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Validation of the Risk Estimator Decision aid for Atrial Fibrillation (RED-AF) for Predicting 30-Day Adverse Events in Emergency Department Patients With Atrial Fibrillation

Tyler W. Barrett, MD, MSCI^a, Cathy A. Jenkins, MS^b, and Wesley H. Self, MD, MPH^a

^aDepartment of Emergency Medicine, Vanderbilt University Medical Center, Nashville, TN

^bDepartment of Biostatistics, Vanderbilt University School of Medicine, Nashville, TN

Abstract

Objective—Nearly 70% of emergency departments (ED) visits for atrial fibrillation (AF) result in hospitalization. The incidence of serious 30-day adverse events following an ED evaluation for AF remains low. This study's goal was to prospectively validate our previously reported Risk Estimator Decision aid for AF (RED-AF) model for estimating a patient's risk of experiencing a 30-day adverse event.

Methods—This was a prospective cohort study, which enrolled a convenience sample of ED patients presenting with AF. RED-AF, previously derived from a retrospective cohort of 832

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Corresponding Author Contact Information: Tyler Warren Barrett, MD, MSCI, Vanderbilt University School of Medicine, Department of Emergency Medicine, 703 Oxford House, 1313 21st Ave South, Nashville, TN 37232-4700, Office Phone: 615-936-0253, Cell Phone: 615-403-1199, Fax: 615-936-1316, tyler.barrett@vanderbilt.edu.

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Author Contributions: TWB had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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patients, assigns points based on age, sex, coexisting disease (heart failure, hypertension, chronic obstructive pulmonary disease), smoking, home medications (beta blocker, diuretic), physical examination findings (dyspnea, palpitations, peripheral edema), and adequacy of ED ventricular rate control. Primary outcome was occurrence of 1 AF-related adverse outcome (ED visits, rehospitalization, cardiovascular complications, death) within 30 days. We identified a clinically relevant threshold and measured RED-AF's performance in this prospective cohort, assessing its calibration, discrimination, and diagnostic accuracy.

Results—The study enrolled 497 patients between June 2010 and February 2013. Of these, 120 (24%) had 1 adverse event within 30 days. A RED-AF score of 87 was identified as an optimal threshold, resulting in sensitivity (95% CI) and specificity (95% CI) of 96% (91–98) and 19% (15–23), respectively. Positive and negative predictive values were 27% (23–32) and 93% (85–97), respectively. The c-statistic for RED-AF was 0.65 (95% CI, 0.59 to 0.71).

Conclusion—In this separate validation cohort, RED-AF performed moderately well and similar to the original derivation cohort for identifying the risk of short-term AF-related adverse events in ED patients diagnosed with AF.

INTRODUCTION

Background

Atrial fibrillation (AF), the most common sustained arrhythmia, affects between 3 and 6 million Americans, contributes to nearly 100,000 deaths each year, and is associated with \$26 billion in healthcare charges annually.[1–4] AF increases an individual's lifetime risk for thromboembolic complications and death[5, 6]; however, the incidence of a serious 30-day adverse event following an ED evaluation for AF remains low.[7–9]

Importance

Over 70% of patients hospitalized for AF are initially managed in an ED; meanwhile, 70% of these ED visits for AF result in hospital admissions.[10, 11] The costs of AF hospitalization in the United States are expected to rise by 55% in 2020 compared to 2010. [12] The mean hospital length of stay (LOS) for AF has remained unchanged at 3 days since 2000.[12] Without a practice change, the combination of increasing AF prevalence, unnecessarily high ED hospitalizations, and rising healthcare expenditures will continue to burden our healthcare system. There are limited data to help guide ED physicians on which patients with AF can be safely managed as an outpatient and which should be hospitalized. We previously reported the first clinical decision aid, now known as the Risk Estimator Decision aid for Atrial Fibrillation (RED-AF), for estimating risk for 30-day adverse events in ED patients with AF.[8] The original RED-AF manuscript provided a nomogram for calculating predicted risk; however, did not identify a specific clinically relevant threshold for categorizing patients at low risk for a 30-day adverse event.[8]

