Furthermore, females were found to be less likely to receive CA for AF than men despite higher number of AF hospitalizations. The causality of the same is unknown but our results were similar to previous studies on cardiac intervention such as use of Cardiac Resynchronization Therapy[15] and treatment of non-ST-segment elevation acute coronary syndromes.[16]

Our study noted several predictors of increased readmission after CA in AF patients thus identifying the vulnerable subgroup of patients who can benefit from individualized in-hospital as well as post-discharge care. Similar to a prior study,[13] we identified older age, female sex, and certain comorbidities (diabetes mellitus, heart failure, CAD, CKD, chronic pulmonary disease) to be associated with high 90-day readmission rates in AF patients undergoing CA. Similar characteristics except age predicted increased 30-day readmission related to CA in AF patients. High hospital volume for CA was noted to be associated with reduced readmission as noted by Shah et al[5] thus reaffirming the notion that increased procedure experience is associated with better outcomes. Additionally, prior stroke/TIA was a significant predictor of increase readmission in our study converse to the findings published in the previous studies.[5,13]

AF recurrence was the most common etiology (22.7% at 30 days and 24.8% at 90 days follow-up) for readmission followed by heart failure in the study population. Various studies have reported post-ablation AF recurrence rate ranging between 13% and 44% with a long-term follow up.[17,18] Observation by Shah et al[5] that 26.9% of readmissions after 30-day follow-up in catheter ablated AF patients were attributable to AF and atrial flutter coincide with our study. Readmission because of heart failure partly related to the high prevalence of the same in the study population but heart failure has been a well-recognized complication after extensive catheter ablation.[19] High heart failure rate in readmitted subjects in our study compared with Noseworthy et al[13] is partly explained by the greater proportion of subjects aged ≥65 years in our study. Readmission rate because of stroke/TIA and bleeding noted in our study is similar to previously published studies.[17,20–22]

Our study reported an AF recurrence rate of 5.3% which is in line with the observation made by Noseworthy et al[13] who reported an AF recurrence of 5.4% during the 90-day follow-up after CA in AF patients. We identified patient subgroups at high risk of AF recurrence after catheter ablation. Females were noted to have higher association to AF recurrence compared with males which again reaffirms the sex-related variation in outcomes after catheter ablation for AF. Contrary to Berruezo et al[23] hypertension was not found to be a predictor of AF recurrence in our study. Additionally, we noted diabetes mellitus and chronic pulmonary disease to be associated with a high likelihood of AF recurrence. Our findings support the previously noted observation by Goudis[24] that concurrent COPD in AF patients leads to worse outcomes in terms of AF progression, AF recurrence after catheter ablation, and overall mortality. Increased hospital volume for the catheter ablation predicted lower AF recurrence in our study, again highlighting the salubrious importance of increased institutional experience. This information is of high value in patient selection for catheter ablation.

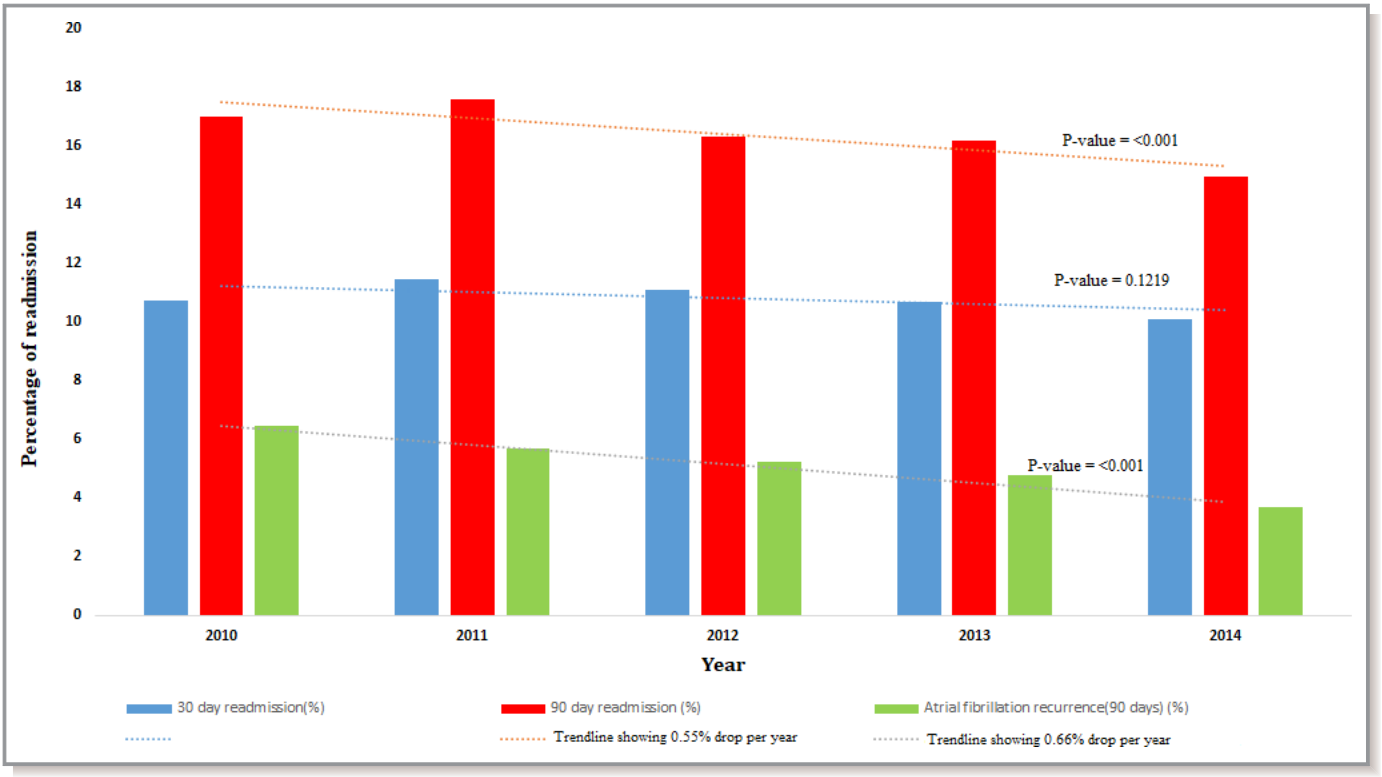


**Figure 2.** Trends of short-term outcomes.

We noted a significant decline in AF recurrence and 90-day readmission rate in post-ablated AF patients during the study period which endorses the findings published by Noseworthy et al.[13] This gradual betterment in outcomes reflects the irrefutable effects of improvement in catheter technology, institutional experience, and post-ablation anti-coagulation techniques. However, a rise in AF ablation related cost of care and length of hospitalization over the study period was noted as well. Our observation that those subgroups of AF patients with higher use of catheter ablation had better outcomes as well (ie, male patients, subjects with higher household income or private insurance coverage, patients admitted in medium/large hospitals, hospitals with academic affiliation or those having non-urgent admission) supports the current inclusion model for catheter ablation.

## Limitations

Though our study originates from the well-designed National Readmission Database from the HCUP, there remain few limitations. The major limitation of our study holds true for most large administrative database analyses, which includes errors in coding primary diagnoses, and under-reporting of secondary diagnoses. Also, clinically insignificant differences can sometimes be presented as statistically significant difference because of large sample size. Furthermore, our data lack some clinical information such as duration of atrial fibrillation, anti-arrhythmic drugs, anti-coagulation use, and cardiac biomarkers. And NRD does not carry information about the race and results from invasive and non-invasive diagnostic modalities which could have predicted adverse outcomes in a much better way. Nevertheless, the NRD database is clinically sound with its near population-based case ascertainment, a large sample size, and valid information on readmissions, with the representation of patients from all regions, not limited to Medicare/Medicaid beneficiaries. The largest publicly available and nationally representative sample allowed us to evaluate some meaningful outcome results for increasingly relevant quality parameters.

## Conclusions

We reported increased hospitalization post AF ablation in women, patients with multiple higher comorbidities whereas lower rates of hospitalization in high volume hospitals and ablations were performed in patients with private insurance. Identifying high-risk group for readmissions and potential reasons and interventions to mitigate them could reduce resource utilization.

## Disclosures

None.

## References


1. Feinberg WM, Blackshear JL, Laupacis A, Kronmal R, Hart RG. Prevalence, age distribution, and gender of patients with atrial fibrillation: analysis and implications. *Arch Intern Med*. 1995;155:469–473.
2. January CT, Wann LS, Alpert JS, Calkins H, Cigarroa JE, Cleveland JC Jr, Conti JB, Ellinor PT, Ezekowitz MD, Field ME, Murray KT, Sacco RL, Stevenson WG, Tchou PJ, Tracy CM, Yancy CW. 2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society. *Circulation*. 2014;130:2071–2104.
3. Clarnette JA, Brooks AG, Mahajan R, Elliott AD, Twomey DJ, Pathak RK, Kumar S, Munawar DA, Young GD, Kalman JM, Lau DH, Sanders P. Outcomes of persistent and long-standing persistent atrial fibrillation ablation: a systematic review and meta-analysis. *Europace*. 2017;00:1–11.
4. HCUP. Health Care and Utilization Project, NRD data overview. 2017.
5. Shah RU, Freeman JV, Shilane D, Wang PJ, Go AS, Hlatky MA. Procedural complications, rehospitalizations, and repeat procedures after catheter ablation for atrial fibrillation. *J Am Coll Cardiol*. 2012;59:143–149.
6. Piccini JP, Sinner MF, Greiner MA, Hammill BG, Fontes JD, Daubert JP, Ellinor PT, Hernandez AF, Walkey AJ, Heckbert SR, Benjamin EJ, Curtis LH. Outcomes of Medicare beneficiaries undergoing catheter ablation for atrial fibrillation. *Circulation*. 2012;126:2200–2207.
7. HCUP. Healthcare and Utilization Project, NRD data description. 2014.
8. Healthcare Cost and Utilization Project (HCUP) Comorbidity Software V. Available at: https://www.hcup-us.ahrq.gov/toolssoftware/comorbidity/comorbidity.jsp. Accessed June 1, 2016.
9. Deyo RA, Cherkin DC, Ciol MA. Adapting a clinical comorbidity index for use with ICD-9-CM administrative databases. *J Clin Epidemiol*. 1992;45:613–619.
10. The US inflation calculator. Available at: http://www.Usinflationcalculator.com/. Accessed May 8, 2018.
11. Weerasooriya R, Khairy P, Litalien J, Macle L, Hocini M, Sacher F, Lellouche N, Knecht S, Wright M, Nault I, Miyazaki S, Scavee C, Clementy J, Haissaguerre M, Jais P. Catheter ablation for atrial fibrillation: are results maintained at 5 years of follow-up? *J Am Coll Cardiol*. 2011;57:160–166.
12. Freeman JV, Wang Y, Akar J, Desai N, Krumholz H. National trends in atrial fibrillation hospitalization, readmission, and mortality for Medicare beneficiaries, 1999–2013. *Circulation*. 2017;135:1227–1239.
13. Noseworthy PA, Kapa S, Haas LR, Van Houten H, Deshmuk AJ, Mulpuru SK, McLeod CJ, Asirvatham SJ, Friedman PA, Shah ND, Packer DL. Trends and predictors of readmission after catheter ablation for atrial fibrillation, 2009–2013. *Am Heart J*. 2015;170:483–489.
14. Munir MB, Sharbaugh MS, Ahmad S, Patil S, Mehta K, Althouse AD, Saba S. Causes and predictors of 30-day readmissions in atrial fibrillation (from the nationwide readmissions database). *Am J Cardiol*. 2017;120:399–403.
15. Alaeddini J, Wood MA, Amin MS, Ellenbogen KA. Gender disparity in the use of cardiac resynchronization therapy in the United States. *Pacing Clin Electrophysiol*. 2008;31:468–472.
16. Blomkalns AL, Chen AY, Hochman JS, Peterson ED, Trynosky K, Diercks DB, Brogan GX, Boden WE, Roe MT, Ohman EM. Gender disparities in the diagnosis and treatment of non-ST-segment elevation acute coronary syndromes: large-scale observations from the CRUSADE (can rapid risk stratification of unstable angina patients suppress adverse outcomes with early implementation of the American College of Cardiology/American Heart Association Guidelines) National Quality Improvement Initiative. *J Am Coll Cardiol*. 2005;45:832–837.
17. D'Ascenzo F, Corleto A, Biondi-Zoccai G, Anselmino M, Ferraris F, di Biase L, Natale A, Hunter RJ, Schilling RJ, Miyazaki S, Tada H, Aonuma K, Yenn-Jiang L, Tao H, Ma C, Packer D, Hammill S, Gaita F. Which are the most reliable predictors of recurrence of atrial fibrillation after transcatheter ablation? A meta-analysis. *Int J Cardiol*. 2013;167:1984–1989.
18. Stabile G, Bertaglia E, Senatore G, De Simone A, Zoppo F, Donnici G, Turco P, Pascotto P, Fazzari M, Vitale DF. Catheter ablation treatment in patients with drug-refractory atrial fibrillation: a prospective, multi-centre, randomized, controlled study (Catheter Ablation for the Cure of Atrial Fibrillation Study). *Eur Heart J*. 2006;27:216–221.
19. Tan HW, Wang XH, Shi HF, Sun YM, Zhou L, Gu JN, Han B, Jiang WF, Yang GS, Liu X. Congestive heart failure after extensive catheter ablation for atrial fibrillation: prevalence, characterization, and outcome. *J Cardiovasc Electrophysiol*. 2011;22:632–637.
20. Pappone C, Rosanio S, Augello G, Gallus G, Vicedomini G, Mazzone P, Gulletta S, Gugliotta F, Pappone A, Santinelli V, Tortoriello V, Sala S, Zangrillo A, Crescenzi G, Benussi S, Alfieri O. Mortality, morbidity, and quality of life after circumferential pulmonary vein ablation for atrial fibrillation: outcomes from a controlled nonrandomized long-term study. *J Am Coll Cardiol*. 2003;42:185–197.
21. Oral H, Chugh A, Ozaydin M, Good E, Fortino J, Sankaran S, Reich S, Igic P, Elmouchi D, Tschopp D, Wimmer A, Dey S, Crawford T, Pelosi F Jr, Jongnarangsin K, Bogun F, Morady F. Risk of thromboembolic events after percutaneous left atrial radiofrequency ablation of atrial fibrillation. *Circulation*. 2006;114:759–765.
22. Freeman JV, Tabada GH, Reynolds K, Sung SH, Liu TI, Gupta N, Go AS. Contemporary procedural complications, hospitalizations, and emergency visits after catheter ablation for atrial fibrillation. *Am J Cardiol*. 2018;121:602–608.
23. Berruezo A, Tamborero D, Mont L, Benito B, Tolosana JM, Sitges M, Vidal B, Arriagada G, Méndez F, Matiello M, Molina I, Brugada J. Pre-procedural predictors of atrial fibrillation recurrence after circumferential pulmonary vein ablation. *Eur Heart J*. 2007;28:836–841.
24. Goudis CA. Chronic obstructive pulmonary disease and atrial fibrillation: an unknown relationship. *J Cardiol*. 2017;69:699–705.

# SUPPLEMENTAL MATERIAL

**Table S1. International Classification of Disease, Version 9 (ICD-9) Codes Used for Atrial Fibrillation and AF ablation case Identification.**

| Inclusion Criteria | ICD-9 Codes |
|---|---|
| Atrial fibrillation (primary position) | 427.31 |
| Ablation of heart tissue via a peripherally inserted catheter (any position) | 37.34 |
| | |
| **Exclusion Criteria** | **ICD-9 Codes** |
| Supraventricular tachycardia | 427.0 |
| Ventricular tachycardia | 427.1 |
| Atrial flutter | 427.32 |
| Other premature beats | 427.69 |
| Cardiac dysrhythmia | 427.89 |
| Wolf-Parkinson-White | 426.7 |
| Lown-Ganong-Levine | 426.81 |
| Atrioventricular nodal tachycardia | 426.89 |
| Pacemaker implantation | 00.50, 00.52, 00.53, 37.71 to 37.79, 37.81 to 37.89 |
| Implantable cardioverter defibrillator implantation | 37.94 to 37.98, 00.51, 00.54 |
| Open surgical ablation* | 37.33 |
| *Open surgical ablation: excision or destruction of lesion of heart using open approach | |

**Table S2. ICD 9 codes for admitting diagnosis of readmission.**

| **Causes of Readmission** | **Result (%)** | | **Level 1** | **Level 2** | **Level 3** |
|---|---|---|---|---|---|
| **Total Readmission** | | | | | |
| | **No ablation** | **ablation** | | | |
| **Cardiac causes/complication** | **49.43** | **59.07** | 1 | | |
| Heart failure | 12.03 | 12.63 | | A | |
| Arrhythmia | 27.16 | 35.18 | | B | |
| *Atrial Fibrillation* | 22.7 | 24.8 | | | I |
| *Atrial Flutter* | 4.8 | 5.1 | | | III |
| *Heart block excluding 1st degree block* | 0.2 | 0.1 | | | II |
| *Sinoatrial node dysfunction* | 1.51 | 1.64 | | | V |
| *Paroxysmal ventricular tachycardia* | 0.67 | 0.68 | | | VI |
| *Paroxysmal supraventricular tachycardia* | 0.47 | 0.52 | | | VII |
| *Others*[&] | 3.25 | 5.15 | | | IV |
| Ischemic heart disease | 3.19 | 2.31 | | C | |
| Heart Valve disease | 1.4 | 0.68 | | D | |
| Hypertension | 0.29 | 0.28 | | E | |
| Hypotension/dizziness/syncope | 1.6 | 1.42 | | F | |
| Pericardial complications | 0.42 | 2.05 | | G | |
| Other cardiac complication | 3.34 | 4.52 | | H | |
| ***Overall Vascular causes/complications*** | **1.06** | **2.22** | 2 | | |
| ***Infections*** | **7.26** | **4.85** | 3 | | |
| Septicemia | 4.14 | 2.26 | | A | |
| ***Pulmonary causes/complications*** | **10.51** | **8.28** | 4 | | |
| Respiratory Failure | 1.73 | 1.01 | | A | |
| Chronic obstructive lung diseases | 2.98 | 2.2 | | B | |

| | | | | | |
|---|---|---|---|---|---|
| Pneumonia | 3.61 | 2.71 | | C | |
| Other respiratory causes/complications | 2.19 | 2.36 | | D | |
| ***GI causes/complication*** | **4.69** | **4.28** | 5 | | |
| ***Neurological complications*** | **4.06** | **2.8** | 6 | | |
| Ischemic Stroke/Transient ischemic attack | 2.48 | 1.59 | | A | |
| Other Neurological causes/complications | 1.58 | 1.21 | | B | |
| ***Kidney or Urinary causes/complications*** | **5.42** | **3.73** | 7 | | |
| Electrolyte imbalance | 0.89 | 0.79 | | A | |
| Acute/Acute on chronic kidney failure | 2.34 | 1.51 | | B | |
| Other kidney/urinary tract etiology/complication | 2.19 | 1.43 | | C | |
| ***Hematology*** | **1.28** | **0.5** | 8 | | |
| Anemia | 0.58 | 0.25 | | A | |
| Others | 0.7 | 0.25 | | B | |
| ***Trauma/Fracture/poisoning*** | **2.52** | **1.2** | 9 | | |
| ***Endocrine causes*** | **1.07** | **0.58** | 10 | | |
| Diabetes mellitus | 0.77 | 0.37 | | A | |
| Others | 0.3 | 0.21 | | B | |
| ***Malignancy*** | **2.27** | **1.21** | 11 | | |
| ***Bleeding complications*** | **4.09** | **4.99** | 12 | | |
| Gastrointestinal bleed | 2.6 | 1.7 | | A | |
| Intracranial bleed | 0.57 | 0.59 | | B | |
| *Intracranial bleed without trauma* | 0.29 | 0.39 | | | I |
| *Intracranial bleed with trauma* | 0.28 | 0.2 | | | II |
| Other bleeding complications | 0.92 | 2.7 | | C | |
| ***Psychiatry causes*** | **1.68** | **0.67** | 13 | | |
| ***Pulmonary Embolism (PE)/Deep Venous Thrombosis (DVT)*** | **0.91** | **1.1** | 14 | | |
| ***Others***[¥] | **4.71** | **4.54** | 15 | | |

