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Achievement and Quality Measure Attainment in Patients Hospitalized with Atrial Fibrillation: Results from the Get With The Guidelines® – Atrial Fibrillation (GWTG-AFIB) Registry

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Abstract

BACKGROUND: The Get With The Guidelines® – Atrial Fibrillation (GWTG-AFIB) Registry uses achievement and quality measures to improve the care of patients with atrial fibrillation (AF). We sought to evaluate overall and site-level variation in attainment of these measures among sites participating in the GWTG-AFIB Registry.

METHODS: From the GWTG-AFIB registry, we included patients with AF admitted between 1/3/2013 and 6/30/2019. We described patient-level attainment and variation in attainment across sites of 6 achievement measures with 1) defect-free scores (percent of patients with all eligible measures attained), and 2) composite opportunity scores (percent of all eligible patient measures attained). We also described attainment of 11 quality measures at the patient-level.

RESULTS: Among 80,951 patients hospitalized for AF (age 70±13 years, 47.0% female; CHA_2DS_2-VASc 3.6±1.8) at 132 sites. Site-level defect-free scores ranged from 4.7% to 85.8% (25^{th}, 50^{th}, 75^{th} percentile: 32.7%, 52.1%, 64.4%). Composite opportunity scores ranged from 39.4% to 97.5% (25^{th}, 50^{th}, 75^{th}: 68.1%, 80.3%, 87.1%). Attainment was notably low for the following quality measures: 1) aldosterone antagonist prescription when ejection fraction ≤35% (29% of those eligible); and 2) avoidance of antiplatelet therapy with OAC in patients without coronary/peripheral artery disease (81% of those eligible).

CONCLUSION: Despite high overall attainment of care measures across GWTG-AFIB registry sites, large site variation was present with meaningful opportunities to improve AF care beyond OAC prescription, including but not limited to prescription of aldosterone antagonists in those with AF and systolic dysfunction and avoidance of non-indicated adjunctive antiplatelet therapy.

Keywords

atrial fibrillation; quality; performance

INTRODUCTION

The American College of Cardiology (ACC) and the American Heart Association (AHA),[1–5] in collaboration with other stakeholders,[6] develop and endorse clinical performance measures sets with the stated goal “to accelerate translation of scientific evidence into clinical practice.” Additionally, these measures are intended to serve as measures of quality of care, allowing for clinicians and institutions to identify opportunities to improve care delivery. The Get With The Guidelines® – Atrial Fibrillation (GWTG-AFIB) registry, a national, hospital based voluntary quality improvement (QI) initiative sponsored by the AHA in partnership with the Heart Rhythm Society (HRS), launched in 2013 with the aim of improving quality of care for patients with atrial fibrillation (AF). Modeled after existing GWTG registries, which have been associated with improved adherence to guideline-endorsed care for other cardiovascular diseases,[7–10] the GWTG-AFIB registry utilizes 6 achievement (also termed performance) and 11 quality measures. Quality measures are distinguished from achievement measures as defined by the ACC/AHA Task Force for Performance Measures in that they may be helpful for improving quality of care but are not currently appropriate for public reporting or use as a metric in pay-for-performance programs based on the available evidence.[11]

To date, substantial effort has been invested in evaluating the prescription of oral anticoagulation (OAC) in patients with AF at increased risk of stroke across populations and care settings.[12–15] However, there has substantially less investigation into attainment of other AF care measures, particularly across institutions, with such an investigation providing insight into contemporary AF care quality at large. Therefore, we sought to 1) characterize attainment of the 6 achievement and 11 quality measures utilized by the GWTG-AFIB registry at both the site- and patient-level, 2) quantify site-level variation in attainment of these measures, and 3) investigate variables associated with high-performing sites across the GWTG-AFIB registry network.

METHODS

We conducted a retrospective cohort study utilizing data from the GWTG-AFIB registry, a national, hospital-based voluntary QI initiative sponsored by the AHA and in partnership with the HRS.[16] The goal of the GWTG-AFIB program is to (1) assist hospitals and clinicians in providing evidence-based care for patients with AF and (2) to improve outcomes in patients with AF.

Similar to other Get With The Guidelines® programs,[7–10,17,18] GWTG-AFIB provides participating hospitals' teams and clinicians educational workshops and webinars on guideline endorsed care of patients with AF. Additionally, online tool kits, for patient and clinician education, and a decision support Patient Management Tool™ (IQVIA, Durham, NC) are made available. Every quarter, performance data on guideline adherence and attainment of achievement/performance and quality measures is provided to participating hospitals. Trained personnel at participating hospitals abstract clinical data on consecutive inpatients using standardized definitions, with data audits to confirm data validity. Inpatient hospitalizations were defined as any episode of care with an overnight stay. The GWTG-AFIB QI initiative, registry, and methods have been described in detail previously.[12,16]

Inclusion & Exclusion Criteria

We included patients admitted with a primary or secondary diagnosis of either AF or atrial flutter (AFL), as determined by primary enrollment site, among hospitals participating in the GWTG-AFIB registry. Dates of study participation that were included in this analysis were from January 3, 2013 (registry inception) through June 30, 2019. We excluded sites that enrolled <25 patients in the registry, an established exclusion threshold in studies investigating variation in quality of care,[19,20] and excluded patients 1) treated with comfort care measures only, 2) transferred to hospice or other facilities during admission, 3) who left against medical advice, and 4) missing a discharge destination, sex, or AF/AFL type (i.e., paroxysmal vs. non-paroxysmal, typical vs. atypical). Patients with undetermined AF/AFL type were not excluded from the final study population.