Goals of This Investigation

This study's goals were to validate RED-AF [8] as a clinical decision aid to estimate the risk of a 30-day adverse events in ED patients with AF in a new prospective cohort and to identify an optimal threshold score for the model to facilitate its use clinically.[13]

METHODS

Study Design and Setting

We conducted a prospective cohort study at Vanderbilt University Medical Center, a university-affiliated, tertiary care ED in the United States. This study utilized the Atrial Fibrillation and Flutter Outcome Risk Determination (AFFORD) cohort; AFFORD design, sample size calculations, and methods have been previously reported.[13] This validation study was performed at the same institution where the RED-AF decision aid was derived. Two of the primary investigators (TWB and CAJ) who derived RED-AF also conducted the validation study. Our medical center's institutional review board reviewed and approved this study. Written informed consent was obtained from all patients prior to enrollment.

Selection of Participants

The research team enrolled a convenience sample of adult (≥ 18 years old) ED patients who had an electrocardiogram (ECG) demonstrating AF or atrial flutter, and signs (e.g., tachycardia, dyspnea) or symptoms (e.g., palpitations, chest pain, shortness of breath, weakness, pre-syncope, or syncope) consistent with symptomatic AF or atrial flutter.[13] The diagnosis of AF or atrial flutter was confirmed by an independent cardiologist's review of the ECG performed at the time of enrollment. As we did in the original derivation cohort, we included patients with both newly diagnosed AF and a prior AF history. We also included patients whose ED evaluation was primarily for AF and those who had asymptomatic AF concurrently with another primary reason for ED evaluation (e.g. pneumonia).[8] Subjects were enrolled seven days a week (0700-midnight). Additionally, study personnel screened patients who presented between midnight and 0700 for eligibility and approached patients who were still available at 0700. The treating ED physician determined all treatment and disposition decisions for enrolled patients and patient care was not influenced by this investigation.

Methods and Measurements

Following informed consent, study personnel collected data on patient demographics, medical history, including details regarding prior AF treatment (if applicable), home medications, and social history through direct patient interviews and review of the electronic medical record. We recorded details of both the ED and inpatient management (for admitted patients), including diagnostic studies, medications, procedures performed, and discharge diagnoses. Study personnel telephoned patients at 30 days following their ED evaluation to record whether they experienced 1 or more of the a priori determined AF-related adverse events (defined below) during the follow-up time interval.[13] All data were collected with standardized data collection instruments and directly entered into the study's Research Electronic Data Capture (REDCap) study database.[14]

A board-certified emergency medicine physician investigator reviewed the ED records of all enrolled patients using a standardized protocol. The review determined whether the ED evaluation was primarily for AF or primarily for another cause and secondarily for AF. A board-certified electrophysiologist investigator reviewed a randomly selected 30% of the enrollments. We measured the absolute agreement and Cohen's kappa statistic with 95%

confidence intervals (CI) between the 2 reviewers' designation of AF as a primary or secondary reason for ED evaluation.[15, 16]

Predictor Variables

We prospectively collected the data for each of the RED-AF predictor variables.[8] These variables included: smoking status, age, inadequate ventricular rate control in the ED, complaint of dyspnea in the ED, home beta-blocker medication, history of heart failure, presence of peripheral edema on examination, history of hypertension, sex, complaint of palpitations in the ED, history of chronic obstructive pulmonary disease (COPD), and home diuretic medication. The documented ventricular pulse rate at 2 hours following initiation of ED management determined whether patients were classified as having adequate ventricular rate control (pulse less <100 beats/min) or not (pulse ≥100 beats/min). Detailed definitions for all the predictors have been previously reported.[8]

Outcomes

RED-AF is used to predict AF-related adverse events within 30-days of an ED visit for symptomatic AF. As was done in the original derivation study, the primary outcome was dichotomous ('No AF-related adverse event', vs. '≥1 AF-related adverse event'). The primary outcome was the occurrence of an adverse event within 30 days of the index ED evaluation. Adverse events included unscheduled ED visits for AF, hospital readmissions for AF, cardiovascular complications, AF-related death, and death due to a cause other than AF [eg, cancer, sepsis]). We defined cardiovascular complications as the occurrence of ≥1 of the following: cardiac arrest, stroke, cardiogenic shock, acute coronary syndrome, unscheduled pacemaker placement, atrial or ventricular arrhythmia, acute heart failure, or need for continuous atrioventricular nodal blocker infusion.[8, 13] We utilized the previously described ED and electrophysiologist record review protocols for classifying adverse events as AF-related or not.