¥ : Skin, subcutaneous, joints, nonspecific lab findings, nonspecific symptoms

&: Other Arrhythmia Includes: Anomalous atrioventricular excitation, Long QT syndrome, Other specified conduction disorders, Conduction disorder, unspecified, Paroxysmal tachycardia, unspecified, Supraventricular premature beats, Other

premature beats, Other specified cardiac dysrhythmias, Cardiac dysrhythmia, unspecified, *First Degree AV block, Ventricular Fibrillation, Cardiac Arrest*

**Description of ICD codes for etiology of 90 days readmission.**

| DX1 | ablation | Description of ICD codes | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|---|
| 39891 | 0.036260668 | Rheumatic heart failure (congestive) | 1 | A | |
| 40291 | 0.26092969 | Unspecified hypertensive heart disease with heart failure | 1 | A | |
| 40401 | 0.022279705 | Hypertensive heart and chronic kidney disease, malignant, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified | 1 | A | |
| 40491 | 0.338849599 | Hypertensive heart and chronic kidney disease, unspecified, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified | 1 | A | |
| 40493 | 0.050807221 | Hypertensive heart and chronic kidney disease, unspecified, with heart failure and chronic kidney disease stage V or end stage renal disease | 1 | A | |
| 4280 | 2.394352994 | Congestive heart failure, unspecified | 1 | A | |
| 42821 | 0.27394774 | Acute systolic heart failure | 1 | A | |
| 42822 | 0.349072797 | Chronic systolic heart failure | 1 | A | |
| 42823 | 4.25221247 | Acute on chronic systolic heart failure | 1 | A | |
| 42830 | 0.259192667 | Diastolic heart failure, unspecified | 1 | A | |
| 42831 | 0.81341855 | Acute diastolic heart failure | 1 | A | |
| 42832 | 0.104429961 | Chronic diastolic heart failure | 1 | A | |
| 42833 | 2.654674356 | Acute on chronic diastolic heart failure | 1 | A | |
| 42841 | 0.134342438 | Acute combined systolic and diastolic heart failure | 1 | A | |
| 42842 | 0.06952436 | Chronic combined systolic and diastolic heart failure | 1 | A | |
| 42843 | 0.618413088 | Acute on chronic combined systolic and diastolic heart failure | 1 | A | |
| | 12.6327083 | | | | |
| 42731 | 24.75072829 | Atrial fibrillation | 1 | B | I |
| 4260 | 0.080683542 | Atrioventricular block, complete | 1 | B | II |
| 42613 | 0.022784517 | Other second degree atrioventricular block | 1 | B | II |

| | | | | | |
|---|---|---|---|---|---|
| 4266 | 0.038978028 | Other heart block | 1 | B | II |
| | 0.142446087 | | | | |
| 42732 | 5.091023432 | Atrial flutter | 1 | B | III |
| 42611 | 0.021530677 | First degree atrioventricular block | 1 | B | IV |
| 42682 | 0.027033107 | Long QT syndrome | 1 | B | IV |
| 4270 | 0.51751844 | Paroxysmal supraventricular tachycardia | 1 | B | VI |
| 4271 | 0.683194576 | Paroxysmal ventricular tachycardia | 1 | B | VII |
| 42741 | 0.050504862 | Ventricular fibrillation | 1 | B | IV |
| 4275 | 0.054151914 | Cardiac arrest | 1 | B | IV |
| 42761 | 0.024487388 | Supraventricular premature beats | 1 | B | IV |
| 42769 | 0.028269532 | Other premature beats | 1 | B | IV |
| 42781 | 1.637933889 | Sinoatrial node dysfunction | 1 | B | V |
| 42789 | 2.105232573 | Other specified cardiac dysrhythmias | 1 | B | IV |
| | 5.149856958 | | | | |
| 41011 | 0.022063184 | Acute myocardial infarction of other anterior wall, initial episode of care | 1 | C | |
| 41031 | 0.020023381 | Acute myocardial infarction of inferoposterior wall, initial episode of care | 1 | C | |
| 41041 | 0.063151413 | Acute myocardial infarction of other inferior wall, initial episode of care | 1 | C | |
| 41071 | 0.606229818 | Subendocardial infarction, initial episode of care | 1 | C | |
| 41091 | 0.032394118 | Acute myocardial infarction of unspecified site, initial episode of care | 1 | C | |
| 4111 | 0.078918602 | Intermediate coronary syndrome | 1 | C | |
| 41189 | 0.022315896 | Other acute and subacute forms of ischemic heart disease, other | 1 | C | |
| 4139 | 0.065858959 | Other and unspecified angina pectoris | 1 | C | |
| 41400 | 0.202706286 | Coronary atherosclerosis of unspecified type of vessel, native or graft | 1 | C | |
| 41401 | 1.087796989 | Coronary atherosclerosis of native coronary artery | 1 | C | |
| 41402 | 0.047806561 | Coronary atherosclerosis of autologous vein bypass graft | 1 | C | |
| 4148 | 0.064327422 | Other specified forms of chronic ischemic heart disease | 1 | C | |
| | 2.313592629 | | | | |
| 3963 | 0.020267879 | Mitral valve insufficiency and aortic valve insufficiency | 1 | D | |
| 4240 | 0.361413326 | Mitral valve disorders | 1 | D | |

| | | | | | |
|---|---|---|---|---|---|
| 4241 | 0.293776683 | Aortic valve disorders | 1 | D | |
| | 0.675457888 | | | | |
| 4010 | 0.109288697 | Malignant essential hypertension | 1 | E | |
| 4019 | 0.172022664 | Unspecified essential hypertension | 1 | E | |
| | 0.281311361 | | | | |
| 4580 | 0.285757077 | Orthostatic hypotension | 1 | F | |
| 45821 | 0.02426044 | Hypotension of hemodialysis | 1 | F | |
| 45829 | 0.196623041 | Other iatrogenic hypotension | 1 | F | |
| 4589 | 0.164733289 | Hypotension, unspecified | 1 | F | |
| 7802 | 0.573606766 | Syncope and collapse | 1 | F | |
| 7804 | 0.176691901 | Dizziness and giddiness | 1 | F | |
| | 1.421672513 | | | | |
| 42090 | 0.355718794 | Acute pericarditis, unspecified | 1 | G | |
| 42099 | 0.14066765 | Other acute pericarditis | 1 | G | |
| 4230 | 0.075688301 | Hemopericardium | 1 | G | |
| 4232 | 0.055389334 | Constrictive pericarditis | 1 | G | |
| 4238 | 0.075844492 | Other specified diseases of pericardium | 1 | G | |
| 4239 | 1.348453844 | Unspecified disease of pericardium | 1 | G | |
| | 2.051762415 | | | | |
| 4254 | 0.074442147 | Other primary cardiomyopathies | 1 | H | |
| 4290 | 0.017572024 | Myocarditis, unspecified | 1 | H | |
| 4294 | 0.148575471 | Functional disturbances following cardiac surgery | 1 | H | |
| 42983 | 0.023045581 | Takotsubo syndrome | 1 | H | |
| 7455 | 0.042598319 | Ostium secundum type atrial septal defect | 1 | H | |
| 7851 | 0.157671603 | Palpitations | 1 | H | |
| 78650 | 0.923288135 | Chest pain, unspecified | 1 | H | |
| 78651 | 0.100928073 | Precordial pain | 1 | H | |
| 78659 | 1.519489914 | Other chest pain | 1 | H | |
| 99600 | 0.04310468 | Mechanical complication of unspecified cardiac device, implant, and graft | 1 | H | |
| 99601 | 0.453928226 | Mechanical complication due to cardiac pacemaker (electrode) | 1 | H | |

| | | | | | |
|---|---|---|---|---|---|
| 99604 | 0.195855863 | Mechanical complication of automatic implantable cardiac defibrillator | 1 | H | |
| 99672 | 0.12590532 | Other complications due to other cardiac device, implant, and graft | 1 | H | |
| 9971 | 0.603461292 | Cardiac complications, not elsewhere classified | 1 | H | |
| V5331 | 0.039334151 | Fitting and adjustment of cardiac pacemaker | 1 | H | |
| V5332 | 0.048872124 | Fitting and adjustment of automatic implantable cardiac defibrillator | 1 | H | |
| | 4.518072923 | | | | |
| 44020 | 0.013397492 | Atherosclerosis of native arteries of the extremities, unspecified | 2 | | |
| 44021 | 0.023057559 | Atherosclerosis of native arteries of the extremities with intermittent claudication | 2 | | |
| 44024 | 0.045106725 | Atherosclerosis of native arteries of the extremities with gangrene | 2 | | |
| 44029 | 0.028047767 | Other atherosclerosis of native arteries of the extremities | 2 | | |
| 4412 | 0.020326126 | Thoracic aneurysm without mention of rupture | 2 | | |
| 4413 | 0.024479696 | Abdominal aneurysm, ruptured | 2 | | |
| 4414 | 0.065474007 | Abdominal aneurysm without mention of rupture | 2 | | |
| 4420 | 0.017895652 | Aneurysm of artery of upper extremity | 2 | | |
| 4423 | 0.284727006 | Aneurysm of artery of lower extremity | 2 | | |
| 44289 | 0.023981838 | Aneurysm of other specified artery | 2 | | |
| 44421 | 0.020957239 | Arterial embolism and thrombosis of upper extremity | 2 | | |
| 44422 | 0.089583761 | Arterial embolism and thrombosis of lower extremity | 2 | | |
| 44489 | 0.035037732 | Embolism and thrombosis of other specified artery | 2 | | |
| 4465 | 0.023057559 | Giant cell arteritis | 2 | | |
| 4470 | 0.182151689 | Arteriovenous fistula, acquired | 2 | | |
| 4510 | 0.021922564 | Phlebitis and thrombophlebitis of superficial vessels of lower extremities | 2 | | |
| 45184 | 0.017840459 | Phlebitis and thrombophlebitis of upper extremities, unspecified | 2 | | |
| 99674 | 0.028833012 | Other complications due to other vascular device, implant, and graft | 2 | | |
| 9972 | 1.255313437 | Peripheral vascular complications, not elsewhere classified | 2 | | |
| | 2.221191322 | | | | |
| 0380 | 0.136066697 | Streptococcal septicemia | 3 | A | |
| 03811 | 0.028966746 | Methicillin susceptible Staphylococcus aureus septicemia | 3 | A | |
| 03812 | 0.154779337 | Methicillin resistant Staphylococcus aureus septicemia | 3 | A | |

| | | | | | |
|---|---|---|---|---|---|
| 0383 | 0.017757387 | Septicemia due to anaerobes | 3 | A | |
| 03842 | 0.357216436 | Septicemia due to escherichia coli [E. coli] | 3 | A | |
| 03843 | 0.022315896 | Septicemia due to pseudomonas | 3 | A | |
| 03849 | 0.027947085 | Other septicemia due to gram-negative organisms | 3 | A | |
| 0388 | 0.071670923 | Other specified septicemias | 3 | A | |
| 0389 | 1.441544859 | Unspecified septicemia | 3 | A | |
| | 2.258265365 | | | | |
| 0059 | 0.021390532 | Food poisoning, unspecified | 3 | | |
| 00845 | 0.260626307 | Intestinal infection due to Clostridium difficile | 3 | | |
| 0088 | 0.139796411 | Intestinal infection due to other organism, not elsewhere classified | 3 | | |
| 01194 | 0.026122222 | Pulmonary tuberculosis, unspecified, tubercle bacilli not found (in sputum) by microscopy, but found by bacterial culture | 3 | | |
| 01334 | 0.026678743 | Tuberculous abscess of brain, tubercle bacilli not found (in sputum) by microscopy, but found by bacterial culture | 3 | | |
| 042 | 0.028437902 | Human immunodeficiency virus [HIV] disease | 3 | | |
| 0521 | 0.022704984 | Varicella (hemorrhagic) pneumonitis | 3 | | |
| 0539 | 0.032659007 | Herpes zoster without mention of complication | 3 | | |
| 0543 | 0.02870589 | Herpetic meningoencephalitis | 3 | | |
| 0661 | 0.029205856 | Tick-borne fever | 3 | | |
| 0793 | 0.03360116 | Rhinovirus infection in conditions classified elsewhere and of unspecified site | 3 | | |
| 07999 | 0.044178219 | Unspecified viral infection | 3 | | |
| 1122 | 0.0534164 | Candidiasis of other urogenital sites | 3 | | |
| 135 | 0.025148565 | Sarcoidosis | 3 | | |
| 68110 | 0.097798585 | Cellulitis and abscess of toe, unspecified | 3 | | |
| 6822 | 0.038824707 | Cellulitis and abscess of trunk | 3 | | |
| 6823 | 0.055250868 | Cellulitis and abscess of upper arm and forearm | 3 | | |
| 6824 | 0.046259518 | Cellulitis and abscess of hand, except fingers and thumb | 3 | | |
| 6826 | 0.428566782 | Cellulitis and abscess of leg, except foot | 3 | | |
| 6827 | 0.128293092 | Cellulitis and abscess of foot, except toes | 3 | | |
| 73027 | 0.03360116 | Unspecified osteomyelitis, ankle and foot | 3 | | |
| 73028 | 0.020957239 | Unspecified osteomyelitis, other specified sites | 3 | | |

| | | | | | |
|---|---|---|---|---|---|
| 7907 | 0.094375165 | Bacteremia | 3 | | |
| 99590 | 0.041767526 | Systemic inflammatory response syndrome, unspecified | 3 | | |
| 99661 | 0.17338163 | Infection and inflammatory reaction due to cardiac device, implant, and graft | 3 | | |
| 99664 | 0.234830809 | Infection and inflammatory reaction due to indwelling urinary catheter | 3 | | |
| 99666 | 0.043854421 | Infection and inflammatory reaction due to internal joint prosthesis | 3 | | |
| 99667 | 0.022063184 | Infection and inflammatory reaction due to other internal orthopedic device, implant, and graft | 3 | | |
| 99859 | 0.321007481 | Other postoperative infection | 3 | | |
| 99932 | 0.018150387 | Bloodstream infection due to central venous catheter | 3 | | |
| 99939 | 0.018150387 | Infection following other infusion, injection, transfusion, or vaccination | 3 | | |
| | 2.589805139 | | | | |
| 51881 | 0.763202778 | Acute respiratory failure | 4 | A | |
| 51884 | 0.250306247 | Acute and chronic respiratory failure | 4 | A | |
| | 1.013509025 | | | | |
| 4660 | 0.151318822 | Acute bronchitis | 4 | B | |
| 490 | 0.020267879 | Bronchitis, not specified as acute or chronic | 4 | B | |
| 4911 | 0.024684601 | Mucopurulent chronic bronchitis | 4 | B | |
| 49120 | 0.039019255 | Obstructive chronic bronchitis without exacerbation | 4 | B | |
| 49121 | 1.0417203 | Obstructive chronic bronchitis with (acute) exacerbation | 4 | B | |
| 49122 | 0.229241673 | Obstructive chronic bronchitis with acute bronchitis | 4 | B | |
| 49322 | 0.491647219 | Chronic obstructive asthma with (acute) exacerbation | 4 | B | |
| 49390 | 0.022021018 | Asthma, unspecified type, unspecified | 4 | B | |
| 49392 | 0.124782816 | Asthma, unspecified type, with (acute) exacerbation | 4 | B | |
| 4941 | 0.055823606 | Bronchiectasis with acute exacerbation | 4 | B | |
| | 2.20052719 | | | | |
| 4809 | 0.022010802 | Viral pneumonia, unspecified | 4 | C | |
| 481 | 0.060852068 | Pneumococcal pneumonia [Streptococcus pneumoniae pneumonia] | 4 | C | |
| 4820 | 0.027645378 | Pneumonia due to Klebsiella pneumoniae | 4 | C | |
| 4821 | 0.016968196 | Pneumonia due to Pseudomonas | 4 | C | |
| 48230 | 0.020643239 | Pneumonia due to Streptococcus, unspecified | 4 | C | |

| | | | | | |
|---|---|---|---|---|---|
| 48242 | 0.143466103 | Methicillin resistant pneumonia due to Staphylococcus aureus | 4 | C | |
| 48282 | 0.022233483 | Pneumonia due to escherichia coli [E. coli] | 4 | C | |
| 48283 | 0.088907243 | Pneumonia due to other gram-negative bacteria | 4 | C | |
| 4829 | 0.100730307 | Bacterial pneumonia, unspecified | 4 | C | |
| 4830 | 0.026572638 | Pneumonia due to mycoplasma pneumoniae | 4 | C | |
| 486 | 2.042984744 | Pneumonia, organism unspecified | 4 | C | |
| 78652 | 0.113025149 | Painful respiration | 4 | C | |
| 99732 | 0.028118325 | Postprocedural aspiration pneumonia | 4 | C | |
| | 2.714157674 | | | | |
| 32723 | 0.026678743 | Obstructive sleep apnea (adult)(pediatric) | 4 | D | |
| 4150 | 0.02316971 | Acute cor pulmonale | 4 | D | |
| 4168 | 0.164016134 | Other chronic pulmonary heart diseases | 4 | D | |
| 4169 | 0.023826119 | Chronic pulmonary heart disease, unspecified | 4 | D | |
| 4178 | 0.020074971 | Other specified diseases of pulmonary circulation | 4 | D | |
| 4659 | 0.053196332 | Acute upper respiratory infections of unspecified site | 4 | D | |
| 5070 | 0.541593443 | Pneumonitis due to inhalation of food or vomitus | 4 | D | |
| 5109 | 0.080316618 | Empyema without mention of fistula | 4 | D | |
| 5110 | 0.027006956 | Pleurisy without mention of effusion or current tuberculosis | 4 | D | |
| 51189 | 0.083657233 | Other specified forms of effusion, except tuberculous | 4 | D | |
| 5119 | 0.371785312 | Unspecified pleural effusion | 4 | D | |
| 51289 | 0.01846304 | Other pneumothorax | 4 | D | |
| 5130 | 0.040988001 | Abscess of lung | 4 | D | |
| 514 | 0.037261679 | Pulmonary congestion and hypostasis | 4 | D | |
| 515 | 0.01846304 | Postinflammatory pulmonary fibrosis | 4 | D | |
| 51633 | 0.020373628 | Acute interstitial pneumonitis | 4 | D | |
| 5183 | 0.020074747 | Pulmonary eosinophilia | 4 | D | |
| 5184 | 0.175058783 | Acute edema of lung, unspecified | 4 | D | |
| 51852 | 0.023789873 | Other pulmonary insufficiency, not elsewhere classified, following trauma and surgery | 4 | D | |
| 51889 | 0.026642464 | Other diseases of lung, not elsewhere classified | 4 | D | |
| 5194 | 0.029361994 | Disorders of diaphragm | 4 | D | |
| 78605 | 0.089608612 | Shortness of breath | 4 | D | |

