Temporal trends and factors associated with increased mortality among atrial fibrillation weekend hospitalizations: an insight from National Inpatient Sample 2005–2014

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Abstract

Objective: Atrial fibrillation (AF) weekend hospitalizations were reported to have poor outcomes compared to weekday hospitalizations. The relatively poor outcomes on the weekends are usually referred to as ‘weekend effect’. We aim to understand trends and outcomes among weekend AF hospitalizations. The primary purpose of this study is to evaluate the trends for weekend AF hospitalizations using Nationwide Inpatient Sample 2005–2014. Hospitalizations with AF as the primary diagnosis, in-hospital mortality, length of stay, co-morbidities and cardioversion procedures have been identified using the international classification of diseases 9 codes.

Results: Since 2005, the weekend AF hospitalizations increased by 27% (72,216 in 2005 to 92,220 in 2014), mortality decreased by 29% (1.32% in 2005 to 0.94% in 2014), increase in urban teaching hospitalizations by 72% (33.32% in 2005 to 57.64% in 2014), twofold increase in depression and a threefold increase in the prevalence of renal failure were noted over the period of 10 years. After adjusting for significant covariates, weekend hospitalizations were observed to have higher odds of in-hospital mortality OR 1.17 (95% CI 1.108–1.235, P < 0.0001). Weekend AF hospitalizations appear to be associated with higher in-hospital mortality. Opportunities to improve care in weekend AF hospitalizations need to be explored.

Keywords: Atrial fibrillation, Weekend hospitalization, In-hospital mortality

Introduction

Atrial fibrillation (AF), the most common sustained arrhythmia in clinical practice had an estimated worldwide prevalence of 33.5 million in 2010 [1]. AF weekend hospitalizations were previously reported to have higher mortality and lower rates of cardioversion [2]. Subsequent studies in this population have demonstrated improved mortality and rates of cardioversion [3, 4]. To date, there has been no temporal trend analysis showing this effect. We sought to investigate the outcomes in the years 2005–2014 through a publicly available national inpatient sample database (NIS).

Main text

Methods

A description of NIS database has been elaborated in prior studies [5–7]. The NIS is one of the largest, all-payer database for the United States in-patient hospitalizations, and it is maintained by the Agency for Health Care Quality and Research (AHRQ). The NIS includes a 20% random sample of all inpatient hospitalizations from 46 states in the United States. Each observation represents a hospitalization with one primary diagnosis, up to
models after survey logistic talizations, length of hospitalization, in-hospital mortal-
diseases, weekend hospitalizations involving AF hospi-
previous studies, trends in demographics, co-morbid
variables for potential confounders. C-statistic was used
tions and in-hospital mortality after including the other
tistical analysis. We used sampling weights to estimate
software were used to perform sta-
table and categorical variables. SAS 9.4 (SAS Institute Inc.,
practical modification (ICD-9-CM) codes.
short of hospital mortality. The first reports
thought to have worse outcomes when admitted to the
hospital on a Saturday or a Sunday [11]. The first reports
appears in the 1970s. Higher mortality and longer hos-
in-hospital mortality.

ticulate hospitalizations with cardioversion/
bat ablation.

We used survey analysis methods to account for the
nt and stratification of encounters for all continu-
s and categorical variables. SAS 9.4 (SAS Institute Inc.,
statistical analysis. We used sampling weights to estimate
tends and national estimates to account for the change in
ampling design as recommended by the AHRQ. For
he demographics, co-morbid diseases, and weekend
ations within each year were compared using Student’s t
continous variables and the Chi square test for categorical variables. Multivariate logistic
egression method was used in SAS (proc surveylogistic) to evaluate the association between weekend hospitalizations and in-hospital mortality after including the other variables for potential confounders. C-statistic was used for goodness of the model fit for a binary outcome. Like previous studies, trends in demographics, co-morbid diseases, weekend hospitalizations involving AF hospitalizations, length of hospitalization, in-hospital mortality were evaluated using the survey logistic models after creating dummy variables for each outcome of interest. A

29 secondary diagnoses and 15 procedure diagnosis with
International Classification of Disease, 9th revision, clinical modification (ICD-9-CM) codes.
NIS hospitalizations have 2 sampling strategies. Before 2012, all hospitalizations were from a random sample of 20% of acute care hospitals in the United States, stratified by bed size, region, and location. Starting in 2012, the NIS included a random sample of 20% of discharges from all acute care hospitals in the United States; this effort reduced the margin of error by 50%, and national estimates decreased by 4.3%. From 1998 to 2011, discharge weights are provided by the AHRQ after a validation pro-
cess, and they are used to calculate national estimates. To account for changes in the sampling strategies, the variable “trend weights” have been used for 2011 and all pre-
ceeding years to facilitate trend analysis from 1998 to 2014 as recommended by AHRQ [8].