Outcomes

The GWTG-AFIB Registry utilizes 6 achievement and 11 quality measures to promote optimal care of hospitalized patients with AF or AFL (Table 1), which are embedded in the GWTG-AFIB patient management tool. Of note, there is substantial overlap between the

GWTG-AFIB measures and the clinical performance and quality measures endorsed by the ACC/AHA, in collaboration with the HRS, for adults with AF or AFL.[1,2]

The primary outcome of the present study was site-level attainment of eligible achievement measures. Site level attainment was quantified by 1) defect-free score, defined as the percentage of patients at a site with all eligible achievement measures attained; and 2) composite opportunity score, defined as the percentage of all eligible patient achievement measures attained at a site. Importantly, patients are not eligible for all measures, for example, patients with CHA_2DS_2-VASc < 2 are excluded from the denominator when determining attainment of FDA-approved anticoagulation prescription prior to discharge. Similarly, patients were deemed ineligible if baseline characteristics necessary to determine eligibility were missing (e.g., left ventricular ejection fraction or estimated glomerular filtration rate) or sites reported a medical reason that medication prescription was contraindicated (Supplemental Table I). Current measure definitions, which have not changed substantively during the study period, were applied across the study period. We also determined the following: 1) the association between baseline characteristics and top performing sites by defect-free and composite opportunity score quartiles and 2) patient-level attainment of achievement and quality measures, for all patients and by arrhythmia type (AF vs. AFL). We reported measure attainment by arrhythmia type as pre-admission anticoagulation prescription for AFL patients, as compared to AF, has been shown to be lower at GWTG-AFIB sites.[12] Of note, AF and AFL were mutually exclusive and reported by the site.

Statistical Methods

We divided sites into quartiles by defect-free score and composite opportunity scores. We also stratified patients by arrhythmia type (AF vs. AFL). Baseline patient and site characteristic variables were summarized by count and percentages when categorical and means with standard deviations when continuous. We compared variables by arrhythmia type using Pearson's chi-squared tests and Wilcoxon-rank sum tests for categorical and continuous variables, respectively. We tested for trend as a monotone association across increasing site-level defect-free and composite score quartiles using 1) Cochran-Mantel-Haenszel Statistics based on rank score were used for categorical variables and 2) the Jonckheere-Terpstra test for continuous/ordinal variables.

For the multivariable analysis, we used logistic regression with generalized estimating equations with independent correlation structure to associate baseline characteristics (independent variables) and care at sites in top-quartiles of defect-free and composite opportunity scores (dependent variables). Independent variables included demographic variables (age, sex, race/ethnicity), AF history (AF vs. AFL, CHA_2DS_2-VASc score), medical history (chronic obstructive pulmonary disease, coronary artery disease, chronic kidney disease [CKD] stage III or greater [estimate glomerular filtration rate (eGFR) < 60 mL/min per 1.73 m^2], dialysis, diabetes, heart failure, ejection fraction <40, hypertension, liver disease, obstructive sleep apnea, peripheral vascular disease, prior hemorrhage, prior myocardial infarction, prior percutaneous intervention, prior stroke or transient ischemic attack, active smoker, thyroid disease), and patient insurance (private/health maintenance

organization/other, Medicaid, Medicare, Medicare through private/health maintenance organization/other [Medicare Part C], no insurance/unable to determine). Age was evaluated for non-linearity with respect to the logit of each outcome and non-linearity was addressed with linear splines. We used multiple imputation to handle missing data in the models, with 25 imputed datasets created using the fully conditional specification method. Missing medical conditions were assumed to have not been present. Rates of missingness were low overall, with the exception of patient insurance (15.0%), ejection fraction (9.3%), and eGFR (11.0%). Site characteristics were not included in the final models due to large odds ratios and wide confidence intervals when included in preliminary models.

All institutions participating in the GWTG-AFIB registry received local institutional review board approval if an informed consent exemption was not granted under the common rule (as data was primarily used for local QI). Additionally, this study was approved by the institutional board review of Duke University. IQVIA (Parsippany, NJ) served as the data collection and coordinating center and the Duke Clinical Research Institute (DCRI) served as the data analytic center. All analyses were performed using SAS, version 9.4 (SAS Institute, Cary, NC, USA) and a two-tailed p-value <0.05 was considered significant for all statistical tests.