Predicting Risk of Adverse Events Using RED-AF

When using RED-AF to estimate risk, each of the 12 RED-AF predictor variables was assigned risk points according to the values listed in Figure 1. The possible scores range from 10 to 300 for adult (≥18 years) males and 15 to 300 for adult females. Total points can be translated into predicted risk for 30-day adverse events using the instrument presented in Figure 1 or a web-based calculator. Using RED-AF, a hypothetical 25 year-old woman who has no other risk factors and achieves rate control in the ED has a score of 22, which is associated with a 7.6% risk of an adverse outcome within 30 days. A 60 year-old man with RED-AF risk factors of hypertension and lower extremity peripheral edema has a predicted risk of 19%. A 78 year-old male who smokes, has a history of COPD and heart failure, and fails to achieve adequate ventricular rate control in the ED has a predicted 54% risk of an adverse event within 30 days.

We calculated a total point score for all patients in the validation cohort. After the RED-AF scores were calculated, we chose a clinically relevant threshold that represented the highest score in which the observed false negative classification for the primary outcome, occurrence of ≥1 30-day event, was less than 2%. This 2% cutoff was chosen based on prior

reported risk tolerance for adverse events in other ED cardiovascular complaints.[17, 18] The RED-AF clinical threshold corresponding to a 2% false negative classification was determined to be 87 points.

Analysis

We measured the RED-AF's performance in this prospective validation cohort, assessing its calibration, discrimination, and diagnostic accuracy.[19] The rule's calibration was measured by plotting actual vs. predicted probabilities on a curve and discrimination was measured using the c-statistic. For this validation study, our primary focus was measuring RED-AF's accuracy to predict risk of a 30-day AF-related adverse event. Using sensitivity and specificity across the full range of RED-AF scores, we constructed a receiver operating characteristic (ROC) curve and calculated area under the curve. Using the RED-AF threshold of 87 points, we calculated sensitivity, specificity, and predictive values with 95% confidence intervals (CI) of RED-AF to identify an AF-related adverse event within 30 days of the index ED evaluation.

We also calculated the odds ratios (ORs) and 95% CIs for each predictor variable to identify patients who experienced an AF-related adverse event.

We conducted subgroup analyses to evaluate the decision aid's performance among patients whose ED evaluation was primarily for AF and individuals whose AF was secondary to an alternative principal complaint. A secondary analysis was performed to evaluate the impact of hospitalization following the index ED visit on RED-AF's performance. All analyses were performed using R programming language, Version 3.0.1.[20]

RESULTS

Characteristics of Study Subjects

Between June 9, 2010 and February 28, 2013, 4151 patients were screened for the study, 1020 met all eligibility criteria, and 519 were enrolled. Of the 501 patients not enrolled, 399 refused participation, 63 were not consentable, and 39 patients were missed. Of the 519 enrollees, 15 individuals were withdrawn and 7 patients were lost to follow-up. Eleven of withdrawals were for failure to meet inclusion criteria when an independent cardiologist's interpretation of their ED electrocardiogram reported a rhythm other than AF or atrial flutter. Table 1 presents a description of the baseline characteristics of the previously studied derivation (n = 832) and current validation cohorts (n=497).[8] The emergency medicine principal investigator identified that 326 (66%) of the ED visits were primarily for AF. An independent review of 163 (31%) records by an electrophysiologist investigator observed concordance in 135 (83%), corresponding to a kappa of 0.80 (95% CI: 0.703 to 0.895).