The study was exempted by the University of Iowa, Iowa City, institutional review board as it includes only de-identified, publicly available data. For our analysis, we only used NIS data from 2005 to 2014. Similar to previous studies, we used the ICD-9-CM code 427.31 to identify hospitalizations involving hospitalizations with principal diagnosis (dx1) of AF [9]. The variables for hos-
pitalization demographics were provided in the dataset (example: age, gender, length of stay). The weekend hospitalizations (Saturday–Sunday) were identified using ‘AWEEKEND’ variable. Hospitalizations with anti-coagu-
ation were identified using the ICD-9-CM code ‘V58.61’. ICD-9-procedure codes 9961, 9962, 9969 and 3734 were
used to identify hospitalizations with cardioversion/ablation.

Univariate and multivariate logistic regression analyses were performed. In multivariate analysis, the week-end hospitalizations were associated with higher odds of in-hospital mortality (OR 1.170, 95% CI 1.108–1.125, P < 0.0001) (Table 2). Apart from the weekend admission status, acute respiratory failure, congestive heart failure, renal failure and urban hospital admission (teaching and non-teaching) were found to be strong predictors of in-hospital mortality.

Over the period of 10 years, we noticed increasing number of weekend hospitalizations with AF (72,216 in 2005 to 92,220 in 2014) (Table 3). In-hospital mortality has gradually decreased (1.32% in 2005 vs 0.94% in 2014, P trend < 0.0001), decreasing mean LOS (3.66 days in 2005 to 3.49 days in 2014, P trend < 0.0001), higher prevalence of depression (5.47% in 2005 vs 9.72% in 2014, P trend < 0.0001), increased rates of cardioversion (11.49% in 2005 vs 17.34% in 2014, P trend < 0.0001), twofold increase in rates of anti-coagulation (9.52% in 2005 vs 17.09% in 2014, P trend < 0.0001).