The authors are solely responsible for the design and conduct of this study, all study analyses, the drafting and editing of the paper and its final contents. No extramural funding was used to support this work.

RESULTS

The analysis cohort included 132 sites, which treated 72,665 patients (90%) and 8,286 patients (10%) with AF and AFL, respectively (Figure 1) (Supplemental Table II). Top-quartile sites by defect-free score were less likely to be rural (quartile 4 vs. quartile 1: 0.0% vs. 5.4%, P<0.001) and more likely to have 500+ beds (quartile 4 vs. quartile 1: 54.5% vs. 34.7%, p<0.001) or be academic/teaching hospitals (quartile 4: 94.2% vs. quartile 1: 72.1%, P<0.001) (Table 2). Similar site differences were observed for composite opportunity score quartiles (Supplemental Table III).

Achievement Measures

At the site-level, defect-free scores of achievement measures ranged from 4.7% to 85.8% with a median site score of 52.1% (25^{th}, 75^{th}: 32.7%, 64.4%) (Figure 2). Composite opportunity scores of achievement measures ranged from 39.4% to 97.5% with a median site score of 80.3% (25^{th}, 75^{th}: 68.1%, 87.1%) (Figure 2). Site-level attainment and variation in defect-free and composite scores of achievement measures were numerically similar between AF and AFL patients (Supplemental Figure I–IV).

In multivariable models that included patient baseline characteristics only, the following variables were positively associated with receiving care at a top-quartile site by defect-free score: 1) heart failure (odds ratio [OR] 1.25, 95% confidence interval [CI] 1.04–1.50, P=0.015), 2) sleep apnea (OR 1.50, 95%CI 1.23–1.83, P<0.001), and 3) Medicare Part C insurance (OR 1.60, 95%CI 1.04–2.46, P=0.034). The following variables were negatively

associated with receiving care at a top-quartile site by defect-free score: 1) age >75 (per 10 year increase) (OR 0.74, 95%CI 0.59–0.92, P=0.008, 2) other race (or unable to determine) (OR 0.47, 95%CI 0.27–0.83, P=0.009), 3) chronic obstructive pulmonary disease (OR 0.81, 95%CI 0.67–0.97, P=0.026), 4) diabetes (OR 0.86, 95%CI 0.78–0.95, P=0.005), and 5) peripheral vascular disease (OR 0.78, 95%CI 0.64–0.94, P=0.011) (Supplemental Table IV). Similar findings were observed when variables were associated with receiving care at a top-quartile site by composite opportunity score, as compared to defect-free score, with the following exceptions 1) Medicare Part C insurance and peripheral vascular disease were not associated, and 2) CKD Stage III or greater (eGFR <60 mL/min per 1.73 m^2) was negatively associated (OR 0.83, 95%CI 0.73–0.94, P=0.004) (Supplemental Table V).

At the patient-level, mean attainment of eligible achievement measures was 80.2% ±29.0% (composite opportunity score) with 43,639 patients (60.0%) attaining all eligible achievement measures (defect-free score). Notably, OAC was prescribed in 53,504 patients, 95% of those eligible. The achievement measure with the lowest attainment was documentation of CHA_2DS_2-VASc score, performed in 67% of those eligible (Table 1). AF patients, as compared to patients with AFL, were older and more likely to be women (age: 70.2±13.2 vs. 67.1±12.9, P<0.001; female: 48.2% vs. 35.9%, P<0.001), had slightly higher CHA_2DS_2-VASc scores (3.7±1.9 vs. 3.4±1.8, P<0.001), and were less likely to have an ejection fraction <40% (14.1% vs. 18.2%, P<0.001) (Supplemental Table II). AF patients, as compared to AFL, were slightly more likely to attain all eligible achievement measures (60.4% vs. 57.0%, P<0.001).

Quality Measures

Quality measure attainment at the patient-level exceeded 65% for all measures, with the exception of aldosterone antagonist prescription when ejection fraction was ≤35% (29% of those eligible). Additionally, attainment for the following quality measure was notable: 1) avoidance of inappropriate prescription of direct thrombin or factor Xa inhibitor to patients with a mechanical heart valve (87% of those eligible); 2) avoidance of inappropriate prescription of antiplatelet along with OAC therapy to patients without coronary artery disease, cerebrovascular accident/transient ischemic attack, peripheral vascular disease (81% of those eligible); and 3) avoidance of inappropriate prescription of antiarrhythmic drugs to patients with permanent AF (65% of those eligible) (Table 1). However, avoidance of inappropriate antiarrhythmic drug prescription increased to 92% of those eligible when patients with persistent AF were excluded from the denominator (i.e., denominator restricted to those with permanent or long-standing persistent AF).