Main Results

Of the 497 patients, 120 (24%) experienced 1 30-day adverse event. Table 2 reports the overall frequencies of 30-day adverse events. The Appendix Table 1 provides additional details on the 30 (6%) patients who died during follow-up. The c-statistic of RED-AF for the primary outcome of any 30-day AF-related adverse event in this validation cohort was 0.65

(95% CI, 0.59 to 0.71), which was similar to the c-statistic of 0.67 (95% CI, 0.63 to 0.71) obtained from the original derivation cohort.[8] Figure 2 illustrates RED-AF's calibration plot, which demonstrates that the "bias-corrected" estimate is moderately nonlinear but only slightly worse than the "apparent" calibration. The 0.9 quantile of absolute error in predicted probabilities between the "bias corrected" and "apparent" model is 0.07, suggesting only a small degree of bias from overfitting in the original model.

The receiver operating characteristics (ROC) curves for RED-AF's performance in the primary outcome in both the original derivation and the validation cohorts are presented in Figure 3. Using the 87 point RED-AF threshold to identify patients with 30-day adverse events, the sensitivity (95% CI) and specificity (95%CI) for RED-AF were 96% (91–98) and 19% (15–23%), respectively. The corresponding predictive values positive and negative were 27% (23–32) and 93% (85–97), respectively. Additional details are provided in Appendix Table 2.

Table 3 provides the predicted risks for a 30-day adverse event based on an individual's RED-AF point total. Of the 75 patients with RED-AF scores ≥ 87 , the decision aid failed to identify 5 patients who had a 30-day adverse event including a 72 year-old male with paroxysmal AF who was hospitalized and died under hospice care due to sepsis. Among the other 4 patients, 3 individuals were evaluated in the ED or clinic for symptomatic AF and did not require admission to the hospital. A 62 year-old male was admitted for recurrent intraabdominal infection complicated by recurrent AF. Additional details on these patients are provided in the Appendix Table 3. None of the 75 patients with a RED-AF score ≥ 87 had a stroke or AF-related death.

Subgroup Analyses

The ROC curves for the subgroups (primary AF and secondary AF ED visits) showed similar performance for the primary outcome as shown in the Appendix Figure. The Appendix Table 4 presents the odds ratios for each of the RED-AF predictor variables to identify patients who experience an AF-related adverse event in its original cohort[8] and in this external validation cohort. The use of home rate control medications (ie, beta receptor and calcium channel antagonists) were not strong predictors in this cohort. Hospitalization following the index ED visit did not result in a clinically important change in the adjusted OR of the RED-AF predictors; however, hospitalization has an adjusted OR of 2.30 (1.05, 5.04) for 30-day adverse events.

LIMITATIONS

This study has several limitations. We validated the RED-AF decision aid at the same center as the original derivation study. Two study investigators (TWB and CAJ) authored the original RED-AF derivation paper. ED patients with AF were managed by many of the same ED attendings in both study periods although the resident physicians were unique in both studies. These may potentially result in an inflated performance of this decision aid and lead to selection bias. However, 92% of the patients in this validation cohort were not included in the original derivation study. As we did in the derivation study, this investigation included patients whose ED evaluations were for primary AF (66%) and individuals in whom AF was

complicating an alternative primary complaint (34%). We chose to include both groups to maximize the decision aid's generalizability and utility as numerous studies have shown that ED patients with AF often present with alternative primary complaints. [8, 9, 21–23] AF, even when detected incidentally or as a secondary complaint, may complicate the ED evaluation and ultimate disposition decision. Given the multiple comorbidities (eg, cancer, chronic kidney disease, COPD) in our patient population, we separated AF-related deaths and deaths due to a cause other than AF based on investigator determination. There is the potential that deaths may have been misclassified as AF-related or due to an alternative cause.

We did perform a subgroup analysis using only the primary AF population and found similar performance for the RED-AF model. Although other AF investigators have questioned the inclusion of patients with a clear alternative primary ED diagnosis, [22] we opine that our AF clinical decision aid, derived and now validated in ED patients with both primary and secondary AF diagnoses, will provide ED physicians with the first objective decision aid to identify low risk patients.