Discussion
The main findings and trends noted in the current study of weekend AF hospitalizations are (1) improving trends in in-hospital mortality over 10 years from 2005 to 2014. (2) Weekend hospitalizations are associated with higher odds of in-hospital mortality. (3) Decreasing the mean length of hospital stay, and (4) increasing trends of utili-
ization rates of cardioversion and anticoagulation. The ‘weekend effect’ is a concern where the patients are thought to have worse outcomes when admitted to the hospital on a Saturday or a Sunday [11]. The first reports of the weekend hospitalizations having higher mortality appeared in the 1970s. Higher mortality and longer hospital LOS have been reported among AF hospitalizations...
| Demographic characteristic                                      | AF on weekday | AF on weekend | P value  |
|---------------------------------------------------------------|---------------|---------------|----------|
| Unweighted index admissions                                   | 752,845       | 180,573       |          |
| Weighted index admissions                                     | 3,645,465     | 874,944       |          |
| Age in years at admission                                     |               |               |          |
| Mean age (in years), standard deviation                       | 69.85, 13.90  | 70.02, 14.74  | <0.0001  |
| 18 to 34                                                       | 1.48%         | 2.08%         | <0.0001  |
| 35 to 49                                                       | 6.54%         | 7.37%         |          |
| 50 to 64                                                       | 24.39%        | 22.73%        |          |
| 65 to 79                                                       | 39.63%        | 37.23%        |          |
| Greater than 80                                                | 27.85%        | 30.49%        |          |
| Died during hospitalization                                    |               |               | <0.0001  |
| Did not die                                                   | 99.11%        | 98.92%        |          |
| Died                                                           | 0.89%         | 1.08%         |          |
| Disposition                                                    |               |               | <0.0001  |
| Routine                                                        | 76.44%        | 72.63%        |          |
| Transfer to short-term hospital                               | 2.37%         | 2.73%         |          |
| Transfer other: includes Skilled Nursing Facility (SNF), Intermediate Care Facility (ICF), and another type of facility | 9.51%         | 11.94%        |          |
| Home Health Care (HHC)                                         | 10.01%        | 10.55%        |          |
| Against medical advice (AMA)                                  | 0.76%         | 1.05%         |          |
| Died in hospital                                              | 0.89%         | 1.08%         |          |
| Discharged alive, destination unknown                          | 0.02%         | 0.02%         |          |
| Elective vs. non-elective admission                           |               |               | <0.0001  |
| Non-elective                                                  | 82.70%        | 95.35%        |          |
| Elective                                                       | 17.30%        | 4.65%         |          |
| Indicator of sex                                              |               |               | <0.0001  |
| Male                                                          | 50.26%        | 47.74%        |          |
| Female                                                         | 49.74%        | 52.26%        |          |
| Length of hospital stay                                        |               |               |          |
| Mean length of stay (days) ± standard deviation               | 3.48±3.72     | 3.52±3.79     | <0.0001  |
| 0–3 days                                                      | 65.66%        | 64.67%        | <0.0001  |
| 4 to 6 days                                                   | 22.56%        | 25.13%        |          |
| 7 to 9 days                                                   | 7.45%         | 5.38%         |          |
| 10 to 12 days                                                 | 2.15%         | 2.84%         |          |
| >12 days                                                      | 2.15%         | 1.98%         |          |
| Primary expected payer                                         |               |               | <0.0001  |
| Medicare                                                      | 65.49%        | 81.93%        |          |
| Medicaid                                                      | 4.08%         | 8.25%         |          |
| Private insurance                                             | 25.29%        | 5.76%         |          |
| Self-pay                                                      | 2.83%         | 1.47%         |          |
| No charge                                                     | 0.32%         | 0.46%         |          |
| Other                                                         | 1.99%         | 2.13%         |          |
| Race                                                          |               |               | <0.0001  |
| White                                                         | 83.39%        | 81.93%        |          |
| Black                                                         | 7.49%         | 8.25%         |          |
| Hispanic                                                      | 5.13%         | 5.76%         |          |
| Asian                                                         | 1.35%         | 1.47%         |          |
| Pacific Islander                                              | 0.51%         | 0.46%         |          |
| Other                                                         | 2.13%         | 2.13%         |          |
| Cost of hospitalization in USD-(mean)                         | 8414.7±10,343 | 7479±8785.9   | <0.0001  |
| Bed size of the hospital                                      |               |               | <0.0001  |
during the weekend by Deshmukh et al. and Weeda et al. [3, 12]. Subsequent study reported no difference in weekend and weekday AF in-hospital mortality [13].

In comparison to the prior studies, ours is the first study analyzing the trends of weekend AF hospitalizations. Our results match the results of Weeda et al. [3] where there is improved mortality among weekend hospitalization with AF. Though the lower utilization of cardioversion has been demonstrated through the years, the rates of cardioversion have significantly been improving, and at the same time, the in-hospital mortality has been decreasing during the same time period. This can be attributed to improved access to life-saving procedures. However, the overall utilization rates of cardioversion continue to be low among the weekend hospitalizations when compared to the weekday hospitalization. This is likely due to staffing issues, the availability of anesthesia, or coverage for a trans-esophageal echocardiogram at some institutions.

In the nationwide US practice, the weekend AF hospitalizations appear to have improved rates of in-hospital mortality, rates of cardioversion utilization and improved utilization of anticoagulation. However, the overall rates of in-hospital mortality continue to be poor in comparison to weekday hospitalizations. Further studies are required to identify the opportunities to improve AF weekend care.

**Limitations**

Although our study has a large nationally representative database sample, these findings should be interpreted considering the following limitations. First, we identified our cases using ICD-9 discharge diagnosis codes, and details of the initial presentation (for example, emergency room visit) are not available, thereby, limiting the ability to confirm the diagnosis. Second, the NIS data does not provide information on important clinical predictors of outcomes such as the duration and the type of AF, left atrial diameter, the presence of thrombus in the left atrium and the baseline functional status, which can potentially influence the outcomes for in-hospital mortality. Third, given the description of ICD-9 codes in the database, it is not possible to differentiate pre-existing comorbidities from complications which have occurred during the hospitalization. Fourth, data regarding specific