DISCUSSION

Across 132 sites participating in The Get With The Guidelines® – Atrial Fibrillation (GWTG-AFIB) Registry, which cared for over 80,000 patients, overall attainment of the 6 achievement and 11 quality measures utilized by the registry to facilitate optimal care of patients hospitalized with AF was high. Notably, OAC was prescribed to 95% of patients at increased risk of stroke without contraindications. However, 1) large variation in achievement measure attainment was identified across sites, 2) attainment of all eligible

achievement measures occurred in only 60% of patients, and 3) opportunities exist to improve attainment of multiple notable quality measures. These findings highlight that meaningful opportunities to improve AF care quality exist beyond OAC prescription.

In the recently published first results of the GWTG-AFIB registry,[12] the quality of OAC prescription across the registry was notable. In addition to a high overall rate of OAC prescription in those without contraindications, participating centers demonstrated improvement in OAC prescription from 80% to 97% from study start to finish. These findings confirmed that a high-degree of adherence to AF care measures is achievable in clinical practice, particularly with the use of QI programs like GWTG-AFIB.

In the current analysis, we investigated all AF care measures as identified by the ACC and AHA (including OAC prescription). While attainment of achievement/performance measures was high, there was significant variation across hospitals and sites. However, to provide context, the overall AF composite opportunity score observed in this study was similar to the previously reported GWTG-Heart Failure (HF) composite opportunity score for HF performance measures. Additionally, a similar degree of variation across sites was observed in measure attainment between GWTG-AFIB and -HF registry sites.[7] Of note, in contrast to the current AF reimbursement landscape, reimbursement incentives for HF performance measure attainment were broadly in use at the time measure attainment across GWTG-HF sites was determined.[21] We also found that smaller, non-academic, rural hospitals that care for older patients may have lower attainment of achievement and quality measures. If confirmed, identification of barriers to guideline-concurrent AF care at these sites should be a priority.

Since prior bleeding and perceived risk of bleeding are common reasons for lack of OAC in patients with AF and increased risk of stroke,[12] efforts to mitigate bleeding risk in this population have appropriately identified elimination of antiplatelet therapy in patients who do not have a guideline indication for antiplatelet therapy.[22] Highlighting the number of patients who may benefit from this bleeding-avoidance strategy, 19% of the patients without an indication for antiplatelet therapy in this study were prescribed both OAC and an antiplatelet medication.

Prescription of an aldosterone antagonist at discharge had the lowest attainment of any measure (quality or achievement), consistent with existing HF literature[23] and previously observed in patients with AF and concomitant HF.[24] Of note, a trend towards reduced stroke risk with aldosterone antagonist use in patients with AF has been observed, with proof of causation awaiting trial.[25] Use of direct oral anticoagulants in patients with AF and a mechanical heart valve was higher than expected (13% of patients), considering the RE-ALIGN results and class III recommendations for their use in this population.[26–28] However, it is possible that prosthetic valves may have been misclassified as mechanical and included in the denominator. Confirmation of this finding in other real-world data sources and identification of drivers of prescription are warranted.

This study has important limitations. Participating hospitals are committed to local AF care QI and therefore the findings at these sites may not be completely generalizable to

routine clinical practice or sites participating in the registry which met exclusion criteria. Participation in the registry facilitates attainment of these measures, as evidenced by prior results from the GWTG-AFIB registry.[12] For these reasons, although reflective of AF care quality across included registry sites, these findings may overestimate attainment of the studied care measures at large. However, even if these data represent an optimal care scenario they still highlight key opportunities for improvement. Missingness for ejection fraction and eGFR were approximately 10%, which could affect results if missingness is not random. Also, although all hypotheses were established a priori and analyses prespecified in an analysis plan, we did not adjust for multiple comparisons, which may raise the likelihood of Type I error. Rather, we elected to not overstate any conclusions reached solely based on statistical significance. Additionally, care measure attainment was assessed during hospitalization and my not reflect long-term persistence in attainment of these measures in the outpatient setting. Finally, data were abstracted from medical chart review, and although processes were in place to monitor data quality and completeness, we are still dependent on the documentation completeness and accuracy.

Conclusions

Successful adherence to clinical care measures defined by the ACC and AHA to improve patient outcomes was high in the GWTG-AFIB registry. Despite the high degree of adherence to achievement and quality measures, there are significant and meaningful opportunities to improve AF care beyond OAC prescription, including but not limited to prescription of aldosterone antagonists in those with AF and systolic dysfunction and avoidance of non-indicated adjunctive antiplatelet therapy. These findings should inform future efforts to improve the quality of care for persons with AF.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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ABBREVIATIONS

ACC	American College of Cardiology
AF	atrial fibrillation
AFL	atrial flutter
AHA	American Heart Association
CKD	chronic kidney disease
CI	confidence interval
eGFR	estimate glomerular filtration rate

GWTG-AFIB	Get With The Guidelines® – Atrial Fibrillation
HRS	Heart Rhythm Society
OAC	oral anticoagulation
OR	odds ratio
QI	quality improvement