We enrolled ED patients at a university-affiliated referral center; therefore, the study is subject to potential selection bias as our ED population of AF patients may have more complicated medical comorbidities and be at increased risk for 30-day events. The AF decision aid includes 12 variables and requires use of a nomogram or web-based application that will provide a facile, real time, risk estimate for ED physicians. Such web-based and smart phone applications are being used more frequently in the ED and allow for decision aid refinement through application updates.[24] Further evaluation of RED-AF's performance as compared to physician's gestalt to predict adverse outcomes in AF is indicated. The clinical decision aid will require external validation in other health care settings and among physicians unfamiliar with the decision aid to ascertain its generalizability in AF prior to implementation in clinical practice. Our research team continues to investigate potential updates that might improve the decision aid's performance and easy application in the ED setting. We also intend to investigate the impact of incorporating this AF decision aid into the ED management of AF and how it compares to unaided physician gestalt.

DISCUSSION

We found that RED-AF performed moderately well at identifying risk for 30-day adverse events in ED patients with AF. The performance of RED-AF in this external cohort was similar to the original derivation cohort and has a c-statistic that compares favorably to those previously reported for the CHADS2 (0.68–0.80) and CHA2DS2-VASc scores (0.59–0.67). [25, 26] The ED clinician may use RED-AF to estimate the probability for a 30-day event, which may be helpful when deciding on patient disposition from the ED. The data required for calculating the estimated 30-day risk is available within the first 2 hours of ED evaluation and includes clinically sensible predictors such as patient age and cardiopulmonary comorbidities. The ability to achieve adequate rate control at 2 hours following initiation of ED treatment remains an important predictor. Given the preference of clinicians in the United States for rate control treatment in acute AF, [10, 27, 28] this is an

important and sensible factor for risk stratifying patients within 2 hours. For example, a 45 year old male with lone AF who is adequately rate controlled within the first hour of ED management has a predicted probability an adverse event within 30 days of <5% and may be an excellent candidate for discharge and outpatient management. Whereas, a 70 year old male smoker with ventricular rates in the 120–130's and dyspnea despite intravenous diltiazem has >40% predicted probability for an adverse event and may benefit from hospitalization.

For the past two decades, nearly 70% of ED patients who are treated for AF in the United States have been hospitalized.[10, 28] These hospitalization frequencies are in stark contrast to the ED disposition practices in Canada, Europe and Australia where less than a third of patients are hospitalized.[21, 27, 29, 30] There continues to be considerable United States regional variation in hospitalization practices for ED patients with AF.[10, 28] The impact of hospitalizing ED patients with acute AF on short-term adverse events remains unanswered. Our analysis did not detect that including hospitalization resulted in a clinically important change in the OR for the RED-AF predictors. However, the adjusted OR for hospitalization reported 2-fold increased odds of experiencing an adverse event. This introduces an interesting discussion of whether hospitalization alone or some component of inpatient AF management increases one's risk of a 30-day event or whether hospitalized patients represent a higher risk population who are sicker with more comorbidities. This is a topic of active research for our study team.

The American College of Cardiology (ACC) / American Heart Association (AHA) / European Society of Cardiology (ESC) current AF management guidelines have 3 objectives – rate control, prevention of thromboembolism, and correction of the rhythm disturbance.[4, 31, 32] According to the guidelines[32], a patient with a first-documented episode of AF who achieves rate control does not necessarily need a hospital admission, yet these patients continue to be routinely hospitalized in the US.[8] Neither the 2014 AHA/ACC/HRS guidelines nor the 2012 focused update of the ESC guidelines specifically address ED treatment and disposition.[4, 31] The American College of Emergency Physicians does not have an AF clinical guideline. Establishing the severity of an AF exacerbation and contribution to a patient's overall condition is difficult and imprecise. ED patients may have significant cardiovascular and non-cardiac co-morbidities that incite or contribute to an individual's hemodynamic instability.[28, 29] This may contribute to the conservative hospitalization frequencies among US ED physicians.[10, 28] Decision aids are an essential component of chronic AF management, especially for long-term anticoagulation.[4, 31] A 2014 Cochrane review concluded, "there is high-quality evidence that decision aids compared to usual care improve people's knowledge regarding options, and reduce their decisional conflict." [33] These factors support the need for an objective, clinical decision aid to support ED physicians in identifying low risk patients who may be safely discharged from the ED and managed as outpatients. Rather than compute a dichotomous (low risk vs. not low risk) result, RED-AF provides ED physicians with the opportunity to individualize the risk threshold based on their own practice and local community standards. This investigation is the next step in our goal of implementing a more personalized treatment approach for ED patients with AF. AF patients desire increased knowledge of their disease, more discussion regarding the risks and benefits of treatment options, and increased