| | | | | | |
|---|---|---|---|---|---|
| 78609 | 0.177222458 | Other respiratory abnormalities | 4 | D | |
| 7862 | 0.02807022 | Cough | 4 | D | |
| 79902 | 0.040909349 | Hypoxemia | 4 | D | |
| 99739 | 0.199195271 | Other respiratory complications | 4 | D | |
| | 2.360804729 | | | | |
| 4552 | 0.127390769 | Internal hemorrhoids with other complication | 5 | | |
| 4555 | 0.022737437 | External hemorrhoids with other complication | 5 | | |
| 4558 | 0.023045581 | Unspecified hemorrhoids with other complication | 5 | | |
| 5300 | 0.022328934 | Achalasia and cardiospasm | 5 | | |
| 53010 | 0.024535294 | Esophagitis, unspecified | 5 | | |
| 53020 | 0.024560055 | Ulcer of esophagus without bleeding | 5 | | |
| 5305 | 0.022109071 | Dyskinesia of esophagus | 5 | | |
| 53081 | 0.127175746 | Esophageal reflux | 5 | | |
| 53500 | 0.041934774 | Acute gastritis, without mention of hemorrhage | 5 | | |
| 53540 | 0.031077002 | Other specified gastritis, without mention of hemorrhage | 5 | | |
| 53550 | 0.055488752 | Unspecified gastritis and gastroduodenitis, without mention of hemorrhage | 5 | | |
| 5362 | 0.026433865 | Persistent vomiting | 5 | | |
| 5363 | 0.050281482 | Gastroparesis | 5 | | |
| 53649 | 0.072158129 | Other gastrostomy complications | 5 | | |
| 5368 | 0.023655384 | Dyspepsia and other specified disorders of function of stomach | 5 | | |
| 5370 | 0.022063184 | Acquired hypertrophic pyloric stenosis | 5 | | |
| 53989 | 0.025148565 | Other complications of other bariatric procedure | 5 | | |
| 5401 | 0.017938786 | Acute appendicitis with peritoneal abscess | 5 | | |
| 5409 | 0.06744836 | Acute appendicitis without mention of peritonitis | 5 | | |
| 5565 | 0.021445482 | Left-sided ulcerative (chronic) colitis | 5 | | |
| 5570 | 0.05245093 | Acute vascular insufficiency of intestine | 5 | | |
| 5571 | 0.028017117 | Chronic vascular insufficiency of intestine | 5 | | |
| 5579 | 0.159813863 | Unspecified vascular insufficiency of intestine | 5 | | |
| 5589 | 0.20132546 | Other and unspecified noninfectious gastroenteritis and colitis | 5 | | |
| 5601 | 0.14115512 | Paralytic ileus | 5 | | |
| 5602 | 0.027482138 | Volvulus | 5 | | |

| | | | | | |
|---|---|---|---|---|---|
| 56031 | 0.023919827 | Gallstone ileus | 5 | | |
| 56081 | 0.073265999 | Intestinal or peritoneal adhesions with obstruction (postoperative) (postinfection) | 5 | | |
| 56089 | 0.020163643 | Other specified intestinal obstruction | 5 | | |
| 5609 | 0.370408126 | Unspecified intestinal obstruction | 5 | | |
| 56211 | 0.175326626 | Diverticulitis of colon (without mention of hemorrhage) | 5 | | |
| 56400 | 0.019088203 | Constipation, unspecified | 5 | | |
| 5641 | 0.051957152 | Irritable bowel syndrome | 5 | | |
| 5650 | 0.031334939 | Anal fissure | 5 | | |
| 566 | 0.030419047 | Abscess of anal and rectal regions | 5 | | |
| 5680 | 0.024479696 | Peritoneal adhesions (postoperative) (postinfection) | 5 | | |
| 5693 | 0.197273043 | Hemorrhage of rectum and anus | 5 | | |
| 56949 | 0.035084099 | Other specified disorders of rectum and anus | 5 | | |
| 5711 | 0.021843967 | Acute alcoholic hepatitis | 5 | | |
| 5712 | 0.028047767 | Alcoholic cirrhosis of liver | 5 | | |
| 5715 | 0.02807022 | Cirrhosis of liver without mention of alcohol | 5 | | |
| 5722 | 0.068355161 | Hepatic encephalopathy | 5 | | |
| 5724 | 0.044807052 | Hepatorenal syndrome | 5 | | |
| 5728 | 0.035266334 | Other sequelae of chronic liver disease | 5 | | |
| 57400 | 0.300451766 | Calculus of gallbladder with acute cholecystitis, without mention of obstruction | 5 | | |
| 57410 | 0.072650562 | Calculus of gallbladder with other cholecystitis, without mention of obstruction | 5 | | |
| 57420 | 0.116658862 | Calculus of gallbladder without mention of cholecystitis, without mention of obstruction | 5 | | |
| 57470 | 0.022021018 | Calculus of gallbladder and bile duct with other cholecystitis, without mention of obstruction | 5 | | |
| 57471 | 0.038747188 | Calculus of gallbladder and bile duct with other cholecystitis, with obstruction | 5 | | |
| 5750 | 0.019088559 | Acute cholecystitis | 5 | | |
| 57511 | 0.056099578 | Chronic cholecystitis | 5 | | |
| 57512 | 0.027898063 | Acute and chronic cholecystitis | 5 | | |

| | | | | | |
|---|---|---|---|---|---|
| 5761 | 0.057820231 | Cholangitis | 5 | | |
| 5768 | 0.018083929 | Other specified disorders of biliary tract | 5 | | |
| 5770 | 0.200076022 | Acute pancreatitis | 5 | | |
| 5772 | 0.02419763 | Cyst and pseudocyst of pancreas | 5 | | |
| 78701 | 0.157341961 | Nausea with vomiting | 5 | | |
| 78720 | 0.022481685 | Dysphagia, unspecified | 5 | | |
| 78900 | 0.137975585 | Abdominal pain, unspecified site | 5 | | |
| 78901 | 0.030904698 | Abdominal pain, right upper quadrant | 5 | | |
| 78902 | 0.02055134 | Abdominal pain, left upper quadrant | 5 | | |
| 78903 | 0.027033107 | Abdominal pain, right lower quadrant | 5 | | |
| 78906 | 0.080481626 | Abdominal pain, epigastric | 5 | | |
| 78907 | 0.021333622 | Abdominal pain, generalized | 5 | | |
| 78909 | 0.022906986 | Abdominal pain, other specified site | 5 | | |
| 9974 | 0.065839732 | Digestive system complications not elsewhere classified | 5 | | |
| | 4.27895593 | | | | |
| 43310 | 0.088495449 | Occlusion and stenosis of carotid artery without mention of cerebral infarction | 6 | A | |
| 43311 | 0.020127765 | Occlusion and stenosis of carotid artery with cerebral infarction | 6 | A | |
| 43400 | 0.019990596 | Cerebral thrombosis without mention of cerebral infarction | 6 | A | |
| 43411 | 0.268359186 | Cerebral embolism with cerebral infarction | 6 | A | |
| 43490 | 0.031297694 | Cerebral artery occlusion, unspecified without mention of cerebral infarction | 6 | A | |
| 43491 | 0.599008419 | Cerebral artery occlusion, unspecified with cerebral infarction | 6 | A | |
| 4358 | 0.024059479 | Other specified transient cerebral ischemias | 6 | A | |
| 4359 | 0.497080041 | Unspecified transient cerebral ischemia | 6 | A | |
| 4370 | 0.023644182 | Cerebral atherosclerosis | 6 | A | |
| 4371 | 0.017411889 | Other generalized ischemic cerebrovascular disease | 6 | A | |
| | 1.589474699 | | | | |
| 3310 | 0.028978913 | Alzheimer's disease | 6 | B | |
| 3315 | 0.046496917 | Idiopathic normal pressure hydrocephalus (INPH) | 6 | B | |
| 33182 | 0.018677599 | Dementia with lewy bodies | 6 | B | |
| 33812 | 0.028437902 | Acute post-thoracotomy pain | 6 | B | |

| | | | | | |
|---|---|---|---|---|---|
| 33818 | 0.042065329 | Other acute postoperative pain | 6 | B | |
| 33819 | 0.020267879 | Other acute pain | 6 | B | |
| 3383 | 0.059194279 | Neoplasm related pain (acute) (chronic) | 6 | B | |
| 3384 | 0.022015514 | Chronic pain syndrome | 6 | B | |
| 34460 | 0.022260707 | Cauda equina syndrome without mention of neurogenic bladder | 6 | B | |
| 3453 | 0.021839017 | Grand mal status | 6 | B | |
| 34540 | 0.027645378 | Localization-related (focal) (partial) epilepsy and epileptic syndromes with complex partial seizures, without mention of intractable epilepsy | 6 | B | |
| 34580 | 0.048763783 | Other forms of epilepsy and recurrent seizures, without mention of intractable epilepsy | 6 | B | |
| 34590 | 0.053359517 | Epilepsy, unspecified, without mention of intractable epilepsy | 6 | B | |
| 34670 | 0.038757833 | Chronic migraine without aura, without mention of intractable migraine without mention of status migrainosus | 6 | B | |
| 34680 | 0.048682552 | Other forms of migraine, without mention of intractable migraine without mention of status migrainosus | 6 | B | |
| 34690 | 0.049047782 | Migraine, unspecified, without mention of intractable migraine without mention of status migrainosus | 6 | B | |
| 34691 | 0.062629077 | Migraine, unspecified, with intractable migraine, so stated, without mention of status migrainosus | 6 | B | |
| 3481 | 0.050849013 | Anoxic brain damage | 6 | B | |
| 34830 | 0.027033107 | Encephalopathy, unspecified | 6 | B | |
| 34831 | 0.016985689 | Metabolic encephalopathy | 6 | B | |
| 34839 | 0.067357802 | Other encephalopathy | 6 | B | |
| 34982 | 0.022548665 | Toxic encephalopathy | 6 | B | |
| 3558 | 0.03286126 | Mononeuritis of lower limb, unspecified | 6 | B | |
| 3569 | 0.023625621 | Unspecified hereditary and idiopathic peripheral neuropathy | 6 | B | |
| 3576 | 0.028833012 | Polyneuropathy due to drugs | 6 | B | |
| 35801 | 0.021697145 | Myasthenia gravis with (acute) exacerbation | 6 | B | |
| 35979 | 0.022109071 | Other inflammatory and immune myopathies, NEC | 6 | B | |
| 37739 | 0.024841249 | Other optic neuritis | 6 | B | |
| 4373 | 0.035084099 | Cerebral aneurysm, nonruptured | 6 | B | |
| 4377 | 0.021922564 | Transient global amnesia | 6 | B | |

| | | | | | |
|---|---|---|---|---|---|
| 4378 | 0.025720216 | Other ill-defined cerebrovascular disease | 6 | B | |
| 78009 | 0.01876572 | Other alteration of consciousness | 6 | B | |
| 78093 | 0.022867323 | Memory loss | 6 | B | |
| 7820 | 0.030492612 | Disturbance of skin sensation | 6 | B | |
| 7840 | 0.047636804 | Headache | 6 | B | |
| 7843 | 0.03315395 | Aphasia | 6 | B | |
| | 1.213504901 | | | | |
| 2760 | 0.017572024 | Hyperosmolality and/or hypernatremia | 7 | A | |
| 2761 | 0.618521898 | Hyposmolality and/or hyponatremia | 7 | A | |
| 2767 | 0.079441526 | Hyperpotassemia | 7 | A | |
| 2768 | 0.074592572 | Hypopotassemia | 7 | A | |
| | 0.790128019 | | | | |
| 5845 | 0.08044266 | Acute kidney failure with lesion of tubular necrosis | 7 | B | |
| 5849 | 1.208624685 | Acute kidney failure, unspecified | 7 | B | |
| 5856 | 0.058234241 | End stage renal disease | 7 | B | |
| 40300 | 0.027033107 | Hypertensive chronic kidney disease, malignant, with chronic kidney disease stage I through stage IV, or unspecified | 7 | B | |
| 40390 | 0.068677231 | Hypertensive chronic kidney disease, unspecified, with chronic kidney disease stage I through stage IV, or unspecified | 7 | B | |
| 40391 | 0.068788567 | Hypertensive chronic kidney disease, unspecified, with chronic kidney disease stage V or end stage renal disease | 7 | B | |
| | 1.51180049 | | | | |
| 59000 | 0.022439692 | Chronic pyelonephritis without lesion of renal medullary necrosis | 7 | C | |
| 59080 | 0.022546188 | Pyelonephritis, unspecified | 7 | C | |
| 5921 | 0.150934329 | Calculus of ureter | 7 | C | |
| 5939 | 0.024841249 | Unspecified disorder of kidney and ureter | 7 | C | |
| 59582 | 0.022328934 | Irradiation cystitis | 7 | C | |
| 5960 | 0.077217066 | Bladder neck obstruction | 7 | C | |
| 5990 | 0.606997487 | Urinary tract infection, site not specified | 7 | C | |
| 60000 | 0.061018588 | Hypertrophy (benign) of prostate without urinary obstruction and other lower urinary tract symptom (LUTS) | 7 | C | |

| | | | | | |
|---|---|---|---|---|---|
| 60001 | 0.097537179 | Hypertrophy (benign) of prostate with urinary obstruction and other lower urinary tract symptoms (LUTS) | 7 | C | |
| 6010 | 0.041476277 | Acute prostatitis | 7 | C | |
| 78899 | 0.020603697 | Other symptoms involving urinary system | 7 | C | |
| 99631 | 0.097220731 | Mechanical complication due to urethral (indwelling) catheter | 7 | C | |
| 99673 | 0.060186504 | Other complications due to renal dialysis device, implant, and graft | 7 | C | |
| 99676 | 0.063223801 | Other complications due to genitourinary device, implant, and graft | 7 | C | |
| 99681 | 0.027080134 | Complications of transplanted kidney | 7 | C | |
| 9975 | 0.04171593 | Urinary complications, not elsewhere classified | 7 | C | |
| | 1.437367786 | | | | |
| 2809 | 0.048661546 | Iron deficiency anemia, unspecified | 8 | A | |
| 28319 | 0.026122222 | Other non-autoimmune hemolytic anemias | 8 | A | |
| 28521 | 0.044202269 | Anemia in chronic kidney disease | 8 | A | |
| 28522 | 0.022906986 | Anemia in neoplastic disease | 8 | A | |
| 28529 | 0.032584921 | Anemia of other chronic disease | 8 | A | |
| 2859 | 0.072865218 | Anemia, unspecified | 8 | A | |
| | 0.247343161 | | | | |
| 28659 | 0.024965659 | Other hemorrhagic disorder due to intrinsic circulating anticoagulants, antibodies, or inhibitors | 8 | B | |
| 28804 | 0.033149204 | Neutropenia due to infection | 8 | B | |
| 28981 | 0.020603697 | Primary hypercoagulable state | 8 | B | |
| 79092 | 0.173758035 | Abnormal coagulation profile | 8 | B | |
| | 0.252476595 | | | | |
| 73382 | 0.017425632 | Nonunion of fracture | 9 | | |
| 8020 | 0.040446576 | Closed fracture of nasal bones | 9 | | |
| 80505 | 0.027033107 | Closed fracture of fifth cervical vertebra | 9 | | |
| 8052 | 0.0404249 | Closed fracture of dorsal [thoracic] vertebra without mention of spinal cord injury | 9 | | |
| 8056 | 0.045625187 | Closed fracture of sacrum and coccyx without mention of spinal cord injury | 9 | | |
| 80702 | 0.02058344 | Closed fracture of two ribs | 9 | | |
| 80703 | 0.021385729 | Closed fracture of three ribs | 9 | | |

| | | | | | |
|---|---|---|---|---|---|
| 80705 | 0.028267075 | Closed fracture of five ribs | 9 | | |
| 8082 | 0.01988548 | Closed fracture of pubis | 9 | | |
| 81241 | 0.027967953 | Closed supracondylar fracture of humerus | 9 | | |
| 82003 | 0.01988548 | Closed fracture of base of neck of femur | 9 | | |
| 82009 | 0.133395741 | Other closed transcervical fracture of neck of femur | 9 | | |
| 82021 | 0.075722232 | Closed fracture of intertrochanteric section of neck of femur | 9 | | |
| 8208 | 0.062935123 | Closed fracture of unspecified part of neck of femur | 9 | | |
| 8244 | 0.051739031 | Bimalleolar fracture, closed | 9 | | |
| 8246 | 0.019409379 | Trimalleolar fracture, closed | 9 | | |
| 8250 | 0.02058344 | Fracture of calcaneus, closed | 9 | | |
| 82535 | 0.021390532 | Open fracture of metatarsal bone(s) | 9 | | |
| 85011 | 0.025720216 | Concussion, with loss of consciousness of 30 minutes or less | 9 | | |
| 85181 | 0.022015514 | Other and unspecified cerebral laceration and contusion, without mention of open intracranial wound, with no loss of consciousness | 9 | | |
| 8604 | 0.021697145 | Traumatic pneumohemothorax without mention of open wound into thorax | 9 | | |
| 86504 | 0.028150632 | Injury to spleen without mention of open wound into cavity, massive parenchymal disruption | 9 | | |
| 8670 | 0.102836536 | Injury to bladder and urethra, without mention of open wound into cavity | 9 | | |
| 87211 | 0.022233483 | Open wound of auricle, ear, complicated | 9 | | |
| 8782 | 0.023625621 | Open wound of scrotum and testes, without mention of complication | 9 | | |
| 8911 | 0.030590997 | Open wound of knee, leg [except thigh], and ankle, complicated | 9 | | |
| 9222 | 0.022481685 | Contusion of abdominal wall | 9 | | |
| 9245 | 0.017401496 | Contusion of unspecified part of lower limb | 9 | | |
| 9551 | 0.027080134 | Injury to median nerve | 9 | | |
| 95901 | 0.025148565 | Head injury, unspecified | 9 | | |
| 9623 | 0.079011304 | Poisoning by insulins and antidiabetic agents | 9 | | |
| 9642 | 0.02697595 | Poisoning by anticoagulants | 9 | | |
| 96509 | 0.021333622 | Poisoning by other opiates and related narcotics | 9 | | |
| | 1.190408935 | | | | |