| Effect                                      | Odds ratio | 95% confidence limits | P value |
|---------------------------------------------|------------|-----------------------|---------|
| Weekend hospitalization                     | 1.170      | 1.108 1.235           | <0.0001 |
| Length of stay                              | 1.026      | 1.01 1.031            | <0.0001 |
| AGE                                         | 1.054      | 1.052 1.057           | <0.0001 |
| Hospital region-north east                  | Reference group |                      |         |
| Hospital region-midwest                     | 0.729      | 0.673 0.791           | <0.0001 |
| Hospital region-south                       | 0.885      | 0.825 0.95            | 7E−04   |
| Hospital region-west                        | 0.791      | 0.723 0.865           | <0.0001 |
| Hypertension                                | 0.569      | 0.542 0.596           | <0.0001 |
| Uncomplicated diabetes                      | 0.975      | 0.92 1.034            | 0.401   |
| Complicated diabetes                        | 1.194      | 1.067 1.338           | 0.002   |
| Congestive heart failure                    | 1.668      | 1.354 2.054           | <0.0001 |
| Valvular heart disease                      | 1.305      | 0.97 1.755            | 0.079   |
| Renal failure                               | 1.957      | 1.847 2.075           | <0.0001 |
| Obesity                                     | 0.641      | 0.585 0.703           | <0.0001 |
| Female sex                                  | 0.937      | 0.894 0.982           | 0.007   |
| Small sized hospital                        | Reference group |                      |         |
| Medium sized hospital                       | 1.11       | 1.023 1.204           | 0.012   |
| Large sized hospital                        | 1.092      | 1.015 1.176           | 0.018   |
| Rural hospital                              | Reference group |                      |         |
| Urban non-teaching hospital                 | 0.861      | 0.799 0.927           | <0.0001 |
| Urban teaching hospital                     | 0.887      | 0.823 0.955           | 0.002   |
| Acute respiratory failure                   | 21.2       | 19.997 22.476         | <0.0001 |

The adjusted odds ratio's, 95% confidence intervals and their P-values represent the odds of in-hospital mortality after adjusting for the covariates listed in the table.
Table 3  Trends of hospitalization for atrial fibrillation admitted over the weekend 2005–2014

| Years | 2005  | 2006  | 2007  | 2008  | 2009  | 2010  | 2011  | 2012  | 2013  | 2014  | P value (trend) |
|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----------------|
| Total number of hospitalization (weighted) | 72,216 | 75,822 | 77,539 | 88,127 | 90,013 | 89,600 | 97,140 | 97,174 | 95,089 | 92,220 |                 |
| Age in years | | | | | | | | | | | |
| 18 to 34 | 2.33% | 2.54% | 2.36% | 2.03% | 2.21% | | | | | | |
| 35 to 49 | 8.16% | 8.55% | 8.44% | 7.72% | 7.78% | | | | | | |
| 50 to 64 | 22.09% | 22.36% | 21.89% | 21.75% | 22.29% | | | | | | |