REFERENCES

1. Heidenreich PA, Solis P, Estes NAM, Fonarow GC, Jurgens CY, Marine JE, McManus DD, McNamara RL. 2016 ACC/AHA Clinical Performance and Quality Measures for Adults With Atrial Fibrillation or Atrial Flutter. Circulation Cardiovasc Qual Outcomes. 2016;9:443–488.
2. Heidenreich PA, Estes NAM, Fonarow GC, Jurgens CY, Kittleson MM, Marine JE, McManus DD, McNamara RL. 2020 Update to the 2016 ACC/AHA Clinical Performance and Quality Measures for Adults With Atrial Fibrillation or Atrial Flutter. Circulation Cardiovasc Qual Outcomes. 2020; doi: 10.1161/HCQ.0000000000000100.
3. Jneid H, Addison D, Bhatt DL, Fonarow GC, Gokak S, Grady KL, Green LA, Heidenreich PA, Ho PM, Jurgens CY, King ML, Kumbhani DJ, Pancholy S. 2017 AHA/ACC Clinical Performance and Quality Measures for Adults With ST-Elevation and Non-ST-Elevation Myocardial Infarction: A Report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. Circulation Cardiovasc Qual Outcomes. 2017;10:e000032.
4. Thomas RJ, Balady G, Banka G, Beckie TM, Chiu J, Gokak S, Ho PM, Keteyian SJ, King M, Lui K, Pack Q, Sanderson BK, Wang TY. 2018 ACC/AHA Clinical Performance and Quality Measures for Cardiac Rehabilitation: A Report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. Circulation Cardiovasc Qual Outcomes. 2018;11:e000037.
5. Casey DE, Thomas RJ, Bhalla V, Commodore-Mensah Y, Heidenreich PA, Kolte D, Muntner P, Smith SC, Spertus JA, Windle JR, Wozniak GD, Ziaeian B. 2019 AHA/ACC Clinical Performance and Quality Measures for Adults With High Blood Pressure: A Report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. Circulation Cardiovasc Qual Outcomes. 2019;12:e000057.
6. Jneid H, Addison D, Bhatt DL, et al. 2017 AHA/ACC Clinical Performance and Quality Measures for Adults With ST-Elevation and Non-ST-Elevation Myocardial Infarction: A Report of the American College of Cardiology/American Heart Association Task Force on Performance Measures. J Am Coll Cardiol. Oct 17 2017;70(16):2048–2090. [PubMed: 28943066]
7. Heidenreich PA, Hernandez AF, Yancy CW, Liang L, Peterson ED, Fonarow GC. Get With The Guidelines Program Participation, Process of Care, and Outcome for Medicare Patients Hospitalized With Heart Failure. Circulation Cardiovasc Qual Outcomes. 2012;5:37–43.
8. Schwamm LH, Fonarow GC, Reeves MJ, Pan W, Frankel MR, Smith EE, Ellrodt G, Cannon CP, Liang L, Peterson E, Labresh KA. Get With the Guidelines-Stroke is associated with sustained improvement in care for patients hospitalized with acute stroke or transient ischemic attack. Circulation. 2008;119:107–15. [PubMed: 19075103]
9. Krantz MJ, Tanner J, Horwich TB, Yancy C, Albert NM, Hernandez AF, Dai D, Fonarow GC, Hospitals GW the GSC and. Influence of hospital length of stay for heart failure on quality of care. Am J Cardiol. 2008;102:1693–7. [PubMed: 19064026]
10. Ormseth CH, Sheth KN, Saver JL, Fonarow GC, Schwamm LH. The American Heart Association's Get With the Guidelines (GWTG)-Stroke development and impact on stroke care. Stroke Vasc Neurology. 2017;2:94–105.
11. Bonow RO, Masoudi FA, Rumsfeld JS, Delong E, Estes NAM, Goff DC, Grady K, Green LA, Loth AR, Peterson ED, Piña IL, Radford MJ, Shahian DM. ACC/AHA classification of care metrics: performance measures and quality metrics: a report of the American College

of Cardiology/American Heart Association Task Force on Performance Measures. Circulation. 2008;118:2662–6. [PubMed: 19005092]