| | | | | | |
|---|---|---|---|---|---|
| 25002 | 0.035084099 | Diabetes mellitus without mention of complication, type II or unspecified type, uncontrolled | 10 | A | |
| 25012 | 0.022772836 | Diabetes with ketoacidosis, type II or unspecified type, uncontrolled | 10 | A | |
| 25060 | 0.110178154 | Diabetes with neurological manifestations, type II or unspecified type, not stated as uncontrolled | 10 | A | |
| 25062 | 0.028097767 | Diabetes with neurological manifestations, type II or unspecified type, uncontrolled | 10 | A | |
| 25070 | 0.038490504 | Diabetes with peripheral circulatory disorders, type II or unspecified type, not stated as uncontrolled | 10 | A | |
| 25080 | 0.136826709 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | 10 | A | |
| | 0.371450069 | | | | |
| 2410 | 0.02407807 | Nontoxic uninodular goiter | 10 | B | |
| 2411 | 0.027645378 | Nontoxic multinodular goiter | 10 | B | |
| 2449 | 0.051521779 | Unspecified acquired hypothyroidism | 10 | B | |
| 2536 | 0.109000037 | Other disorders of neurohypophysis | 10 | B | |
| | 0.212245263 | | | | |
| 1531 | 0.017633684 | Malignant neoplasm of transverse colon | 11 | | |
| 1532 | 0.025811039 | Malignant neoplasm of descending colon | 11 | | |
| 1533 | 0.022391323 | Malignant neoplasm of sigmoid colon | 11 | | |
| 1536 | 0.019088559 | Malignant neoplasm of ascending colon | 11 | | |
| 1539 | 0.024902132 | Malignant neoplasm of colon, unspecified site | 11 | | |
| 1540 | 0.030720259 | Malignant neoplasm of rectosigmoid junction | 11 | | |
| 1548 | 0.018853593 | Malignant neoplasm of other sites of rectum, rectosigmoid junction, and anus | 11 | | |
| 1571 | 0.030959489 | Malignant neoplasm of body of pancreas | 11 | | |
| 1579 | 0.020830611 | Malignant neoplasm of pancreas, part unspecified | 11 | | |
| 1622 | 0.048989242 | Malignant neoplasm of main bronchus | 11 | | |
| 1623 | 0.114431349 | Malignant neoplasm of upper lobe, bronchus or lung | 11 | | |
| 1625 | 0.02419763 | Malignant neoplasm of lower lobe, bronchus or lung | 11 | | |
| 1628 | 0.02267155 | Malignant neoplasm of other parts of bronchus or lung | 11 | | |
| 1629 | 0.180118502 | Malignant neoplasm of bronchus and lung, unspecified | 11 | | |

| | | | | | |
|---|---|---|---|---|---|
| 1759 | 0.026122222 | Malignant neoplasm of other and unspecified sites of male breast | 11 | | |
| 1888 | 0.027080134 | Malignant neoplasm of other specified sites of bladder | 11 | | |
| 1889 | 0.027967953 | Malignant neoplasm of bladder, part unspecified | 11 | | |
| 1890 | 0.085882059 | Malignant neoplasm of kidney, except pelvis | 11 | | |
| 1960 | 0.026642464 | Secondary and unspecified malignant neoplasm of lymph nodes of head, face, and neck | 11 | | |
| 1970 | 0.028047767 | Secondary malignant neoplasm of lung | 11 | | |
| 1972 | 0.030414229 | Secondary malignant neoplasm of pleura | 11 | | |
| 1976 | 0.027809986 | Secondary malignant neoplasm of retroperitoneum and peritoneum | 11 | | |
| 1983 | 0.042874017 | Secondary malignant neoplasm of brain and spinal cord | 11 | | |
| 1985 | 0.022391323 | Secondary malignant neoplasm of bone and bone marrow | 11 | | |
| 20288 | 0.039591643 | Other malignant lymphomas, lymph nodes of multiple sites | 11 | | |
| 20300 | 0.062910565 | Multiple myeloma, without mention of having achieved remission | 11 | | |
| 2111 | 0.026549563 | Benign neoplasm of stomach | 11 | | |
| 2113 | 0.019631546 | Benign neoplasm of colon | 11 | | |
| 2124 | 0.020730647 | Benign neoplasm of pleura | 11 | | |
| 2126 | 0.022546188 | Benign neoplasm of thymus | 11 | | |
| 220 | 0.052912046 | Benign neoplasm of ovary | 11 | | |
| 2396 | 0.016996711 | Neoplasm of unspecified nature of brain | 11 | | |
| | 1.208700022 | | | | |
| 5307 | 0.028519382 | Gastroesophageal laceration-hemorrhage syndrome | 12 | A | |
| 53100 | 0.029560214 | Acute gastric ulcer with hemorrhage, without mention of obstruction | 12 | A | |
| 53140 | 0.070234984 | Chronic or unspecified gastric ulcer with hemorrhage, without mention of obstruction | 12 | A | |
| 53240 | 0.047230789 | Chronic or unspecified duodenal ulcer with hemorrhage, without mention of obstruction | 12 | A | |
| 53541 | 0.146609817 | Other specified gastritis, with hemorrhage | 12 | A | |
| 53551 | 0.057966912 | Unspecified gastritis and gastroduodenitis, with hemorrhage | 12 | A | |
| 53783 | 0.056089196 | Angiodysplasia of stomach and duodenum with hemorrhage | 12 | A | |
| 56212 | 0.116654317 | Diverticulosis of colon with hemorrhage | 12 | A | |
| 56213 | 0.042188399 | Diverticulitis of colon with hemorrhage | 12 | A | |
| 56881 | 0.054450983 | Hemoperitoneum (nontraumatic) | 12 | A | |

| | | | | | |
|---|---|---|---|---|---|
| 56985 | 0.053856857 | Angiodysplasia of intestine with hemorrhage | 12 | A | |
| 56986 | 0.022546188 | Dieulafoy lesion (hemorrhagic) of intestine | 12 | A | |
| 5780 | 0.027921217 | Hematemesis | 12 | A | |
| 5781 | 0.236099113 | Blood in stool | 12 | A | |
| 5789 | 0.743949585 | Hemorrhage of gastrointestinal tract, unspecified | 12 | A | |
| | 1.733877952 | | | | |
| 430 | 0.033167995 | Subarachnoid hemorrhage | 12 | B | I |
| 431 | 0.16797725 | Intracerebral hemorrhage | 12 | B | I |
| 4321 | 0.154745776 | Subdural hemorrhage | 12 | B | I |
| 4329 | 0.032374601 | Unspecified intracranial hemorrhage | 12 | B | I |
| | 0.388265622 | | | | |
| 80021 | 0.024841249 | Closed fracture of vault of skull with subarachnoid, subdural, and extradural hemorrhage, with no loss of consciousness | 12 | B | II |
| 80422 | 0.022896283 | Closed fractures involving skull or face with other bones with subarachnoid, subdural, and extradural hemorrhage, with brief [less than one hour] loss of consciousness | 12 | B | II |
| 85220 | 0.025311751 | Subdural hemorrhage following injury without mention of open intracranial wound, unspecified state of consciousness | 12 | B | II |
| 85221 | 0.025148565 | Subdural hemorrhage following injury without mention of open intracranial wound, with no loss of consciousness | 12 | B | II |
| 85226 | 0.01846304 | Subdural hemorrhage following injury without mention of open intracranial wound, with loss of consciousness of unspecified duration | 12 | B | II |
| 85300 | 0.044066949 | Other and unspecified intracranial hemorrhage following injury without mention of open intracranial wound, unspecified state of consciousness | 12 | B | II |
| 85301 | 0.01845534 | Other and unspecified intracranial hemorrhage following injury without mention of open intracranial wound, with no loss of consciousness | 12 | B | II |
| 85306 | 0.020023381 | Other and unspecified intracranial hemorrhage following injury without mention of open intracranial wound, with loss of consciousness of unspecified duration | 12 | B | II |
| | 0.199206558 | | | | |
| 2800 | 0.072612625 | Iron deficiency anemia secondary to blood loss (chronic) | 12 | C | |

| | | | | | |
|---|---|---|---|---|---|
| 2851 | 0.262599305 | Acute posthemorrhagic anemia | 12 | C | |
| 4590 | 0.027396812 | Hemorrhage, unspecified | 12 | C | |
| 59970 | 0.016968196 | Hematuria, unspecified | 12 | C | |
| 59971 | 0.174931325 | Gross hematuria | 12 | C | |
| 7847 | 0.022704984 | Epistaxis | 12 | C | |
| 78630 | 0.050112669 | Hemoptysis, unspecified | 12 | C | |
| 78639 | 0.024981634 | Other hemoptysis | 12 | C | |
| 99811 | 0.223271551 | Hemorrhage complicating a procedure | 12 | C | |
| 99812 | 1.831456517 | Hematoma complicating a procedure | 12 | C | |
| | 2.707035616 | | | | |
| 2910 | 0.051087881 | Alcohol withdrawal delirium | 13 | | |
| 29181 | 0.023826119 | Alcohol withdrawal | 13 | | |
| 2920 | 0.04319292 | Drug withdrawal | 13 | | |
| 29281 | 0.021333622 | Drug-induced delirium | 13 | | |
| 29572 | 0.013568769 | Schizoaffective disorder, chronic | 13 | | |
| 29620 | 0.043276318 | Major depressive affective disorder, single episode, unspecified | 13 | | |
| 29630 | 0.101900782 | Major depressive affective disorder, recurrent episode, unspecified | 13 | | |
| 29632 | 0.021842885 | Major depressive affective disorder, recurrent episode, moderate | 13 | | |
| 29633 | 0.042916067 | Major depressive affective disorder, recurrent episode, severe, without mention of psychotic behavior | 13 | | |
| 29636 | 0.016440641 | Major depressive affective disorder, recurrent episode, in full remission | 13 | | |
| 29644 | 0.02058344 | Bipolar I disorder, most recent episode (or current) manic, severe, specified as with psychotic behavior | 13 | | |
| 29650 | 0.038961542 | Bipolar I disorder, most recent episode (or current) depressed, unspecified | 13 | | |
| 2989 | 0.020926464 | Unspecified psychosis | 13 | | |
| 30000 | 0.025009291 | Anxiety state, unspecified | 13 | | |
| 30011 | 0.020221174 | Conversion disorder | 13 | | |
| 3004 | 0.065824229 | Dysthymic disorder | 13 | | |
| 30300 | 0.034044804 | Acute alcoholic intoxication in alcoholism, unspecified | 13 | | |
| 30390 | 0.024965659 | Other and unspecified alcohol dependence, unspecified | 13 | | |

| | | | | | |
|---|---|---|---|---|---|
| 30590 | 0.023625621 | Other, mixed, or unspecified drug abuse, unspecified | 13 | | |
| 3064 | 0.018322701 | Gastrointestinal malfunction arising from mental factors | 13 | | |
| | 0.67187093 | | | | |
| 41511 | 0.108749282 | Iatrogenic pulmonary embolism and infarction | 14 | | |
| 41519 | 0.462288025 | Other pulmonary embolism and infarction | 14 | | |
| 45340 | 0.121795006 | Acute venous embolism and thrombosis of unspecified deep vessels of lower extremity | 14 | | |
| 45341 | 0.323547821 | Acute venous embolism and thrombosis of deep vessels of proximal lower extremity | 14 | | |
| 45381 | 0.023451559 | Acute venous embolism and thrombosis of superficial veins of upper extremity | 14 | | |
| 45382 | 0.026557052 | Acute venous embolism and thrombosis of deep veins of upper extremity | 14 | | |
| | 1.066388745 | | | | |
| 27400 | 0.04376019 | Gouty arthropathy, unspecified | 15 | | |
| 27651 | 0.17104001 | Dehydration | 15 | | |
| 27652 | 0.046370468 | Hypovolemia | 15 | | |
| 27661 | 0.03315395 | Transfusion associated circulatory overload | 15 | | |
| 27669 | 0.159489416 | Other fluid overload | 15 | | |
| 2779 | 0.030982357 | Unspecified disorder of metabolism | 15 | | |
| 3693 | 0.031783037 | Unqualified visual loss, both eyes | 15 | | |
| 38610 | 0.013368982 | Peripheral vertigo, unspecified | 15 | | |
| 38611 | 0.043425706 | Benign paroxysmal positional vertigo | 15 | | |
| 4568 | 0.018945362 | Varices of other sites | 15 | | |
| 55200 | 0.020150896 | Femoral hernia with obstruction, unilateral or unspecified (not specified as recurrent) | 15 | | |
| 55221 | 0.02407807 | Incisional ventral hernia with obstruction | 15 | | |
| 5523 | 0.030982357 | Diaphragmatic hernia with obstruction | 15 | | |
| 55329 | 0.026642464 | Other ventral hernia without mention of obstruction or gangrene | 15 | | |
| 6185 | 0.019328702 | Prolapse of vaginal vault after hysterectomy | 15 | | |
| 6273 | 0.027645378 | Postmenopausal atrophic vaginitis | 15 | | |
| 6861 | 0.022109071 | Pyogenic granuloma of skin and subcutaneous tissue | 15 | | |

| | | | | | |
|---|---|---|---|---|---|
| 70714 | 0.024981634 | Ulcer of heel and midfoot | 15 | | |
| 70719 | 0.017974973 | Ulcer of other part of lower limb | 15 | | |
| 7092 | 0.024706975 | Scar conditions and fibrosis of skin | 15 | | |
| 7093 | 0.021922564 | Degenerative skin disorders | 15 | | |
| 7098 | 0.022190336 | Other specified disorders of skin | 15 | | |
| 7140 | 0.027033107 | Rheumatoid arthritis | 15 | | |
| 71516 | 0.114913868 | Osteoarthrosis, localized, primary, lower leg | 15 | | |
| 71535 | 0.193021903 | Osteoarthrosis, localized, not specified whether primary or secondary, pelvic region and thigh | 15 | | |
| 71536 | 0.266786043 | Osteoarthrosis, localized, not specified whether primary or secondary, lower leg | 15 | | |
| 71538 | 0.02573498 | Osteoarthrosis, localized, not specified whether primary or secondary, other specified sites | 15 | | |
| 71595 | 0.048739899 | Osteoarthrosis, unspecified whether generalized or localized, pelvic region and thigh | 15 | | |
| 71596 | 0.17940187 | Osteoarthrosis, unspecified whether generalized or localized, lower leg | 15 | | |
| 71617 | 0.028437902 | Traumatic arthropathy, ankle and foot | 15 | | |
| 71681 | 0.022328934 | Other specified arthropathy, shoulder region | 15 | | |
| 71941 | 0.032685594 | Pain in joint, shoulder region | 15 | | |
| 7210 | 0.18596623 | Cervical spondylosis without myelopathy | 15 | | |
| 7211 | 0.066076362 | Cervical spondylosis with myelopathy | 15 | | |
| 7213 | 0.01968791 | Lumbosacral spondylosis without myelopathy | 15 | | |
| 72210 | 0.042666674 | Displacement of lumbar intervertebral disc without myelopathy | 15 | | |
| 72252 | 0.072767557 | Degeneration of lumbar or lumbosacral intervertebral disc | 15 | | |
| 72400 | 0.024706975 | Spinal stenosis, unspecified region | 15 | | |
| 72402 | 0.087572454 | Spinal stenosis, lumbar region, without neurogenic claudication | 15 | | |
| 72403 | 0.022403526 | Spinal stenosis, lumbar region, with neurogenic claudication | 15 | | |
| 7242 | 0.022755136 | Lumbago | 15 | | |
| 7244 | 0.026642464 | Thoracic or lumbosacral neuritis or radiculitis, unspecified | 15 | | |
| 7245 | 0.022546188 | Backache, unspecified | 15 | | |
| 7262 | 0.040446576 | Other affections of shoulder region, not elsewhere classified | 15 | | |

| | | | | | |
|---|---|---|---|---|---|
| 72705 | 0.017633684 | Other tenosynovitis of hand and wrist | 15 | | |
| 72886 | 0.026433865 | Necrotizing fasciitis | 15 | | |
| 72889 | 0.057660293 | Other disorders of muscle, ligament, and fascia | 15 | | |
| 7292 | 0.023184161 | Neuralgia, neuritis, and radiculitis, unspecified | 15 | | |
| 72989 | 0.038317641 | Other musculoskeletal symptoms referable to limbs | 15 | | |
| 72992 | 0.092794399 | Nontraumatic hematoma of soft tissue | 15 | | |
| 7336 | 0.064255409 | Tietze's disease | 15 | | |
| 73679 | 0.02491092 | Other acquired deformities of ankle and foot | 15 | | |
| 7384 | 0.024059479 | Acquired spondylolisthesis | 15 | | |
| 78060 | 0.139079929 | Fever, unspecified | 15 | | |
| 78064 | 0.024061245 | Chills (without fever) | 15 | | |
| 78079 | 0.290358344 | Other malaise and fatigue | 15 | | |
| 7823 | 0.023826119 | Edema | 15 | | |
| 7837 | 0.057378459 | Adult failure to thrive | 15 | | |
| 7905 | 0.064503428 | Other nonspecific abnormal serum enzyme levels | 15 | | |
| 8438 | 0.03340716 | Sprains and strains of other specified sites of hip and thigh | 15 | | |
| 8488 | 0.022867323 | Other specified sites of sprains and strains | 15 | | |
| 9352 | 0.017633684 | Foreign body in stomach | 15 | | |
| 99641 | 0.029141278 | Mechanical loosening of prosthetic joint | 15 | | |
| 99642 | 0.058865503 | Dislocation of prosthetic joint | 15 | | |
| 99647 | 0.022391323 | Other mechanical complication of prosthetic joint implant | 15 | | |
| 99649 | 0.027809986 | Other mechanical complication of other internal orthopedic device, implant, and graft | 15 | | |
| 99659 | 0.037156204 | Mechanical complication due to other implant and internal device, not elsewhere classified | 15 | | |
| 99677 | 0.03360116 | Other complications due to internal joint prosthesis | 15 | | |
| 99799 | 0.056109557 | Complications affecting other specified body systems, not elsewhere classified | 15 | | |
| 99809 | 0.018214029 | Postoperative shock, other | 15 | | |
| 99813 | 0.025463709 | Seroma complicating a procedure | 15 | | |
| 9982 | 0.058028426 | Accidental puncture or laceration during a procedure, not elsewhere classified | 15 | | |

| | | | | | |
|---|---|---|---|---|---|
| 99851 | 0.143465291 | Infected postoperative seroma | 15 | | |
| 9986 | 0.130625253 | Persistent postoperative fistula | 15 | | |
| 99883 | 0.023316668 | Non-healing surgical wound | 15 | | |
| 99889 | 0.137017228 | Other specified complications of procedures not elsewhere classified | 15 | | |
| V0382 | 0.026549563 | Other specified vaccinations against streptococcus pneumoniae [pneumococcus] | 15 | | |
| V553 | 0.023483821 | Attention to colostomy | 15 | | |
| V5789 | 0.121395949 | Care involving other specified rehabilitation procedure | 15 | | |
| V5811 | 0.039591643 | Encounter for antineoplastic chemotherapy | 15 | | |
| V5812 | 0.039591643 | Encounter for antineoplastic immunotherapy | 15 | | |