| 65 to 79 | 37.35% | 36.99% | 37.27% | 37.26% | 37% | | | | | | |
| Greater than 80 | 29.89% | 29.4% | 29.92% | 31.06% | 30.62% | | | | | | |
| Indicator of sex | | | | | | | | | | | |
| Male | 47.68% | 47.99% | 47.16% | 47.22% | 47.75% | | | | | | |
| Female | 52.32% | 52.01% | 52.84% | 52.78% | 52.25% | | | | | | |
| Died during hospitalization | | | | | | | | | | | |
| Did not die | 98.68% | 98.87% | 98.85% | 98.88% | 98.92% | | | | | | |
| Died | 1.32% | 1.13% | 1.15% | 1.12% | 1.08% | | | | | | |
| Race | | | | | | | | | | | |
| White | 85.34% | 82.48% | 81.55% | 82.28% | 82.23% | | | | | | |
| Black | 6.27% | 7.11% | 8.54% | 7.6% | 7.43% | | | | | | |
| Hispanic | 5.06% | 6.25% | 5.81% | 5.39% | 5.5% | | | | | | |
| Asian or Pacific Islander | 1.31% | 1.31% | 1.66% | 1.55% | 1.45% | | | | | | |
| Native American | 0.17% | 0.46% | 0.47% | 0.58% | 0.56% | | | | | | |
| Other | 1.85% | 1.78% | 1.96% | 2.61% | 2.83% | | | | | | |
| Length of stay (LOS) | | | | | | | | | | | |
| 0 to 3 | 62.84% | 63.52% | 63.99% | 64.09% | 63.81% | | | | | | |
| 4 to 6 | 26.36% | 25.36% | 25.32% | 25.52% | 25.81% | | | | | | |
| 7 to 9 | 5.59% | 5.53% | 5.79% | 5.47% | 5.54% | | | | | | |
| 10 to 12 | 2.91% | 3.09% | 2.98% | 3.03% | 2.95% | | | | | | |
| Greater than 12 | 2.31% | 2.49% | 1.91% | 1.9% | 1.9% | | | | | | |
| Mean LOS (days) | 3.66 | 3.65 | 3.55 | 3.56 | 3.53 | | | | | | |
| Hospital location and teaching status | | | | | | | | | | | |
| Rural | 16.83% | 15.84% | 16.66% | 15.74% | 14.83% | | | | | | |
| Urban non teaching | 49.85% | 43.73% | 45.48% | 46.67% | 47.46% | | | | | | |
| Urban teaching | 33.32% | 40.43% | 37.86% | 37.59% | 37.71% | | | | | | |
| Comorbidities | | | | | | | | | | | |
| Alcohol abuse | 4.05% | 4.56% | 4.42% | 4.07% | 4.48% | | | | | | |
| Congestive heart failure | 0.39% | 0.36% | 0.26% | 0.31% | 0.5% | | | | | | |
| Depression | 5.47% | 6.18% | 6.59% | 7.5% | 7.28% | | | | | | |
| Diabetes with chronic complications | 2.39% | 2.24% | 2.61% | 2.71% | 2.96% | | | | | | |
| Hypertension (combine uncomplicated and complicated) | 56.07% | 59.4% | 61.12% | 63.5% | 65.14% | | | | | | |
| Liver disease | 0.97% | 0.97% | 1% | 1.38% | 1.49% | | | | | | |
| Obesity | 7.03% | 7.77% | 9.53% | 10.41% | 11.93% | | | | | | |
| Peripheral vascular disorder | 4.66% | 5.31% | 5.59% | 6.04% | 6.01% | | | | | | |
| Psychoses | 1.58% | 1.93% | 1.74% | 2.38% | 2.13% | | | | | | |
| Renal failure | 5.02% | 8.19% | 9.51% | 9.74% | 11.33% | | | | | | |
| Uncomplicated diabetes | 17.43% | 18.7% | 19.37% | 20.11% | 21.02% | | | | | | |
| Cardioversion rates | 11.49% | 12.21% | 12.02% | 12.55% | 13.63% | | | | | | |
| Anticoagulation | 9.52% | 10.55% | 12.07% | 12.13% | 14.37% | | | | | | |
| Cost of hospitalization (in US dollars) | 6260.13 | 6807.54 | 7060.35 | 7287.86 | 7332.45 | | | | | | |
| Years | 2010  | 2011  | 2012  | 2013  | 2014  | P value (trend) |
|-------|-------|-------|-------|-------|-------|----------------|
| Total number of hospitalization (weighted) | 89,600 | 97,140 | 97,174 | 95,089 | 92,220 | |
### Table 3 (continued)