engagement in management decisions.[34–37] We believe that educating patients about their short term risk for complications related to their AF, the risk of potential hospital associated complications, [38, 39] and including patients and their caregivers in a shared decision making process on the most appropriate ED disposition using validated decision support tools such as RED-AF will safely reduce total AF hospital days, 30-day readmissions, and improve patient quality of life.[36]

In summary, in this separate validation cohort, RED-AF performed moderately well and similar to the original derivation cohort for identifying the risk of short-term AF-related adverse events in ED patients diagnosed with AF.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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VARIABLE	POINT ALLOTMENT
Age (years)	
20	11
30	22
40	33
50	44
60	56
70	67
80	78
90	89
100	100
Sex	
Female	6
Male	0
Shortness of breath	
Yes	27
No	0
Palpitations	
Yes	0
No	5
Home use of beta blockers	
Yes	23
No	0
Home use of diuretics	
Yes	0
No	0
History of heart failure	
Yes	19
No	0
History of COPD	
Yes	6
No	0
History of hypertension	
Yes	12
No	0
Cigarette smoker	
Current or quit within last year	52
Never or Quit > 1 year ago	0
Peripheral edema on ED physical examination	
Yes	15
No	0
Ventricular rate control at 2 hours (pulse < 100bpm)	
Inadequate rate control	29
Adequate rate control	0
Total RED-AF Points	

Figure 1.

RED-AF model based on data from the original derivation cohort. Points are assigned for each of the 12 predictors. The total points correspond to an absolute predicted risk for 30-day adverse events.[8]

Figure 2.

Calibration plot for the RED-AF clinical prediction model in the validation cohort. This plot illustrates the calibration accuracy of the original model (“Apparent”) and the bootstrap model (“Bias-corrected”) for 30-day adverse events with locally weighted scatterplot smoothing used to model the relationship between actual and predicted probabilities. As can be seen, the model’s calibration function estimate is moderately nonlinear, with the corrected calibration showing good agreement with the apparent calibration.

Figure 3.

Receiver Operating Characteristic (ROC) Curves for RED-AF. The Figure presents the ROC curves for RED-AF in both the original derivation cohort (n=832) and the validation cohort (n=497).

Appendix Figure 1.

Table 1

Baseline Characteristics of the Derivation and Validation Cohorts

Variable	Derivation Cohort (n=832) Frequency, No. (%)	Validation Cohort (n=497) Frequency, No. (%)
Age (in years)*	68 (57, 79)	67 (58, 78)
Female	342 (41)	177 (36)
Newly diagnosed AF	296 (36)	131 (26)
Paroxysmal/Persistent AF	346 (41)	244 (49)
Permanent AF	168 (20)	122 (25)
CHADS2 score*	2 (1, 3)	2 (1, 3)
Maximum pulse rate in ED (bpm)*	124 (97, 145)	123 (91, 144)
Adequate heart rate control in ED, yes [^]	500 (60)	293 (59)
Home beta-blocker use, yes	368 (44)	259 (52)
Home diltiazem/ verapamil use, yes	130 (16)	86 (17)
Home diuretic use, yes	393 (47)	247 (50)
Home sotalol use, yes	49 (6)	36 (7)
Home warfarin use, yes	283 (34)	166 (33)
Current smoker, yes	115 (14)	60 (12)
History of myocardial infarction, yes	135 (16)	109 (22)
History of coronary artery disease, yes	272 (33)	169 (34)
History of COPD, yes	126 (15)	78 (16)
History of hypertension, yes	561 (67)	356 (72)
History of valvular heart disease, yes	162 (19)	132 (27)
History of heart failure, yes	216 (26)	167 (34)
History of diabetes, yes	199 (24)	128 (26)
Complaint of palpitations in ED, yes	336 (40)	44 (9)
Complaint of shortness of breath in ED, yes	384 (46)	267 (54)
Presence of edema on physical exam in ED, yes	229 (28)	158 (32)

Categorical variables presented as number followed by percentage in parentheses.