**Description of ICD codes for etiology of 30 days readmission.**

| DX1 | ablation | Description of ICD codes | Level 1 | Level 2 | Level 3 |
|---|---|---|---|---|---|
| 39891 | 0.055700183 | Rheumatic heart failure (congestive) | 1 | A | |
| 40291 | 0.361454887 | Unspecified hypertensive heart disease with heart failure | 1 | A | |
| 40491 | 0.288356194 | Hypertensive heart and chronic kidney disease, unspecified, with heart failure and with chronic kidney disease stage I through stage IV, or unspecified | 1 | A | |
| 40493 | 0.044764055 | Hypertensive heart and chronic kidney disease, unspecified, with heart failure and chronic kidney disease stage V or end stage renal disease | 1 | A | |
| 4280 | 2.794355543 | Congestive heart failure, unspecified | 1 | A | |
| 42821 | 0.196693549 | Acute systolic heart failure | 1 | A | |
| 42822 | 0.471497014 | Chronic systolic heart failure | 1 | A | |
| 42823 | 4.544556808 | Acute on chronic systolic heart failure | 1 | A | |
| 42830 | 0.331354467 | Diastolic heart failure, unspecified | 1 | A | |
| 42831 | 1.154282048 | Acute diastolic heart failure | 1 | A | |
| 42832 | 0.090060658 | Chronic diastolic heart failure | 1 | A | |
| 42833 | 2.709324398 | Acute on chronic diastolic heart failure | 1 | A | |
| 42841 | 0.113485779 | Acute combined systolic and diastolic heart failure | 1 | A | |
| 42842 | 0.027778809 | Chronic combined systolic and diastolic heart failure | 1 | A | |
| 42843 | 0.580130515 | Acute on chronic combined systolic and diastolic heart failure | 1 | A | |
| 42731 | 22.64960738 | Atrial fibrillation | 1 | B | I |
| 4260 | 0.100178058 | Atrioventricular block, complete | 1 | B | II |
| 42613 | 0.034999404 | Other second degree atrioventricular block | 1 | B | II |
| 4266 | 0.059874333 | Other heart block | 1 | B | II |
| 42732 | 4.778286857 | Atrial flutter | 1 | B | III |
| 4270 | 0.465142096 | Paroxysmal supraventricular tachycardia | 1 | B | VI |
| 4271 | 0.665015517 | Paroxysmal ventricular tachycardia | 1 | B | VII |
| 42741 | 0.036599415 | Ventricular fibrillation | 1 | B | IV |
| 4275 | 0.08318301 | Cardiac arrest | 1 | B | IV |

| | | | | | |
|---|---|---|---|---|---|
| 42761 | 0.037615193 | Supraventricular premature beats | 1 | B | IV |
| 42781 | 1.507446876 | Sinoatrial node dysfunction | 1 | B | V |
| 42789 | 2.212772927 | Other specified cardiac dysrhythmias | 1 | B | IV |
| 41041 | 0.06333183 | Acute myocardial infarction of other inferior wall, initial episode of care | 1 | C | |
| 41071 | 0.514646269 | Subendocardial infarction, initial episode of care | 1 | C | |
| 41091 | 0.049760758 | Acute myocardial infarction of unspecified site, initial episode of care | 1 | C | |
| 4111 | 0.089608235 | Intermediate coronary syndrome | 1 | C | |
| 41189 | 0.034279553 | Other acute and subacute forms of ischemic heart disease, other | 1 | C | |
| 41400 | 0.158649864 | Coronary atherosclerosis of unspecified type of vessel, native or graft | 1 | C | |
| 41401 | 0.866444001 | Coronary atherosclerosis of native coronary artery | 1 | C | |
| 41402 | 0.031998 | Coronary atherosclerosis of autologous vein bypass graft | 1 | C | |
| 4148 | 0.060182828 | Other specified forms of chronic ischemic heart disease | 1 | C | |
| 4240 | 0.233018756 | Mitral valve disorders | 1 | D | |
| 4241 | 0.113572896 | Aortic valve disorders | 1 | D | |
| 4010 | 0.053033355 | Malignant essential hypertension | 1 | E | |
| 4019 | 0.233698648 | Unspecified essential hypertension | 1 | E | |
| 4580 | 0.328142795 | Orthostatic hypotension | 1 | F | |
| 45821 | 0.037266576 | Hypotension of hemodialysis | 1 | F | |
| 45829 | 0.273307835 | Other iatrogenic hypotension | 1 | F | |
| 4589 | 0.17817814 | Hypotension, unspecified | 1 | F | |
| 7802 | 0.598893681 | Syncope and collapse | 1 | F | |
| 7804 | 0.236883041 | Dizziness and giddiness | 1 | F | |
| 42090 | 0.455966177 | Acute pericarditis, unspecified | 1 | G | |
| 42099 | 0.216080242 | Other acute pericarditis | 1 | G | |
| 4230 | 0.116265157 | Hemopericardium | 1 | G | |
| 4232 | 0.029322026 | Constrictive pericarditis | 1 | G | |
| 4238 | 0.037181787 | Other specified diseases of pericardium | 1 | G | |
| 4239 | 1.744647457 | Unspecified disease of pericardium | 1 | G | |
| 4168 | 0.141103516 | Other chronic pulmonary heart diseases | 1 | H | |
| 4254 | 0.054855804 | Other primary cardiomyopathies | 1 | H | |
| 4290 | 0.026992469 | Myocarditis, unspecified | 1 | H | |
| 4294 | 0.157125375 | Functional disturbances following cardiac surgery | 1 | H | |

| | | | | | |
|---|---|---|---|---|---|
| 42983 | 0.035400427 | Takotsubo syndrome | 1 | H | |
| 7455 | 0.031282521 | Ostium secundum type atrial septal defect | 1 | H | |
| 7851 | 0.242200095 | Palpitations | 1 | H | |
| 78650 | 0.967898327 | Chest pain, unspecified | 1 | H | |
| 78651 | 0.073361491 | Precordial pain | 1 | H | |
| 78659 | 1.59797417 | Other chest pain | 1 | H | |
| 99600 | 0.066213302 | Mechanical complication of unspecified cardiac device, implant, and graft | 1 | H | |
| 99601 | 0.545730688 | Mechanical complication due to cardiac pacemaker (electrode) | 1 | H | |
| 99604 | 0.156045269 | Mechanical complication of automatic implantable cardiac defibrillator | 1 | H | |
| 99661 | 0.180874581 | Infection and inflammatory reaction due to cardiac device, implant, and graft | 1 | H | |
| 99672 | 0.124851169 | Other complications due to other cardiac device, implant, and graft | 1 | H | |
| 9971 | 0.808873857 | Cardiac complications, not elsewhere classified | 1 | H | |
| 44020 | 0.02057995 | Atherosclerosis of native arteries of the extremities, unspecified | 2 | | |
| 44024 | 0.033675355 | Atherosclerosis of native arteries of the extremities with gangrene | 2 | | |
| 4412 | 0.031223058 | Thoracic aneurysm without mention of rupture | 2 | | |
| 4413 | 0.037603377 | Abdominal aneurysm, ruptured | 2 | | |
| 4414 | 0.070495736 | Abdominal aneurysm without mention of rupture | 2 | | |
| 4420 | 0.027489595 | Aneurysm of artery of upper extremity | 2 | | |
| 4423 | 0.39921174 | Aneurysm of artery of lower extremity | 2 | | |
| 44289 | 0.036838614 | Aneurysm of other specified artery | 2 | | |
| 44422 | 0.110842444 | Arterial embolism and thrombosis of lower extremity | 2 | | |
| 44489 | 0.053821626 | Embolism and thrombosis of other specified artery | 2 | | |
| 4470 | 0.250482045 | Arteriovenous fistula, acquired | 2 | | |
| 4510 | 0.033675355 | Phlebitis and thrombophlebitis of superficial vessels of lower extremities | 2 | | |
| 45184 | 0.027404814 | Phlebitis and thrombophlebitis of upper extremities, unspecified | 2 | | |
| 99674 | 0.044290526 | Other complications due to other vascular device, implant, and graft | 2 | | |
| 9972 | 1.849520439 | Peripheral vascular complications, not elsewhere classified | 2 | | |
| 0380 | 0.129111947 | Streptococcal septicemia | 3 | A | |
| 03811 | 0.044495955 | Methicillin susceptible Staphylococcus aureus septicemia | 3 | A | |
| 03812 | 0.205759271 | Methicillin resistant Staphylococcus aureus septicemia | 3 | A | |
| 0383 | 0.027277207 | Septicemia due to anaerobes | 3 | A | |
| 03842 | 0.354015706 | Septicemia due to escherichia coli [E. coli] | 3 | A | |

| | | | | | |
|---|---|---|---|---|---|
| 03843 | 0.034279553 | Septicemia due to pseudomonas | 3 | A | |
| 0388 | 0.110094043 | Other specified septicemias | 3 | A | |
| 0389 | 1.701567667 | Unspecified septicemia | 3 | A | |
| 00845 | 0.36677978 | Intestinal infection due to Clostridium difficile | 3 | | |
| 0088 | 0.146806013 | Intestinal infection due to other organism, not elsewhere classified | 3 | | |
| 01194 | 0.040126469 | Pulmonary tuberculosis, unspecified, tubercle bacilli not found (in sputum) by microscopy, but found by bacterial culture | 3 | | |
| 01334 | 0.040981343 | Tuberculous abscess of brain, tubercle bacilli not found (in sputum) by microscopy, but found by bacterial culture | 3 | | |
| 042 | 0.043683596 | Human immunodeficiency virus [HIV] disease | 3 | | |
| 0521 | 0.034877233 | Varicella (hemorrhagic) pneumonitis | 3 | | |
| 0539 | 0.050167654 | Herpes zoster without mention of complication | 3 | | |
| 0543 | 0.044095253 | Herpetic meningoencephalitis | 3 | | |
| 0661 | 0.044863253 | Tick-borne fever | 3 | | |
| 0793 | 0.0516149 | Rhinovirus infection in conditions classified elsewhere and of unspecified site | 3 | | |
| 07999 | 0.067862371 | Unspecified viral infection | 3 | | |
| 6822 | 0.033547018 | Cellulitis and abscess of trunk | 3 | | |
| 6823 | 0.047701025 | Cellulitis and abscess of upper arm and forearm | 3 | | |
| 6824 | 0.071059465 | Cellulitis and abscess of hand, except fingers and thumb | 3 | | |
| 6826 | 0.414483075 | Cellulitis and abscess of leg, except foot | 3 | | |
| 6827 | 0.197071625 | Cellulitis and abscess of foot, except toes | 3 | | |
| 73028 | 0.032192514 | Unspecified osteomyelitis, other specified sites | 3 | | |
| 7907 | 0.1004461 | Bacteremia | 3 | | |
| 99590 | 0.064159295 | Systemic inflammatory response syndrome, unspecified | 3 | | |
| 99859 | 0.398145309 | Other postoperative infection | 3 | | |
| 99932 | 0.027880896 | Bloodstream infection due to central venous catheter | 3 | | |
| 99939 | 0.027880896 | Infection following other infusion, injection, transfusion, or vaccination | 3 | | |
| 51881 | 0.904220487 | Acute respiratory failure | 4 | A | |
| 51884 | 0.30206047 | Acute and chronic respiratory failure | 4 | A | |
| 4660 | 0.119489831 | Acute bronchitis | 4 | B | |
| 490 | 0.031133585 | Bronchitis, not specified as acute or chronic | 4 | B | |

| | | | | | |
|---|---|---|---|---|---|
| 4911 | 0.037918132 | Mucopurulent chronic bronchitis | 4 | B | |
| 49121 | 1.007818794 | Obstructive chronic bronchitis with (acute) exacerbation | 4 | B | |
| 49122 | 0.200429898 | Obstructive chronic bronchitis with acute bronchitis | 4 | B | |
| 49322 | 0.432527281 | Chronic obstructive asthma with (acute) exacerbation | 4 | B | |
| 49390 | 0.03382659 | Asthma, unspecified type, unspecified | 4 | B | |
| 49392 | 0.156725202 | Asthma, unspecified type, with (acute) exacerbation | 4 | B | |
| 4809 | 0.033810897 | Viral pneumonia, unspecified | 4 | C | |
| 4820 | 0.042466195 | Pneumonia due to Klebsiella pneumoniae | 4 | C | |
| 48230 | 0.031710177 | Pneumonia due to Streptococcus, unspecified | 4 | C | |
| 48242 | 0.186079378 | Methicillin resistant pneumonia due to Staphylococcus aureus | 4 | C | |
| 48283 | 0.102271255 | Pneumonia due to other gram-negative bacteria | 4 | C | |
| 4829 | 0.047701025 | Bacterial pneumonia, unspecified | 4 | C | |
| 486 | 2.333631459 | Pneumonia, organism unspecified | 4 | C | |
| 5070 | 0.559543833 | Pneumonitis due to inhalation of food or vomitus | 4 | C | |
| 51633 | 0.031296026 | Acute interstitial pneumonitis | 4 | C | |
| 32723 | 0.040981343 | Obstructive sleep apnea (adult)(pediatric) | 4 | D | |
| 4150 | 0.035591102 | Acute cor pulmonale | 4 | D | |
| 4659 | 0.081715137 | Acute upper respiratory infections of unspecified site | 4 | D | |
| 5109 | 0.065545324 | Empyema without mention of fistula | 4 | D | |
| 5110 | 0.041485512 | Pleurisy without mention of effusion or current tuberculosis | 4 | D | |
| 51189 | 0.095655552 | Other specified forms of effusion, except tuberculous | 4 | D | |
| 5119 | 0.537196926 | Unspecified pleural effusion | 4 | D | |
| 514 | 0.057237841 | Pulmonary congestion and hypostasis | 4 | D | |
| 515 | 0.028361163 | Postinflammatory pulmonary fibrosis | 4 | D | |
| 5183 | 0.030836915 | Pulmonary eosinophilia | 4 | D | |
| 5184 | 0.217591729 | Acute edema of lung, unspecified | 4 | D | |
| 51852 | 0.036543736 | Other pulmonary insufficiency, not elsewhere classified, following trauma and surgery | 4 | D | |
| 5194 | 0.045103098 | Disorders of diaphragm | 4 | D | |
| 78605 | 0.093646015 | Shortness of breath | 4 | D | |
| 78609 | 0.179128612 | Other respiratory abnormalities | 4 | D | |
| 78652 | 0.13635189 | Painful respiration | 4 | D | |

| | | | | | |
|---|---|---|---|---|---|
| 4552 | 0.079089259 | Internal hemorrhoids with other complication | 5 | | |
| 4555 | 0.034927084 | External hemorrhoids with other complication | 5 | | |
| 4558 | 0.035400427 | Unspecified hemorrhoids with other complication | 5 | | |
| 5300 | 0.03429958 | Achalasia and cardiospasm | 5 | | |
| 53010 | 0.037688781 | Esophagitis, unspecified | 5 | | |
| 53020 | 0.037726816 | Ulcer of esophagus without bleeding | 5 | | |
| 5305 | 0.033961848 | Dyskinesia of esophagus | 5 | | |
| 53081 | 0.120317353 | Esophageal reflux | 5 | | |
| 53500 | 0.021697154 | Acute gastritis, without mention of hemorrhage | 5 | | |
| 53540 | 0.04773753 | Other specified gastritis, without mention of hemorrhage | 5 | | |
| 53550 | 0.085236534 | Unspecified gastritis and gastroduodenitis, without mention of hemorrhage | 5 | | |
| 5362 | 0.040605186 | Persistent vomiting | 5 | | |
| 5363 | 0.077237622 | Gastroparesis | 5 | | |
| 53649 | 0.110842444 | Other gastrostomy complications | 5 | | |
| 5370 | 0.033891362 | Acquired hypertrophic pyloric stenosis | 5 | | |
| 5401 | 0.027555853 | Acute appendicitis with peritoneal abscess | 5 | | |
| 5409 | 0.069454787 | Acute appendicitis without mention of peritonitis | 5 | | |
| 5570 | 0.035187293 | Acute vascular insufficiency of intestine | 5 | | |
| 5571 | 0.043037227 | Chronic vascular insufficiency of intestine | 5 | | |
| 5579 | 0.062463597 | Unspecified vascular insufficiency of intestine | 5 | | |
| 5589 | 0.309256991 | Other and unspecified noninfectious gastroenteritis and colitis | 5 | | |
| 5601 | 0.147820637 | Paralytic ileus | 5 | | |
| 56031 | 0.036743359 | Gallstone ileus | 5 | | |
| 56081 | 0.083051367 | Intestinal or peritoneal adhesions with obstruction (postoperative) (postinfection) | 5 | | |
| 56089 | 0.030973468 | Other specified intestinal obstruction | 5 | | |
| 5609 | 0.265916124 | Unspecified intestinal obstruction | 5 | | |
| 56211 | 0.139142022 | Diverticulitis of colon (without mention of hemorrhage) | 5 | | |
| 56400 | 0.029321478 | Constipation, unspecified | 5 | | |
| 5641 | 0.079811627 | Irritable bowel syndrome | 5 | | |
| 5680 | 0.037603377 | Peritoneal adhesions (postoperative) (postinfection) | 5 | | |
| 56949 | 0.05389285 | Other specified disorders of rectum and anus | 5 | | |