12. Piccini JP, Xu H, Cox M, Matsouaka RA, Fonarow GC, Butler J, Curtis AB, Desai N, Fang M, McCabe PJ, II RLP, Turakhia M, Russo AM, Knight BP, Sidhu M, Hurwitz JL, Ellenbogen KA, Lewis WR, Hospitals F the GWTG-ACWG and. Adherence to Guideline-Directed Stroke Prevention Therapy for Atrial Fibrillation Is Achievable. Circulation. 2019;139:1497–1506. [PubMed: 30700141]
13. Lopes RD, Elliott LE, White HD, Hochman JS, Werf FV de, Ardissino D, Nielsen TT, Weaver WD, Widimsky P, Armstrong PW, Granger CB. Antithrombotic therapy and outcomes of patients with atrial fibrillation following primary percutaneous coronary intervention: results from the APEX-AMI trial. Eur Heart J. 2009;30:2019–28. [PubMed: 19502623]
14. Piccini JP, Hernandez AF, Zhao X, Patel MR, Lewis WR, Peterson ED, Fonarow GC, Hospitals GWTGSC and. Quality of Care for Atrial Fibrillation Among Patients Hospitalized for Heart Failure. J Am Coll Cardiol. 2009;54:1280–1289. [PubMed: 19778670]
15. Gage BF, Boechler M, Doggette AL, Fortune G, Flaker GC, Rich MW, Radford MJ. Adverse Outcomes and Predictors of Underuse of Antithrombotic Therapy in Medicare Beneficiaries With Chronic Atrial Fibrillation. Stroke. 2000;31:822–827. [PubMed: 10753982]
16. Lewis WR, Piccini JP, Turakhia MP, Curtis AB, Fang M, Suter RE, Page RL, Fonarow GC. Get With The Guidelines AFIB. Circulation Cardiovasc Qual Outcomes. 2014;7:770–777.
17. Bradley SM, Huszti E, Warren SA, Merchant RM, Sayre MR, Nichol G. Duration of hospital participation in Get With the Guidelines-Resuscitation and survival of in-hospital cardiac arrest. Resuscitation. 2012;83:1349–57. [PubMed: 22429975]
18. Hira RS, Bhatt DL, Fonarow GC, Heidenreich PA, Ju C, Virani SS, Bozkurt B, Petersen LA, Hernandez AF, Schwamm LH, Eapen ZJ, Albert MA, Liang L, Matsouaka RA, Peterson ED, Jneid H. Temporal Trends in Care and Outcomes of Patients Receiving Fibrinolytic Therapy Compared to Primary Percutaneous Coronary Intervention: Insights From the Get With The Guidelines Coronary Artery Disease (GWTG-CAD) Registry. J Am Heart Assoc. 2016;5.
19. Hess CN, Shah BR, Peng SA, Thomas L, Roe MT, Peterson ED. Association of Early Physician Follow-Up and 30-Day Readmission After Non–ST-Segment–Elevation Myocardial Infarction Among Older Patients. Circulation 2013;128:1206–1213. [PubMed: 23946265]
20. Hernandez AF, Greiner MA, Fonarow GC, Hammill BG, Heidenreich PA, Yancy CW, Peterson ED, Curtis LH. Relationship Between Early Physician Follow-up and 30-Day Readmission Among Medicare Beneficiaries Hospitalized for Heart Failure. Jama 2010;303:1716–1722. [PubMed: 20442387]
21. Fonarow GC, Peterson ED. Heart failure performance measures and outcomes: real or illusory gains. Jama. 2009;302:792–4. [PubMed: 19690314]
22. Steinberg BA, Kim S, Piccini JP, Fonarow GC, Lopes RD, Thomas L, Ezekowitz MD, Ansell J, Kowey P, Singer DE, Gersh B, Mahaffey KW, Hylek E, Go AS, Chang P, Peterson ED, Patients O-AI and. Use and associated risks of concomitant aspirin therapy with oral anticoagulation in patients with atrial fibrillation: insights from the Outcomes Registry for Better Informed Treatment of Atrial Fibrillation (ORBIT-AF) Registry. Circulation. 2013;128:721–8. [PubMed: 23861512]
23. Albert NM, Yancy CW, Liang L, Zhao X, Hernandez AF, Peterson ED, Cannon CP, Fonarow GC. Use of Aldosterone Antagonists in Heart Failure. Jama. 2009;302:1658. [PubMed: 19843900]
24. Loring Z, Shrader P, Allen LA, Blanco R, Chan PS, Ezekowitz MD, Fonarow GC, Freeman JV, Gersh BJ, Mahaffey KW, Naccarelli GV, Pieper K, Reiffel JA, Singer DE, Steinberg BA, Thomas LE, Peterson ED, Piccini JP. Guideline-directed therapies for comorbidities and clinical outcomes among individuals with atrial fibrillation. Am Heart J. 2019;219:21–30. [PubMed: 31710841]
25. Fudim M, Liu PR, Shrader P, Blanco RG, Allen LA, Fonarow GC, Gersh BJ, Kowey PR, Mahaffey KW, Hylek E, Go AS, Thomas L, Peterson ED, Piccini JP. Mineralocorticoid Receptor Antagonism in Patients With Atrial Fibrillation: Findings From the ORBIT-AF (Outcomes Registry for Better Informed Treatment of Atrial Fibrillation) Registry. J Am Heart Assoc. 2018;7.
26. Eikelboom JW, Connolly SJ, Brueckmann M, Granger CB, Kappetein AP, Mack MJ, Blatchford J, Devenny K, Friedman J, Guiver K, Harper R, Khder Y, Lobmeyer MT, Maas H, Voigt J-U, Simoons ML, Werf FV de, Investigators R-A. Dabigatran versus warfarin in patients with mechanical heart valves. New Engl J Medicine. 2013;369:1206–14.