* Continuous variables are represented as the median with interquartile range in parentheses.

[^] Patients were subsequently classified as having adequate or inadequate rate control according to whether that data point was less than 100 beats/min.

Abbreviations in table: AF – atrial fibrillation; COPD - chronic obstructive pulmonary disease; ED – emergency department

Table 2

Frequency of 30-Day Adverse Events (n=497)

Adverse Event	0–30 day events
Death, AF-related	4 (<1%)
Stroke (thromboembolic or hemorrhagic)	13 (3%)
Death, cause other than AF	26 (5%)
Cardiac arrest, resuscitated	13 (3%)
Cardiogenic shock	4 (<1%)
Emergent pacemaker placement	1 (<1%)
Ventricular arrhythmia requiring emergent treatment	7 (1%)
Acute heart failure	13 (3%)
Acute coronary syndrome	7 (1%)
Unscheduled hospitalization, AF-related	32 (6%)
Continuous AV nodal blocker infusion required	17 (3%)
ED visit, AF-related	41 (8%)
Atrial arrhythmia requiring emergent treatment	76 (15%)
Experienced ≥ 1 adverse event	120*

* 25 people experienced more than 1 event in both the 0–30 days intervals

AF: Atrial Fibrillation

AV: Atrioventricular

ED: Emergency Department

PCI: Percutaneous Coronary Intervention

Table 3

Predicted Risks For A 30-Day Adverse Event Based On An Individual's RED-AF Point Total (n=497)[^]

Total Points	Predicted Risk For A 30-Day Adverse Event	No. Of Patients In Validation Cohort (%)	No. Of Patients Hospitalized Following Their Index ED Visit	No. Of Patients Who Had 1 Adverse Event	No. Of Patients Returned To The ED For An AF-Related Reason	No. Of Patients Who Were Readmitted For An AF-Related Reason	* No. Of Patients Who Experienced a CV Complication	No. Of Patients Who Had A Stroke	No. Of Patients Who Died- AF Related	No. Of Patients Who Died – Cause Other than AF
<= 16	0–0.04	0	0	0	0	0	0	0	0	0
17–62	0.05–0.09	17 (3.4)	7	0	0	0	0	0	0	0
63–87	0.10–0.14	58 (11.7)	43	5	3	0	5	0	0	1
88–112	0.15–0.19	125 (25.2)	93	24	8	6	18	2	0	3
113–130	0.20–0.24	107 (21.5)	96	31	8	6	24	3	0	6
131–146	0.25–0.29	57 (11.5)	53	12	8	6	11	1	0	1
147–160	0.30–0.34	61 (12.3)	55	22	6	6	13	5	2	6
161–173	0.35–0.39	29 (5.8)	27	10	1	1	7	1	1	5
174–185	0.40–0.44	21 (4.2)	20	6	1	2	4	1	1	2
186–198	0.45–0.49	17 (3.4)	17	7	3	4	7	0	0	1
199–210	0.50–0.54	4 (0.8)	3	3	2	1	3	0	0	1
211–223	0.55–0.59	1 (0.2)	1	0	0	0	0	0	0	0
>= 224	>=0.60	0	0	0	0	0	0	0	0	0

[^] An individual patient may be represented in more than 1 column. For example, a patient with a score between 63–87 had a recurrent acute atrial arrhythmia resulting in an ED evaluation and would be represented in more than 1 column.

* Cardiovascular (CV) complication includes cardiac arrest, cardiogenic shock, acute coronary syndrome, unscheduled pacemaker placement, atrial or ventricular arrhythmia, acute heart failure, or need for continuous atrioventricular nodal blocker infusion. Strokes are documented within their own column.