| | | | | | |
|---|---|---|---|---|---|
| 5715 | 0.043118798 | Cirrhosis of liver without mention of alcohol | 5 | | |
| 5722 | 0.034414162 | Hepatic encephalopathy | 5 | | |
| 5724 | 0.068828325 | Hepatorenal syndrome | 5 | | |
| 5728 | 0.054172783 | Other sequelae of chronic liver disease | 5 | | |
| 57400 | 0.2155727 | Calculus of gallbladder with acute cholecystitis, without mention of obstruction | 5 | | |
| 57410 | 0.064583009 | Calculus of gallbladder with other cholecystitis, without mention of obstruction | 5 | | |
| 57420 | 0.179200229 | Calculus of gallbladder without mention of cholecystitis, without mention of obstruction | 5 | | |
| 57470 | 0.03382659 | Calculus of gallbladder and bile duct with other cholecystitis, without mention of obstruction | 5 | | |
| 57471 | 0.059519738 | Calculus of gallbladder and bile duct with other cholecystitis, with obstruction | 5 | | |
| 5750 | 0.029322026 | Acute cholecystitis | 5 | | |
| 57511 | 0.03602405 | Chronic cholecystitis | 5 | | |
| 5761 | 0.08881793 | Cholangitis | 5 | | |
| 5770 | 0.097442803 | Acute pancreatitis | 5 | | |
| 5772 | 0.037170094 | Cyst and pseudocyst of pancreas | 5 | | |
| 78701 | 0.138658277 | Nausea with vomiting | 5 | | |
| 78720 | 0.034534223 | Dysphagia, unspecified | 5 | | |
| 78901 | 0.047472853 | Abdominal pain, right upper quadrant | 5 | | |
| 78902 | 0.03156901 | Abdominal pain, left upper quadrant | 5 | | |
| 78903 | 0.041525683 | Abdominal pain, right lower quadrant | 5 | | |
| 78906 | 0.076071189 | Abdominal pain, epigastric | 5 | | |
| 78907 | 0.032770678 | Abdominal pain, generalized | 5 | | |
| 9974 | 0.101136723 | Digestive system complications not elsewhere classified | 5 | | |
| 43310 | 0.105392098 | Occlusion and stenosis of carotid artery without mention of cerebral infarction | 6 | A | |
| 43311 | 0.030918355 | Occlusion and stenosis of carotid artery with cerebral infarction | 6 | A | |
| 43400 | 0.030707648 | Cerebral thrombosis without mention of cerebral infarction | 6 | A | |
| 43411 | 0.335369469 | Cerebral embolism with cerebral infarction | 6 | A | |

| | | | | | |
|---|---|---|---|---|---|
| 43491 | 0.746265614 | Cerebral artery occlusion, unspecified with cerebral infarction | 6 | A | |
| 4358 | 0.036957879 | Other specified transient cerebral ischemias | 6 | A | |
| 4359 | 0.393311458 | Unspecified transient cerebral ischemia | 6 | A | |
| 4370 | 0.036319939 | Cerebral atherosclerosis | 6 | A | |
| 4371 | 0.026746486 | Other generalized ischemic cerebrovascular disease | 6 | A | |
| 3310 | 0.044514645 | Alzheimer's disease | 6 | B | |
| 33182 | 0.028690747 | Dementia with lewy bodies | 6 | B | |
| 33812 | 0.043683596 | Acute post-thoracotomy pain | 6 | B | |
| 33818 | 0.064616751 | Other acute postoperative pain | 6 | B | |
| 3383 | 0.090928611 | Neoplasm related pain (acute) (chronic) | 6 | B | |
| 34580 | 0.043683596 | Other forms of epilepsy and recurrent seizures, without mention of intractable epilepsy | 6 | B | |
| 34670 | 0.059536091 | Chronic migraine without aura, without mention of intractable migraine without mention of status migrainosus | 6 | B | |
| 34680 | 0.074781498 | Other forms of migraine, without mention of intractable migraine without mention of status migrainosus | 6 | B | |
| 34690 | 0.032876335 | Migraine, unspecified, without mention of intractable migraine without mention of status migrainosus | 6 | B | |
| 34691 | 0.096204821 | Migraine, unspecified, with intractable migraine, so stated, without mention of status migrainosus | 6 | B | |
| 3481 | 0.035219496 | Anoxic brain damage | 6 | B | |
| 34839 | 0.041129069 | Other encephalopathy | 6 | B | |
| 34982 | 0.034637112 | Toxic encephalopathy | 6 | B | |
| 3558 | 0.050478338 | Mononeuritis of lower limb, unspecified | 6 | B | |
| 3576 | 0.044290526 | Polyneuropathy due to drugs | 6 | B | |
| 35801 | 0.033329086 | Myasthenia gravis with (acute) exacerbation | 6 | B | |
| 4377 | 0.033675355 | Transient global amnesia | 6 | B | |
| 4378 | 0.039508945 | Other ill-defined cerebrovascular disease | 6 | B | |
| 7840 | 0.041525683 | Headache | 6 | B | |
| 2760 | 0.026992469 | Hyperosmolality and/or hypernatremia | 7 | A | |
| 2761 | 0.461781548 | Hyposmolality and/or hyponatremia | 7 | A | |
| 2768 | 0.080620155 | Hypopotassemia | 7 | A | |

| | | | | | |
|---|---|---|---|---|---|
| 40390 | 0.041734355 | Hypertensive chronic kidney disease, unspecified, with chronic kidney disease stage I through stage IV, or unspecified | 7 | B | |
| 40391 | 0.062582136 | Hypertensive chronic kidney disease, unspecified, with chronic kidney disease stage V or end stage renal disease | 7 | B | |
| 5845 | 0.032095094 | Acute kidney failure with lesion of tubular necrosis | 7 | B | |
| 5849 | 1.376463572 | Acute kidney failure, unspecified | 7 | B | |
| 5856 | 0.045761995 | End stage renal disease | 7 | B | |
| 59080 | 0.034633306 | Pyelonephritis, unspecified | 7 | C | |
| 5921 | 0.190413053 | Calculus of ureter | 7 | C | |
| 59582 | 0.03429958 | Irradiation cystitis | 7 | C | |
| 5960 | 0.038429877 | Bladder neck obstruction | 7 | C | |
| 5990 | 0.780458415 | Urinary tract infection, site not specified | 7 | C | |
| 60000 | 0.093730942 | Hypertrophy (benign) of prostate without urinary obstruction and other lower urinary tract symptom (LUTS) | 7 | C | |
| 60001 | 0.056698669 | Hypertrophy (benign) of prostate with urinary obstruction and other lower urinary tract symptoms (LUTS) | 7 | C | |
| 6010 | 0.063711906 | Acute prostatitis | 7 | C | |
| 99631 | 0.149341225 | Mechanical complication due to urethral (indwelling) catheter | 7 | C | |
| 99664 | 0.360724716 | Infection and inflammatory reaction due to indwelling urinary catheter | 7 | C | |
| 99673 | 0.048760876 | Other complications due to renal dialysis device, implant, and graft | 7 | C | |
| 99676 | 0.09711838 | Other complications due to genitourinary device, implant, and graft | 7 | C | |
| 99732 | 0.043192692 | Postprocedural aspiration pneumonia | 7 | C | |
| 99739 | 0.305984797 | Other respiratory complications | 7 | C | |
| 9975 | 0.064080037 | Urinary complications, not elsewhere classified | 7 | C | |
| 2800 | 0.066072314 | Iron deficiency anemia secondary to blood loss (chronic) | 8 | A | |
| 28319 | 0.040126469 | Other non-autoimmune hemolytic anemias | 8 | A | |
| 2851 | 0.295336865 | Acute posthemorrhagic anemia | 8 | A | |
| 28521 | 0.067899314 | Anemia in chronic kidney disease | 8 | A | |
| 28522 | 0.035187529 | Anemia in neoplastic disease | 8 | A | |
| 28529 | 0.050053851 | Anemia of other chronic disease | 8 | A | |
| 2859 | 0.111928606 | Anemia, unspecified | 8 | A | |

| | | | | | |
|---|---|---|---|---|---|
| 28659 | 0.038349867 | Other hemorrhagic disorder due to intrinsic circulating anticoagulants, antibodies, or inhibitors | 8 | B | |
| 28981 | 0.031649436 | Primary hypercoagulable state | 8 | B | |
| 79092 | 0.23173945 | Abnormal coagulation profile | 8 | B | |
| 73382 | 0.026767595 | Nonunion of fracture | 9 | | |
| 8052 | 0.062096879 | Closed fracture of dorsal [thoracic] vertebra without mention of spinal cord injury | 9 | | |
| 8056 | 0.070085066 | Closed fracture of sacrum and coccyx without mention of spinal cord injury | 9 | | |
| 80703 | 0.03285072 | Closed fracture of three ribs | 9 | | |
| 80705 | 0.043421188 | Closed fracture of five ribs | 9 | | |
| 82009 | 0.09346889 | Other closed transcervical fracture of neck of femur | 9 | | |
| 8208 | 0.066267912 | Closed fracture of unspecified part of neck of femur | 9 | | |
| 82535 | 0.032858098 | Open fracture of metatarsal bone(s) | 9 | | |
| 8488 | 0.035126602 | Other specified sites of sprains and strains | 9 | | |
| 85011 | 0.039508945 | Concussion, with loss of consciousness of 30 minutes or less | 9 | | |
| 8604 | 0.033329086 | Traumatic pneumohemothorax without mention of open wound into thorax | 9 | | |
| 8670 | 0.157967689 | Injury to bladder and urethra, without mention of open wound into cavity | 9 | | |
| 87211 | 0.034152958 | Open wound of auricle, ear, complicated | 9 | | |
| 8911 | 0.046990975 | Open wound of knee, leg [except thigh], and ankle, complicated | 9 | | |
| 9222 | 0.034534223 | Contusion of abdominal wall | 9 | | |
| 9551 | 0.041597922 | Injury to median nerve | 9 | | |
| 9623 | 0.121369637 | Poisoning by insulins and antidiabetic agents | 9 | | |
| 9642 | 0.041437884 | Poisoning by anticoagulants | 9 | | |
| 96509 | 0.032770678 | Poisoning by other opiates and related narcotics | 9 | | |
| 25012 | 0.034981461 | Diabetes with ketoacidosis, type II or unspecified type, uncontrolled | 10 | A | |
| 25060 | 0.091439456 | Diabetes with neurological manifestations, type II or unspecified type, not stated as uncontrolled | 10 | A | |
| 25062 | 0.043161113 | Diabetes with neurological manifestations, type II or unspecified type, uncontrolled | 10 | A | |
| 25080 | 0.136130499 | Diabetes with other specified manifestations, type II or unspecified type, not stated as uncontrolled | 10 | A | |
| 2449 | 0.079142849 | Unspecified acquired hypothyroidism | 10 | B | |

| | | | | | |
|---|---|---|---|---|---|
| 2536 | 0.125701116 | Other disorders of neurohypophysis | 10 | B | |
| 1532 | 0.039648458 | Malignant neoplasm of descending colon | 11 | | |
| 1533 | 0.034395416 | Malignant neoplasm of sigmoid colon | 11 | | |
| 1539 | 0.038252283 | Malignant neoplasm of colon, unspecified site | 11 | | |
| 1622 | 0.075252606 | Malignant neoplasm of main bronchus | 11 | | |
| 1623 | 0.108874178 | Malignant neoplasm of upper lobe, bronchus or lung | 11 | | |
| 1625 | 0.037170094 | Malignant neoplasm of lower lobe, bronchus or lung | 11 | | |
| 1629 | 0.143461262 | Malignant neoplasm of bronchus and lung, unspecified | 11 | | |
| 1890 | 0.102601811 | Malignant neoplasm of kidney, except pelvis | 11 | | |
| 1970 | 0.043084307 | Secondary malignant neoplasm of lung | 11 | | |
| 1972 | 0.04671944 | Secondary malignant neoplasm of pleura | 11 | | |
| 1983 | 0.033569521 | Secondary malignant neoplasm of brain and spinal cord | 11 | | |
| 1985 | 0.034395416 | Secondary malignant neoplasm of bone and bone marrow | 11 | | |
| 20288 | 0.06081691 | Other malignant lymphomas, lymph nodes of multiple sites | 11 | | |
| 20300 | 0.062961862 | Multiple myeloma, without mention of having achieved remission | 11 | | |
| 2111 | 0.040782909 | Benign neoplasm of stomach | 11 | | |
| 5307 | 0.043808758 | Gastroesophageal laceration-hemorrhage syndrome | 12 | A | |
| 53140 | 0.107888291 | Chronic or unspecified gastric ulcer with hemorrhage, without mention of obstruction | 12 | A | |
| 53240 | 0.072551438 | Chronic or unspecified duodenal ulcer with hemorrhage, without mention of obstruction | 12 | A | |
| 53541 | 0.030628212 | Other specified gastritis, with hemorrhage | 12 | A | |
| 56212 | 0.069517126 | Diverticulosis of colon with hemorrhage | 12 | A | |
| 56881 | 0.083642412 | Hemoperitoneum (nontraumatic) | 12 | A | |
| 5693 | 0.221288249 | Hemorrhage of rectum and anus | 12 | A | |
| 5781 | 0.28634984 | Blood in stool | 12 | A | |
| 5789 | 0.582024443 | Hemorrhage of gastrointestinal tract, unspecified | 12 | A | |
| 430 | 0.050949514 | Subarachnoid hemorrhage | 12 | B | I |
| 431 | 0.157566381 | Intracerebral hemorrhage | 12 | B | I |
| 4321 | 0.198824219 | Subdural hemorrhage | 12 | B | I |
| 4329 | 0.027142427 | Unspecified intracranial hemorrhage | 12 | B | I |

| | | | | | |
|---|---|---|---|---|---|
| 80422 | 0.035171089 | Closed fractures involving skull or face with other bones with subarachnoid, subdural, and extradural hemorrhage, with brief [less than one hour] loss of consciousness | 12 | B | II |
| 85300 | 0.067691448 | Other and unspecified intracranial hemorrhage following injury without mention of open intracranial wound, unspecified state of consciousness | 12 | B | II |
| 85301 | 0.028349335 | Other and unspecified intracranial hemorrhage following injury without mention of open intracranial wound, with no loss of consciousness | 12 | B | II |
| 56985 | 0.082729773 | Angiodysplasia of intestine with hemorrhage | 12 | C | |
| 56986 | 0.034633306 | Dieulafoy lesion (hemorrhagic) of intestine | 12 | C | |
| 59971 | 0.235147052 | Gross hematuria | 12 | C | |
| 78630 | 0.032858098 | Hemoptysis, unspecified | 12 | C | |
| 99811 | 0.254061285 | Hemorrhage complicating a procedure | 12 | C | |
| 99812 | 2.737450179 | Hematoma complicating a procedure | 12 | C | |
| 2910 | 0.038349867 | Alcohol withdrawal delirium | 13 | | |
| 29181 | 0.036599415 | Alcohol withdrawal | 13 | | |
| 2920 | 0.034027752 | Drug withdrawal | 13 | | |
| 29572 | 0.02084305 | Schizoaffective disorder, chronic | 13 | | |
| 29620 | 0.066476957 | Major depressive affective disorder, single episode, unspecified | 13 | | |
| 29630 | 0.033808789 | Major depressive affective disorder, recurrent episode, unspecified | 13 | | |
| 29632 | 0.033552959 | Major depressive affective disorder, recurrent episode, moderate | 13 | | |
| 29633 | 0.065923574 | Major depressive affective disorder, recurrent episode, severe, without mention of psychotic behavior | 13 | | |
| 29636 | 0.025254546 | Major depressive affective disorder, recurrent episode, in full remission | 13 | | |
| 29650 | 0.059849008 | Bipolar I disorder, most recent episode (or current) depressed, unspecified | 13 | | |
| 2989 | 0.03214524 | Unspecified psychosis | 13 | | |
| 30000 | 0.03841689 | Anxiety state, unspecified | 13 | | |
| 30300 | 0.052296384 | Acute alcoholic intoxication in alcoholism, unspecified | 13 | | |
| 30390 | 0.038349867 | Other and unspecified alcohol dependence, unspecified | 13 | | |
| 41511 | 0.136076819 | Iatrogenic pulmonary embolism and infarction | 14 | | |
| 41519 | 0.505217556 | Other pulmonary embolism and infarction | 14 | | |
| 45340 | 0.187089885 | Acute venous embolism and thrombosis of unspecified deep vessels of lower extremity | 14 | | |

| | | | | | |
|---|---|---|---|---|---|
| 45341 | 0.430114737 | Acute venous embolism and thrombosis of deep vessels of proximal lower extremity | 14 | | |
| 45381 | 0.03602405 | Acute venous embolism and thrombosis of superficial veins of upper extremity | 14 | | |
| 135 | 0.038630829 | Sarcoidosis | 15 | | |
| 27400 | 0.067220235 | Gouty arthropathy, unspecified | 15 | | |
| 27651 | 0.150984627 | Dehydration | 15 | | |
| 27661 | 0.05092794 | Transfusion associated circulatory overload | 15 | | |
| 27669 | 0.180219455 | Other fluid overload | 15 | | |
| 35979 | 0.033961848 | Other inflammatory and immune myopathies, NEC | 15 | | |
| 3693 | 0.048822073 | Unqualified visual loss, both eyes | 15 | | |
| 38610 | 0.020536157 | Peripheral vertigo, unspecified | 15 | | |
| 38611 | 0.066706433 | Benign paroxysmal positional vertigo | 15 | | |
| 4568 | 0.02910206 | Varices of other sites | 15 | | |
| 55221 | 0.036986437 | Incisional ventral hernia with obstruction | 15 | | |
| 6273 | 0.042466195 | Postmenopausal atrophic vaginitis | 15 | | |
| 70714 | 0.038374405 | Ulcer of heel and midfoot | 15 | | |
| 7092 | 0.037952501 | Scar conditions and fibrosis of skin | 15 | | |
| 7093 | 0.033675355 | Degenerative skin disorders | 15 | | |
| 7098 | 0.034086681 | Other specified disorders of skin | 15 | | |
| 71535 | 0.031282521 | Osteoarthrosis, localized, not specified whether primary or secondary, pelvic region and thigh | 15 | | |
| 71538 | 0.039531625 | Osteoarthrosis, localized, not specified whether primary or secondary, other specified sites | 15 | | |
| 7210 | 0.059519738 | Cervical spondylosis without myelopathy | 15 | | |
| 7211 | 0.068376688 | Cervical spondylosis with myelopathy | 15 | | |
| 7213 | 0.030242692 | Lumbosacral spondylosis without myelopathy | 15 | | |
| 72252 | 0.04773753 | Degeneration of lumbar or lumbosacral intervertebral disc | 15 | | |
| 72400 | 0.037952501 | Spinal stenosis, unspecified region | 15 | | |
| 72402 | 0.034279553 | Spinal stenosis, lumbar region, without neurogenic claudication | 15 | | |
| 7242 | 0.034954273 | Lumbago | 15 | | |
| 7244 | 0.040925615 | Thoracic or lumbosacral neuritis or radiculitis, unspecified | 15 | | |

| | | | | | |
|---|---|---|---|---|---|
| 72886 | 0.040605186 | Necrotizing fasciitis | 15 | | |
| 72889 | 0.088572249 | Other disorders of muscle, ligament, and fascia | 15 | | |
| 7292 | 0.035613299 | Neuralgia, neuritis, and radiculitis, unspecified | 15 | | |
| 72989 | 0.05885991 | Other musculoskeletal symptoms referable to limbs | 15 | | |
| 72992 | 0.063562323 | Nontraumatic hematoma of soft tissue | 15 | | |
| 73679 | 0.038265782 | Other acquired deformities of ankle and foot | 15 | | |
| 78060 | 0.213641336 | Fever, unspecified | 15 | | |
| 78064 | 0.036960592 | Chills (without fever) | 15 | | |
| 78079 | 0.384644277 | Other malaise and fatigue | 15 | | |
| 7837 | 0.032664138 | Adult failure to thrive | 15 | | |
| 7905 | 0.099084021 | Other nonspecific abnormal serum enzyme levels | 15 | | |
| 9352 | 0.027087186 | Foreign body in stomach | 15 | | |
| 99641 | 0.044764055 | Mechanical loosening of prosthetic joint | 15 | | |
| 99642 | 0.026767595 | Dislocation of prosthetic joint | 15 | | |
| 99659 | 0.05707582 | Mechanical complication due to other implant and internal device, not elsewhere classified | 15 | | |
| 99666 | 0.067364983 | Infection and inflammatory reaction due to internal joint prosthesis | 15 | | |
| 99799 | 0.053339436 | Complications affecting other specified body systems, not elsewhere classified | 15 | | |
| 99809 | 0.027978656 | Postoperative shock, other | 15 | | |
| 9982 | 0.047557017 | Accidental puncture or laceration during a procedure, not elsewhere classified | 15 | | |
| 99851 | 0.03429958 | Infected postoperative seroma | 15 | | |
| 9986 | 0.200654069 | Persistent postoperative fistula | 15 | | |
| 99883 | 0.035816844 | Non-healing surgical wound | 15 | | |
| 99889 | 0.210472812 | Other specified complications of procedures not elsewhere classified | 15 | | |
| V0382 | 0.040782909 | Other specified vaccinations against streptococcus pneumoniae [pneumococcus] | 15 | | |
| V5331 | 0.03285072 | Fitting and adjustment of cardiac pacemaker | 15 | | |
| V5789 | 0.155503424 | Care involving other specified rehabilitation procedure | 15 | | |
| V5811 | 0.06081691 | Encounter for antineoplastic chemotherapy | 15 | | |
| V5812 | 0.06081691 | Encounter for antineoplastic immunotherapy | 15 | | |