27. Kirchhof P, Benussi S, Kotecha D, Ahlsson A, Atar D, Casadei B, Castella M, Diener H-C, Heidbuchel H, Hendriks J, Hindricks G, Manolis AS, Oldgren J, Popescu BA, Schotten U, Putte BV, Vardas P, Agewall S, Camm J, Esquivias GB, Budts W, Carerj S, Casselman F, Coca A, Caterina RD, Deftereos S, Dobrev D, Ferro JM, Filippatos G, Fitzsimons D, Gorenek B, Guenoun M, Hohnloser SH, Kolh P, Lip GYH, Manolis A, McMurray J, Ponikowski P, Rosenhek R, Ruschitzka F, Savelieva I, Sharma S, Suwalski P, Tamargo JL, Taylor CJ, Gelder ICV, Voors AA, Windecker S, Zamorano JL, Zeppenfeld K. 2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS. Eur Heart J. 2016;37:2893–2962. [PubMed: 27567408]

28. January CT, Wann LS, Calkins H, Chen LY, Cigarroa JE, ClevelandJr JC, Ellinor PT, Ezekowitz MD, Field ME, Furie KL, Heidenreich PA, Murray KT, Shea JB, Tracy CM, Yancy CW. 2019 AHA/ACC/HRS Focused Update of the 2014 AHA/ACC/HRS Guideline for the Management of Patients With Atrial Fibrillation. Circulation. 2019;140:e125–e151. [PubMed: 30686041]

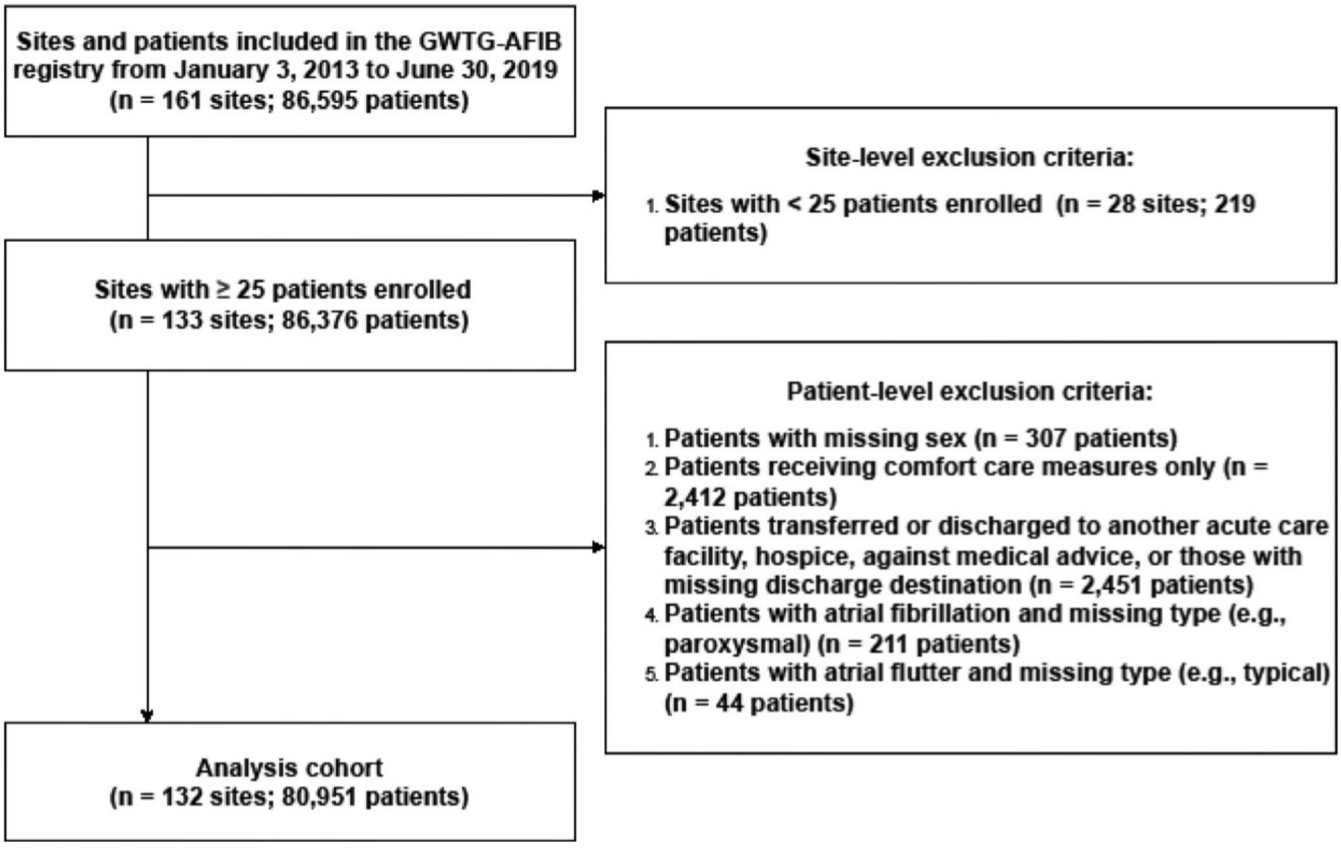

Figure 1: Cohort selection diagram

Inclusion and exclusion criteria used to select the final study population, consisting of 80, 951 patients enrolled at 132 unique participating sites. GWTG-AFIB: Get With The Guidelines - Atrial Fibrillation.