| Years   | 2010  | 2011  | 2012  | 2013  | 2014  | P value (trend) |
|---------|-------|-------|-------|-------|-------|-----------------|
| Age in years |       |       |       |       |       |                 |
| 18 to 34 | 1.92% | 1.99% | 2.07% | 1.71% | 1.82% | < 0.0001        |
| 35 to 49 | 7.32% | 6.76% | 6.7%  | 6.69% | 6.19% | < 0.0001        |
| 50 to 64 | 23.74%| 23.03%| 23.37%| 22.9% | 23.45%| < 0.0001        |
| 65 to 79 | 36.04%| 37%   | 36.89%| 37.91%| 38.53%| 0.0449          |
| Greater than 80 | 30.88%| 31.15%| 30.89%| 30.69%| 29.93%| 0.0177          |
| Indicator of sex |       |       |       |       |       |                 |
| Male     | 48.36%| 47.21%| 47.93%| 47.89%| 48.13%|                 |
| Female   | 51.64%| 52.79%| 52.07%| 52.11%| 51.87%|                 |
| Died during hospitalization |       |       |       |       |       | < 0.0001        |
| Did not die | 99.01%| 98.93%| 99.04%| 98.86%| 99.06%|                 |
| Died     | 0.99% | 1.07% | 0.96% | 1.14% | 0.94% |                 |
| Race     |       |       |       |       |       |                 |
| White    | 81.42%| 82.03%| 81.54%| 81.62%| 80.32%| < 0.0001        |
| Black    | 8.81% | 8.32% | 8.72% | 8.97% | 9.03% | < 0.0001        |
| Hispanic | 5.77% | 6.05% | 5.64% | 5.71% | 6.25% | < 0.0001        |
| Asian or Pacific Islander | 1.44% | 1.29% | 1.42% | 1.54% | 1.66% | < 0.0001        |
| Native American | 0.71% | 0.34% | 0.44% | 0.4%  | 0.43% | 0.0102          |
| Other    | 1.85% | 1.96% | 2.23% | 1.76% | 2.3%  | < 0.0001        |
| Length of stay (LOS) |       |       |       |       |       |                 |
| 0 to 3   | 63.83%| 65.81%| 66.2% | 66.11%| 65.52%| < 0.0001        |
| 4 to 6   | 25.62%| 24.62%| 24.32%| 24.16%| 24.75%| < 0.0001        |
| 7 to 9   | 5.58% | 5.02% | 5.19% | 5.1%  | 5.18% | < 0.0001        |
| 10 to 12 | 2.93% | 2.78% | 2.66% | 2.62% | 2.57% | < 0.0001        |
| Greater than 12 | 2.04% | 1.78% | 1.64% | 2.01% | 1.98%  | < 0.0001        |
| Mean LOS (days) | 3.58 | 3.41 | 3.4 | 3.44% | 3.49 | 0.0001          |
| Hospital location and teaching status |       |       |       |       |       |                 |
| Rural    | 14.83%| 14.64%| 13.92%| 14.08%| 11.73%| < 0.0001        |
| Urban non teaching | 46.38%| 45.72%| 42.51%| 42.1% | 30.63%| < 0.0001        |
| Urban teaching | 38.79%| 39.63%| 43.57%| 43.82%| 57.64%| < 0.0001        |
| Comorbidities |       |       |       |       |       |                 |
| Alcohol abuse | 4.74% | 5.08% | 5.35% | 5.55% | 5.83% | < 0.0001        |
| Congestive heart failure | 0.35% | 0.4% | 0.3% | 0.36% | 0.33% | 0.4994          |
| Depression | 7.95% | 8.84% | 9.08% | 9.2%  | 9.72% | < 0.0001        |
| Diabetes with chronic complications | 2.81% | 3.5% | 3.21% | 3.48% | 3.61% | < 0.0001        |
| Hypertension (combine uncomplicated and complicated) | 66.63% | 68.5% | 69.08% | 69.91% | 71.55% | < 0.0001        |
| Liver disease | 1.7% | 1.76% | 1.86% | 1.79% | 2.15% | < 0.0001        |
| Obesity | 12.08% | 13.01% | 15.2% | 16.23% | 17.62% | < 0.0001        |
| Peripheral vascular disorder | 6.46% | 6.94% | 7.11% | 6.96% | 7.55% | < 0.0001        |
| Psychoses | 2.41% | 2.69% | 2.68% | 2.6% | 2.94% | < 0.0001        |
| Renal failure | 12.71% | 13.5% | 14.28% | 15.24% | 16.15% | < 0.0001        |
| Uncomplicated diabetes | 22.1% | 21.65% | 22.97% | 23.3% | 23.95% | < 0.0001        |
| Cardioversion rates | 14.74% | 14.53% | 15.7% | 15.95% | 17.34% | < 0.0001        |
| Anticoagulation | 15.18% | 15% | 15.48% | 15.67% | 17.09% | < 0.0001        |
| Cost of hospitalization (in US dollars) | 7568.3 | 7656.57 | 7719.1 | 8143.44 | 8265.78 | < 0.0001        |
medical management such as anti-arrhythmic agents are not available in the NIS. And lastly, the diagnostic coding inconsistencies between weekends and weekdays also could not be ruled out. Given these limitations, it would require studies to have rigorous analysis having additional clinical information having a more consistent way of collecting data (such as using consistent diagnostic definitions) and analyzing outcomes considering all the above-mentioned factors [11].

Abbreviations
AF: atrial fibrillation; NIS: National Inpatient Sample; AHRQ: Agency for Health Care Quality and Research; ICD-9 CM: International Classification of Diseases-9, Clinical Modifications; LOS: length of stay; OR: odds ratio.

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Authors’ contributions
DCV, GS, SD and MG all contributed to the study conception/design and the development of the study protocol. DCV was responsible for seeking ethical approval. NWKP, DCB, AD, and AM were responsible for setting up the study, designing study documentation and data validation. DCV and RC undertook all data analyses. DV, AD, SSC, MS, RL, KJ, and FP were all involved in writing the final manuscript. All authors read and approved the final manuscript.

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Ethics approval and consent to participate
Institutional review board (IRB) has determined that this study does not meet the regulatory definition of human subjects research and did not require review, because at the University of Iowa this activity is limited to analysis of publicly available de-identified data.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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