**Table S3**. **ICD 9 codes used to identify co morbidities.**

| Co-morbidities | ICD 9 CM diagnosis codes |
|---|---|
| Obstructive sleep apnea | 327.23 |
| Heart failure | 402.01/11/91, 404.01/03/11/91/93, 428 |
| Coronary artery disease | 410-414, V45.82 |
| Chronic kidney disease (Stage 3 or more) | 585.3/4/5/6, V45.11, 39.95(procedural code) |
| Prior coronary artery bypass graft | V45.81 |
| Hyperthyroidism | 242 |
| Mitral valve disease | 424.0 |
| Prior Stroke/TIA | 438, V12.54 |
| Co morbidities were identified using above ICD 9 codes in secondary diagnosis field | |

**Table S4**. **Deyo's modification of Charlson's co-morbidity index (CCI).**

| Reported ICD-9 CM Codes | Condition | Charlson Score |
|---|---|---|
| 410 – 410.9 | Myocardial infarction | 1 |
| 428 – 428.9 | Congestive heart failure | 1 |
| 433.9, 441 – 441.9, 785.4, V43.4 | Peripheral vascular disease | 1 |
| 430 – 438 | Cerebrovascular disease | 1 |
| 290 – 290.9 | Dementia | 1 |
| 490 – 496, 500 – 505, 506.4 | Chronic pulmonary disease | 1 |
| 710.0, 710.1, 710.4, 714.0 – 714.2, 714.81, 725 | Rheumatologic disease | 1 |
| 531 – 534.9 | Peptic ulcer disease | 1 |
| 571.2, 571.5, 571.6, 571.4 – 571.49 | Mild liver disease | 1 |
| 250 – 250.3, 250.7 | Diabetes | 1 |
| 250.4 – 250.6 | Diabetes with chronic complications | 2 |
| 344.1, 342 – 342.9 | Hemiplegia or paraplegia | 2 |
| 582 – 582.9, 583 – 583.7, 585, 586, 588 – 588.9 | Renal disease | 2 |
| 140-172.9, 174-195.8, 200-208.9 | Any malignancy including leukemia and lymphoma | 2 |
| 572.2 – 572.8 | Moderate or severe liver disease | 3 |
| 196 -199.1 | Metastatic solid tumor | 6 |
| 042 – 044.9 | AIDS | 6 |

**Table S5. Multivariate analysis of utilization of catheter ablation for atrial fibrillation.**

| | Multivariate of catheter ablation in atrial fibrillation | | | |
|---|---|---|---|---|
| | OR | LL | UL | P-value |
| **Age (continuous variable)** [π] | 0.97 | 0.97 | 0.98 | <0.001 |
| **Age groups** | | | | |
| 18-49 | Referent | Referent | Referent | |
| 50-64 | 1.06 | 0.99 | 1.13 | <0.001 |
| 65-79 | 0.82 | 0.76 | 0.89 | <0.001 |
| >=80 | 0.27 | 0.24 | 0.29 | <0.001 |
| **Sex** | | | | |
| Male | Referent | Referent | Referent | |
| Female | 0.76 | 0.73 | 0.78 | <0.001 |
| **Comorbidities** | | | | |
| Obesity[§] | 0.77 | 0.73 | 0.81 | <0.001 |
| Obstructive sleep apnea[α] | 1.17 | 1.10 | 1.24 | <0.001 |
| Hypertension[§] | 0.88 | 0.85 | 0.91 | <0.001 |
| Diabetes[§] | 0.82 | 0.78 | 0.86 | <0.001 |
| Heart failure[@] | 0.72 | 0.69 | 0.76 | <0.001 |
| Coronary artery disease[β] | 0.87 | 0.84 | 0.91 | <0.001 |
| Chronic pulmonary disease[§] | 0.87 | 0.83 | 0.92 | <0.001 |
| Chronic kidney disease[∞](stage 3 more more) | 0.76 | 0.69 | 0.84 | <0.001 |
| Prior coronary artery bypass graft[®] | 0.93 | 0.86 | 1.01 | 0.072 |
| Hyperthyroidism[Ω] | 0.51 | 0.42 | 0.61 | <0.001 |
| Alcohol abuse[§] | 0.28 | 0.24 | 0.32 | <0.001 |
| Mitral valve disease[μ] | 0.89 | 0.84 | 0.95 | 0.001 |
| Prior stroke/Transient ischemic attack[©] | 0.91 | 0.85 | 0.98 | 0.007 |

| | | | | |
|---|---|---|---|---|
| Vascular Disease history[§] | 0.99 | 0.91 | 1.07 | 0.682 |
| Anemia[§] | 0.77 | 0.72 | 0.84 | <0.001 |
| **Median household income category for patient's zip code [#]** | | | | |
| 1. 0-25th percentile | Referent | Referent | Referent | |
| 2. 26-50th percentile | 1.33 | 1.26 | 1.40 | 0.002 |
| 3. 51-75th percentile | 1.48 | 1.40 | 1.56 | <0.001 |
| 4. 76-100th percentile | 1.92 | 1.82 | 2.02 | <0.001 |
| **Primary Payer** | | | | |
| Medicare | Referent | Referent | Referent | |
| Medicaid | 0.72 | 0.64 | 0.80 | 0.003 |
| Private including health maintenance organization | 1.11 | 1.05 | 1.17 | <0.001 |
| Self-pay/no charge/other | 0.53 | 0.47 | 0.59 | <0.001 |
| **Hospital characteristics** | | | | |
| **Hospital bed size [£]** | | | | |
| Small | Referent | Referent | Referent | |
| Medium | 2.84 | 2.59 | 3.11 | <0.001 |
| Large | 4.64 | 4.26 | 5.06 | <0.001 |
| **Hospital teaching status[$]** | | | | |
| Non-teaching | Referent | Referent | Referent | |
| Teaching | 2.90 | 2.79 | 3.01 | <0.001 |
| **Admission type** | | | | |
| Non-elective | Referent | Referent | Referent | |
| Elective | 17.48 | 16.85 | 18.14 | <0.001 |
| **Admission day** | | | | |
| Weekdays | Referent | Referent | Referent | |
| Weekend | 0.29 | 0.27 | 0.32 | <0.001 |

§: Variables are AHRQ co-morbidity measures.

||: Charlson/Deyo Co-morbidity index (CCI) was calculated as per Deyo classification.

#: Represents a quartile classification of the estimated median household income of residents in the patients ZIP Code, derived from ZIP Code-demographic data obtained from Claritas. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations. Because these estimates are updated annually, the value ranges vary by year. https://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nrdnote.jsp

@: Heart failure is identified by ICD 9 codes in secondary diagnosis field and it includes systolic, diastolic and combined heart failure.
£: The bed size cutoff points divided into small, medium, and large have been done so that approximately one-third of the hospitals in a given region, location, and teaching status combination would fall within each bed size category. https://www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nrdnote.jsp
$: A hospital is considered to be a teaching hospital if it has an AMA-approved residency program, is a member of the Council of Teaching Hospitals (COTH) or has a ratio of full-time equivalent interns and residents to beds of 0.25 or higher. https://www.hcup-us.ahrq.gov/db/vars/hosp_ur_teach/nrdnote.jsp
α, β, ∞, ®, Ω, µ, ©: co-morbidities were identified by appropriate ICD 9 CM diagnosis codes in secondary diagnosis field (Table S3)

**Table S6**. **Baseline characteristics of patients of catheter ablation in atrial fibrillation with and without atrial fibrillation recurrence.**

| | Atrial Fibrillation Recurrence | | | |
|---|---|---|---|---|
| | No | Yes | Overall | p-value |
| Index admission | 35396(94.7%) | 1964(5.3%) | 37360 | |
| Patient level variables | | | | |
| **Age (%)** | 65(57-71) | 68(60-74) | 65(57-72) | <0.001 |
| 18-49 | 10.3 | 8.1 | 10.2 | |
| 50-64 | 37.4 | 35.0 | 37.3 | |
| 65-79 | 45.0 | 50.2 | 45.3 | |
| >=80 | 7.3 | 6.7 | 7.2 | |
| **Sex (%)** | | | | <0.001 |
| Male | 64.6 | 56.6 | 64.2 | |
| Female | 35.4 | 43.4 | 35.8 | |
| **Charlson co-morbidity index ‖ (%)** | | | | <0.001 |
| 0 | 58.2 | 52.2 | 57.9 | |
| 1 | 24.5 | 29.5 | 24.8 | |
| >=2 | 17.3 | 18.3 | 17.4 | |
| **Comorbidities (%)** | | | | |
| Obesity§ | 15.1 | 19.3 | 15.3 | <0.001 |
| Obstructive sleep apnea$^{\alpha}$ | 14.3 | 12.9 | 14.2 | 0.078 |
| Hypertension§ | 62.6 | 65.8 | 62.8 | 0.004 |
| Diabetes§ | 18.7 | 24.6 | 19.0 | <0.001 |
| Heart failure@ | 15.9 | 15.4 | 15.9 | 0.613 |
| Coronary artery disease$^{\beta}$ | 25.1 | 26.4 | 25.2 | 0.209 |
| Chronic pulmonary disease§ | 14.0 | 17.5 | 14.2 | <0.001 |

| | | | | |
|---|---|---|---|---|
| Chronic kidney disease[∞](stage 3 more more) | 3.3 | 2.3 | 3.3 | 0.015 |
| Prior coronary artery bypass graft [®] | 5.3 | 5.1 | 5.3 | 0.788 |
| Hyperthyroidism[Ω] | 0.8 | 0.4 | 0.8 | 0.044 |
| Alcohol abuse[§] | 1.1 | 0.4 | 1.1 | 0.002 |
| Mitral Valve disease[µ] | 7.8 | 8.9 | 7.9 | 0.066 |
| Prior stroke/Transient ischemic attack[©] | 6.6 | 6.7 | 6.6 | 0.879 |
| Vascular Disease history[§] | 4.6 | 3.9 | 4.6 | 0.110 |
| Anemia[§] | 5.1 | 7.0 | 5.2 | <0.001 |
| **Median household income category for patient's zip code [#] (%)** | | | | <0.001 |
| 1. 0-25th percentile | 18.4 | 19.1 | 18.4 | |
| 2. 26-50th percentile | 22.2 | 26.9 | 22.4 | |
| 3. 51-75th percentile | 26.6 | 25.4 | 26.5 | |
| 4. 76-100th percentile | 31.1 | 26.6 | 30.9 | |
| **Primary Payer (%)** | | | | <0.001 |
| Medicare | 51.7 | 57.2 | 52.0 | |
| Medicaid | 2.6 | 4.2 | 2.7 | |
| Private including health maintenance organization | 42.7 | 35.7 | 42.3 | |
| Self-pay/no charge/other | 3.0 | 2.9 | 3.0 | |
| **Hospital characteristics** | | | | |
| **Hospital bed size [£] (%)** | | | | <0.001 |
| Small | 3.4 | 4.1 | 3.5 | |
| Medium | 17.5 | 21.2 | 17.7 | |
| Large | 79.1 | 74.7 | 78.9 | |
| **Hospital teaching status [$] (%)** | | | | 0.230 |
| Non-teaching | 25.2 | 24.0 | 25.1 | |

| | | | | |
|---|---|---|---|---|
| Teaching | 74.8 | 76.0 | 74.9 | |
| **Hospital Volume (%)** | | | | 0.023 |
| <50 | 45.6 | 47.1 | 45.9 | |
| 50 to 100 | 24.5 | 25.8 | 24.5 | |
| >100 | 30.0 | 27.1 | 29.9 | |
| **Admission type (%)** | | | | <0.001 |
| Non-elective | 29.7 | 33.9 | 29.9 | |
| Elective | 70.3 | 66.1 | 70.1 | |
| **Admission day (%)** | | | | 0.130 |
| Weekdays | 96.2 | 95.6 | 96.2 | |
| Weekend | 3.8 | 4.5 | 3.8 | |
| **Disposition (%)** | | | | 0.011 |
| Home | 97.9 | 98.8 | 97.9 | |
| Facility/others | 1.9 | 1.1 | 1.8 | |
| In hospital Mortality (%) | 0.2 | 0.0 | 0.1 | 0.084 |
| Length of stay (Median, IQR) days | 1(1-2) | 2(1-4) | 1(1-3) | <0.001 |
| Cost of hospitalization (Median, IQR) USD $ | 23581(17282-30209) | 22318(15235-30314) | 23414(17004-30220) | <0.001 |

§: Variables are AHRQ co-morbidity measures.
||: Charlson/Deyo Co-morbidity index (CCI) was calculated as per Deyo classification.
#: Represents a quartile classification of the estimated median household income of residents in the patients ZIP Code, derived from ZIP Code-demographic data obtained from Claritas. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations. Because these estimates are updated annually, the value ranges vary by year. https://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nrdnote.jsp
@: Heart failure is identified by ICD 9 codes in secondary diagnosis field and it includes systolic, diastolic and combined heart failure.
£: The bed size cutoff points divided into small, medium, and large have been done so that approximately one-third of the hospitals in a given region, location, and teaching status combination would fall within each bed size category. https://www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nrdnote.jsp
$: A hospital is considered to be a teaching hospital if it has an AMA-approved residency program, is a member of the Council of Teaching Hospitals (COTH) or has a ratio of full-time equivalent interns and residents to beds of 0.25 or higher. https://www.hcup-us.ahrq.gov/db/vars/hosp_ur_teach/nrdnote.jsp
α, β, ∞, ®, Ω, µ, ©: co-morbidities were identified by appropriate ICD 9 CM diagnosis codes in secondary diagnosis field (Table S3)

**Table S7. Multivariate analysis of 30 and 90-day readmission in atrial fibrillation patients.**

| | 30-day readmission | | | | 90-day readmission | | | |
|---|---|---|---|---|---|---|---|---|
| | HR | LL | UL | p-value | HR | LL | UL | p-value |
| **Age (continuous variable)[π]** | 1.01 | 1.01 | 1.01 | <0.001 | 1.01 | 1.01 | 1.01 | <0.001 |
| **Age group** | | | | | | | | |
| 18-49 | Referent | Referent | Referent | | Referent | Referent | Referent | |
| 50-64 | 1.34 | 1.29 | 1.40 | <0.001 | 1.29 | 1.25 | 1.33 | <0.001 |
| 65-79 | 1.26 | 1.20 | 1.32 | <0.001 | 1.20 | 1.16 | 1.25 | <0.001 |
| >=80 | 1.36 | 1.29 | 1.43 | <0.001 | 1.29 | 1.24 | 1.34 | <0.001 |
| **Sex** | | | | | | | | |
| Male | Referent | Referent | Referent | | Referent | Referent | Referent | |
| Female | 1.10 | 1.08 | 1.12 | <0.001 | 1.10 | 1.09 | 1.12 | <0.001 |
| Catheter ablation of atrial fibrillation | 1.02 | 0.97 | 1.07 | 0.423 | 0.89 | 0.86 | 0.93 | <0.001 |
| **Charlson co-morbidity index [‖]** | | | | | | | | |
| 0 | Referent | Referent | Referent | | Referent | Referent | Referent | |
| 1 | 1.25 | 1.22 | 1.28 | <0.001 | 1.22 | 1.20 | 1.24 | <0.001 |
| >=2 | 1.64 | 1.60 | 1.70 | <0.001 | 1.53 | 1.49 | 1.56 | <0.001 |
| **Comorbidities** | | | | | | | | |
| Obesity[§] | 0.93 | 0.91 | 0.95 | <0.001 | 0.96 | 0.95 | 0.98 | <0.001 |
| Obstructive sleep apnea[α] | 0.99 | 0.96 | 1,02 | 0.498 | 1.01 | 0.99 | 1.04 | 0.384 |
| Hypertension[§] | 0.99 | 0.97 | 1.00 | 0.106 | 0.99 | 0.98 | 1.00 | 0.249 |
| Diabetes[§] | 1.04 | 1.02 | 1.06 | <0.001 | 1.03 | 1.02 | 1.05 | <0.001 |
| Heart failure[@] | 1.14 | 1.12 | 1.16 | <0.001 | 1.13 | 1.12 | 1.15 | <0.001 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Coronary artery disease[β] | 1.14 | 1.12 | 1.16 | <0.001 | 1.14 | 1.12 | 1.15 | <0.001 |
| Chronic pulmonary disease[§] | 1.18 | 1.16 | 1.20 | <0.001 | 1.15 | 1.13 | 1.16 | <0.001 |
| Chronic kidney disease (stage 3 more more) | 1.20 | 1.17 | 1.23 | <0.001 | 1.18 | 1.16 | 1.21 | <0.001 |
| Prior coronary artery bypass graft [®] | 1.04 | 1.01 | 1.08 | 0.005 | 1.04 | 1.02 | 1.07 | <0.001 |
| Hyperthyroidism[Ω] | 1.00 | 0.94 | 1.06 | 0.990 | 0.99 | 0.95 | 1.04 | 0.772 |
| Alcohol abuse[§] | 1.14 | 1.10 | 1.19 | <0.001 | 1.17 | 1.13 | 1.20 | <0.001 |
| Mitral Valve disease[µ] | 0.99 | 0.96 | 1.01 | 0.318 | 1.00 | 0.98 | 1.02 | 0.714 |
| Prior stroke/Transient ischemic attack[©] | 1.06 | 1.03 | 1.08 | <0.001 | 1.06 | 1.05 | 1.08 | <0.001 |
| Vascular Disease history[§] | 1.12 | 1.09 | 1.15 | <0.001 | 1.10 | 1.07 | 1.13 | <0.001 |
| Anemia[§] | 1.33 | 1.31 | 1.36 | <0.001 | 1.28 | 1.25 | 1.29 | <0.001 |
| **Median household income category for patient's zip code [#]** | | | | | | | | |
| 1. 0-25th percentile | Referent | Referent | Referent | | Referent | Referent | Referent | |
| 2. 26-50th percentile | 0.94 | 0.92 | 0.96 | <0.001 | 0.94 | 0.93 | 0.96 | <0.001 |
| 3. 51-75th percentile | 0.93 | 0.91 | 0.95 | <0.001 | 0.93 | 0.91 | 0.94 | <0.001 |
| 4. 76-100th percentile | 0.92 | 0.90 | 0.94 | <0.001 | 0.92 | 0.91 | 0.94 | <0.001 |
| **Primary Payer** | | | | | | | | |
| Medicare | Referent | Referent | Referent | | Referent | Referent | Referent | |
| Medicaid | 1.15 | 1.10 | 1.20 | <0.001 | 1.18 | 1.09 | 1.16 | <0.001 |
| Private including health maintenance organization | 0.70 | 0.68 | 0.72 | <0.001 | 0.73 | 0.71 | 0.74 | <0.001 |
| Self-pay/no charge/other | 0.74 | 0.70 | 0.77 | <0.001 | 0.76 | 0.73 | 0.78 | <0.001 |
| **Hospital characteristics** | | | | | | | | |
| **Hospital teaching status[$]** | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Non-teaching | Referent | Referent | Referent | | Referent | Referent | Referent | |
| Teaching | 1.03 | 1.01 | 1.05 | <0.001 | 1.03 | 1.02 | 1.04 | <0.001 |
| **Hospital bed size £** | | | | | | | | |
| Small | Referent | Referent | Referent | | Referent | Referent | Referent | |
| Medium | 1.01 | 0.98 | 1.03 | 0.740 | 1.01 | 0.99 | 1.03 | 0.594 |
| Large | 1.00 | 0.98 | 1.03 | 0.727 | 1.01 | 0.99 | 1.03 | 0.269 |
| **Admission type** | | | | | | | | |
| Non-elective | Referent | Referent | Referent | | Referent | Referent | Referent | |
| Elective | 0.88 | 0.86 | 0.91 | <0.001 | 0.92 | 0.90 | 0.94 | <0.001 |
| **Admission day** | | | | | | | | |
| Weekdays | Referent | Referent | Referent | | Referent | Referent | Referent | |
| Weekend | 1.01 | 0.99 | 1.02 | 0.595 | 0.99 | 0.98 | 1.01 | 0.341 |
| **Disposition** | | | | | | | | |
| Home | Referent | Referent | Referent | | Referent | Referent | Referent | |
| Facility/others | 1.22 | 1.19 | 1.25 | <0.001 | 1.19 | 1.17 | 1.21 | <0.001 |
| **Length of stay (days)** | | | | | | | | |
| 1 | Referent | Referent | Referent | | Referent | Referent | Referent | |
| 2 to 3 | 1.20 | 1.18 | 1.23 | <0.001 | 1.19 | 1.17 | 1.21 | <0.001 |
| >3 | 1.53 | 1.50 | 1.57 | <0.001 | 1.45 | 1.43 | 1.47 | <0.001 |

§: Variables are AHRQ co-morbidity measures.
||: Charlson/Deyo Co-morbidity index (CCI) was calculated as per Deyo classification.
#: Represents a quartile classification of the estimated median household income of residents in the patients ZIP Code, derived from ZIP Code-demographic data obtained from Claritas. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations. Because these estimates are updated annually, the value ranges vary by year. https://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nrdnote.jsp
@: Heart failure is identified by ICD 9 codes in secondary diagnosis field and it includes systolic, diastolic and combined heart failure.
£: The bed size cutoff points divided into small, medium, and large have been done so that approximately one-third of the hospitals in a given region, location, and teaching status combination would fall within each bed size category. https://www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nrdnote.jsp

$: A hospital is considered to be a teaching hospital if it has an AMA-approved residency program, is a member of the Council of Teaching Hospitals (COTH) or has a ratio of full-time equivalent interns and residents to beds of 0.25 or higher. https://www.hcup-us.ahrq.gov/db/vars/hosp_ur_teach/nrdnote.jsp; α, β, ∞, ®, Ω, µ, ©: co-morbidities were identified by appropriate ICD 9 CM diagnosis codes in secondary diagnosis field (Table S3)

**Table S8. Impact of catheter ablation on 90-day readmission in different subgroups of atrial fibrillations.**

| **Subgroups** | Sub group analysis of 90-day readmission | | | |
|---|---|---|---|---|
| **Age** | HR | LL | HL | p-value |
| 18-49 | 1.04 | 0.88 | 1.22 | 0.638 |
| 50-64 | 0.83 | 0.77 | 0.89 | <0.001 |
| 65-79 | 0.89 | 0.84 | 0.95 | <0.001 |
| >=80 | 1.00 | 0.90 | 1.11 | 0.927 |
| **Sex** | | | | |
| Male | 0.87 | 0.83 | 0.92 | <0.001 |
| Female | 0.91 | 0.85 | 0.96 | 0.001 |
| **Charlson co-morbidity index** ‖ | | | | |
| 0 | 0.91 | 0.85 | 0.97 | 0.003 |
| 1 | 0.93 | 0.86 | 1.01 | 0.066 |
| >=2 | 0.85 | 0.80 | 0.92 | <0.001 |
| **Comorbidities** | | | | |
| Obesity§ | 0.99 | 0.90 | 1.10 | 0.875 |
| Obstructive sleep apnea$^{\alpha}$ | 0.87 | 0.77 | 0.98 | 0.019 |
| Hypertension§ | 0.88 | 0.84 | 0.93 | <0.001 |
| Diabetes§ | 0.92 | 0.85 | 0.99 | 0.035 |
| Heart failure@ | 0.90 | 0.83 | 0.97 | 0.004 |
| Coronary artery disease$^{\beta}$ | 0.89 | 0.83 | 0.95 | 0.001 |
| Chronic pulmonary disease§ | 0.91 | 0.84 | 1.00 | 0.037 |
| Chronic kidney disease$^{\infty}$(stage 3 more more) | 0.94 | 0.81 | 1.08 | 0.366 |
| Prior coronary artery bypass graft ® | 0.82 | 0.71 | 0.94 | 0.006 |
| Hyperthyroidism$^{\Omega}$ | 1.01 | 0.67 | 1.52 | 0.975 |
| Alcohol abuse§ | 0.73 | 0.51 | 1.05 | 0.094 |
| Mitral Valve disease$^{\mu}$ | 0.86 | 0.76 | 0.98 | 0.025 |

| | | | | |
|---|---|---|---|---|
| Prior stroke/Transient ischemic attack© | 0.90 | 0.79 | 1.03 | 0.122 |
| Vascular Disease history§ | 0.81 | 0.69 | 0.94 | 0.005 |
| Anemia§ | 0.87 | 0.77 | 0.98 | 0.023 |
| **Median household income category for patient's zip code #** | | | | |
| 1. 0-25th percentile | 0.87 | 0.80 | 0.95 | 0.001 |
| 2. 26-50th percentile | 0.88 | 0.81 | 0.95 | 0.002 |
| 3. 51-75th percentile | 0.90 | 0.83 | 0.98 | 0.013 |
| 4. 76-100th percentile | 0.88 | 0.82 | 0.96 | 0.002 |
| **Primary Payer** | | | | |
| Medicare | 0.96 | 0.93 | 0.99 | 0.025 |
| Medicaid | 0.84 | 0.73 | 0.97 | 0.019 |
| Private including health maintenance organization | 0.85 | 0.78 | 0.92 | <0.001 |
| Self-pay/no charge/other | 0.96 | 0.76 | 1.23 | 0.765 |
| **Hospital characteristics** | | | | |
| **Hospital bed size £** | | | | |
| Small | 0.92 | 0.76 | 1.12 | 0.401 |
| Medium | 0.83 | 0.75 | 0.91 | <0.001 |
| Large | 0.89 | 0.85 | 0.93 | <0.001 |
| **Hospital teaching status$** | | | | |
| Non-teaching | 0.91 | 0.84 | 0.98 | 0.009 |
| Teaching | 0.87 | 0.82 | 0.91 | <0.001 |
| **Admission type** | | | | |
| Non-elective | 0.88 | 0.83 | 0.94 | <0.001 |
| Elective | 0.79 | 0.74 | 0.84 | <0.001 |
| **Admission day** | | | | |
| Weekdays | 0.86 | 0.82 | 0.89 | <0.001 |
| Weekend | 1.00 | 0.86 | 1.16 | 0.948 |

§: Variables are AHRQ co-morbidity measures.
||: Charlson/Deyo Co-morbidity index (CCI) was calculated as per Deyo classification.

#: Represents a quartile classification of the estimated median household income of residents in the patients ZIP Code, derived from ZIP Code-demographic data obtained from Claritas. The quartiles are identified by values of 1 to 4, indicating the poorest to wealthiest populations. Because these estimates are updated annually, the value ranges vary by year. https://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nrdnote.jsp

@: Heart failure is identified by ICD 9 codes in secondary diagnosis field and it includes systolic, diastolic and combined heart failure.

£: The bed size cutoff points divided into small, medium, and large have been done so that approximately one-third of the hospitals in a given region, location, and teaching status combination would fall within each bed size category. https://www.hcup-us.ahrq.gov/db/vars/hosp_bedsize/nrdnote.jsp

$: A hospital is considered to be a teaching hospital if it has an AMA-approved residency program, is a member of the Council of Teaching Hospitals (COTH) or has a ratio of full-time equivalent interns and residents to beds of 0.25 or higher. https://www.hcup-us.ahrq.gov/db/vars/hosp_ur_teach/nrdnote.jsp

α, β, ∞, ®, Ω, µ, ©: co-morbidities were identified by appropriate ICD 9 CM diagnosis codes in secondary diagnosis field (Table S3)

**Figure S1. Kaplan Meier survival curve for 30-day readmission.**

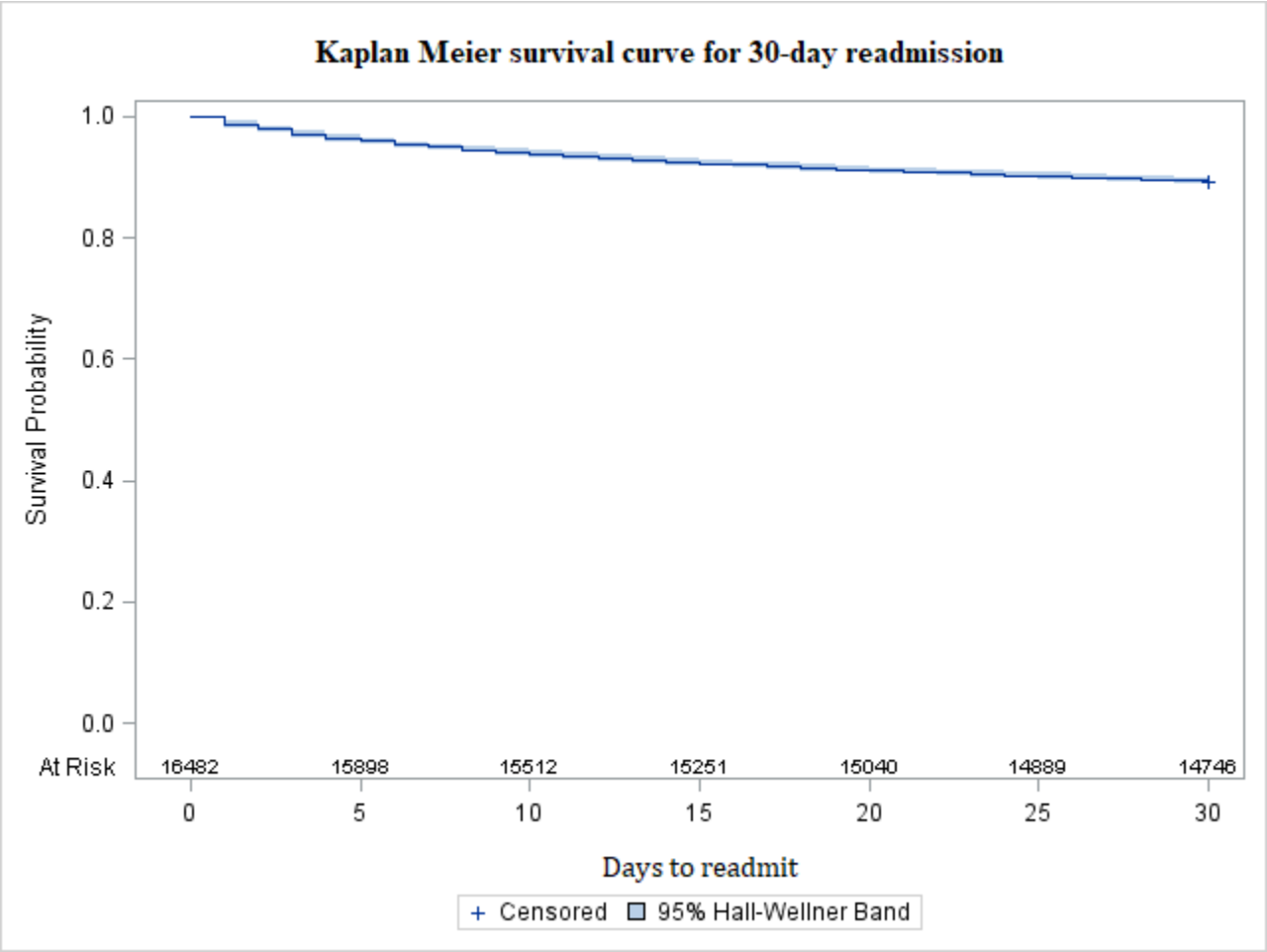

**Figure S2. Kaplan Meier survival cure for 90-day readmission.**

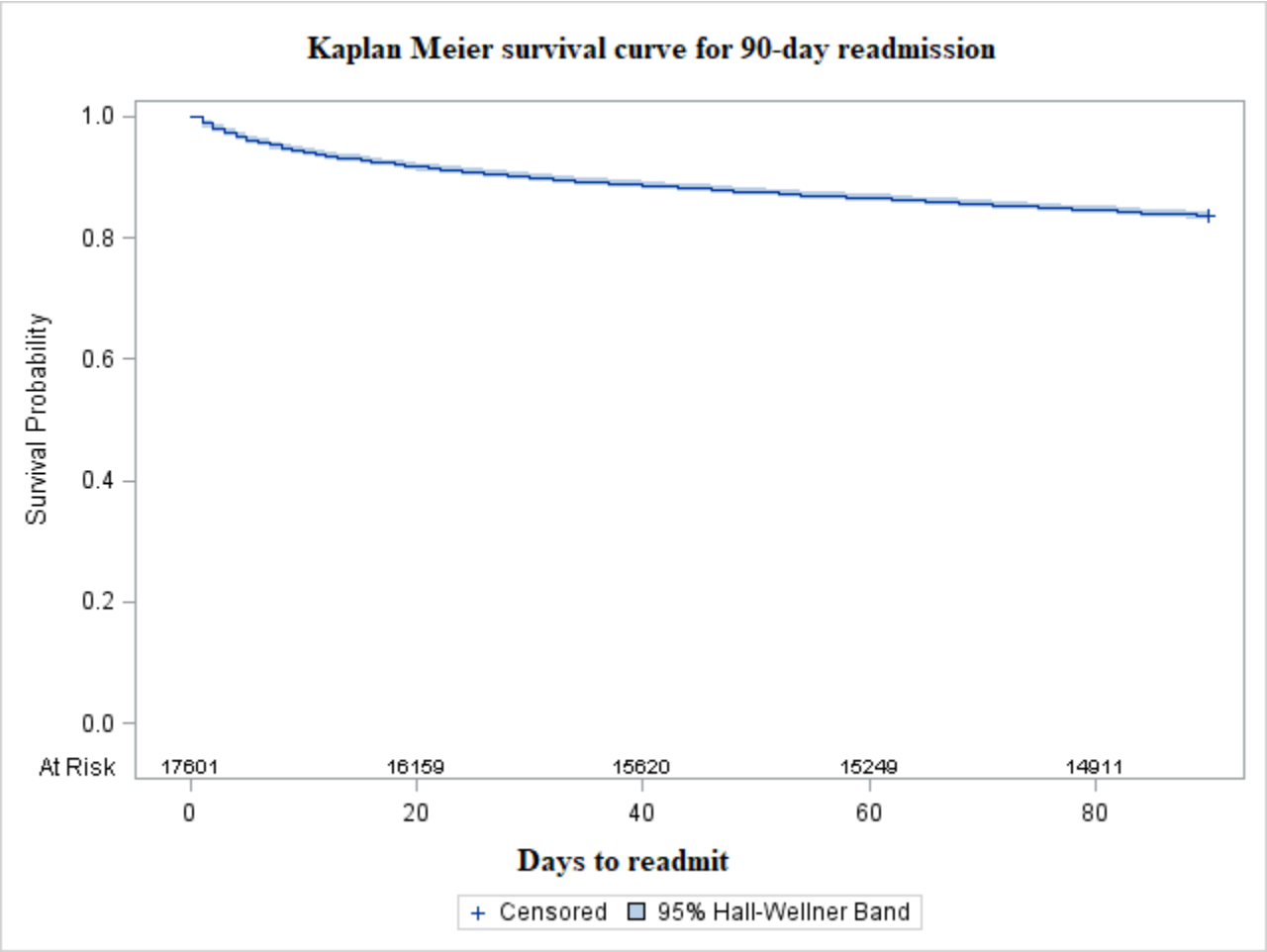

**Figure S3. Kaplan Meier survival of atrial fibrillation recurrence over 90 days.**