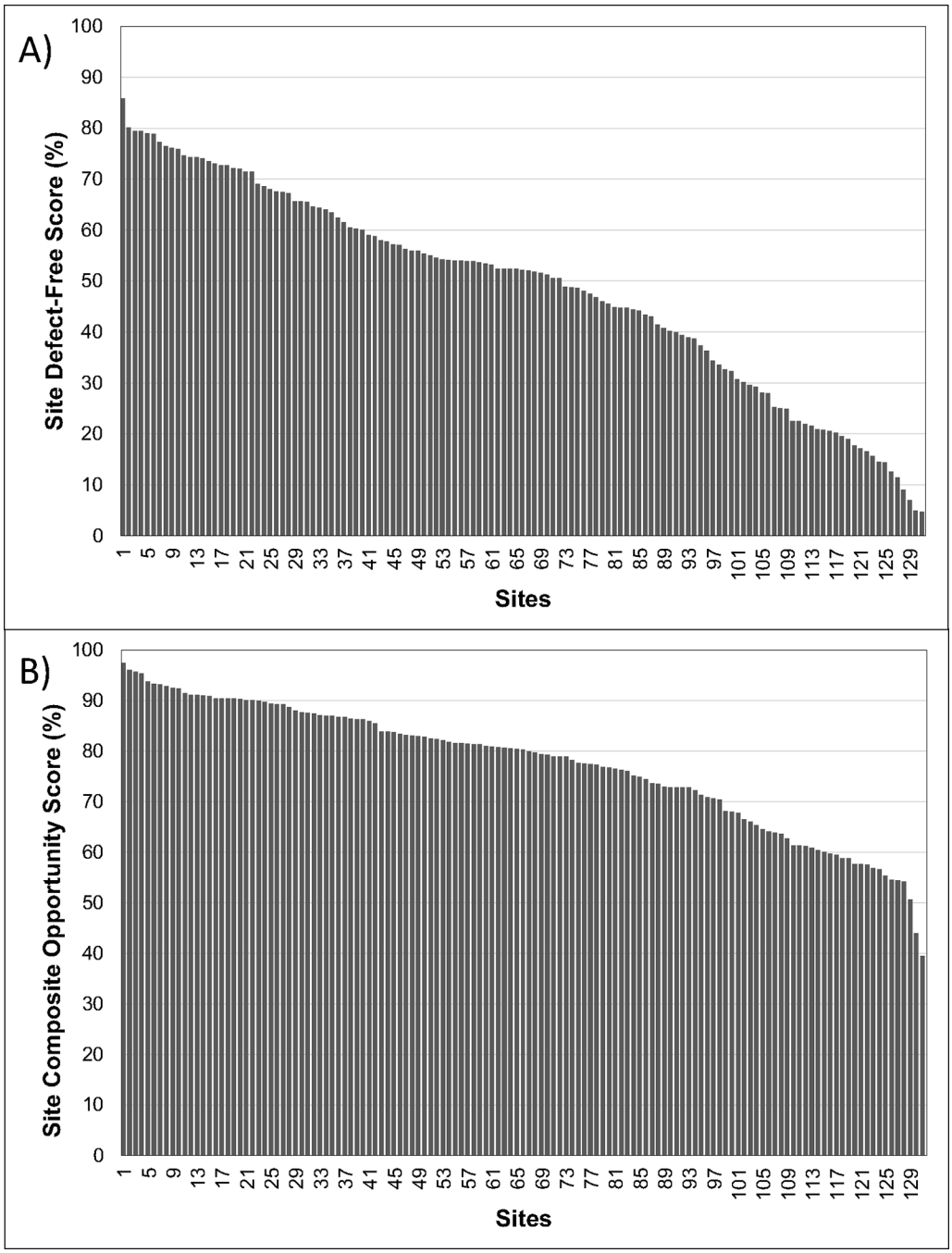

Figure 2: Site-level Variation in Defect-Free and Composite Opportunity Score

A) Sites' (n=132) defect-free scores of GWTG-AFIB achievement measures (median: 52.1, Quartile 1-Quartile 3: 32.7–64.4, Min-Max: 4.7–85.8), defined as the percentage of patients at a site with all eligible achievement measures attained. Sites ranked in descending order by defect-free score. B) Sites' (n=132) composite opportunity scores of GWTG-AFIB achievement measures (median: 80.3, Quartile 1-Quartile 3: 68.1–87.1, Min-Max: 39.4–

97.5), defined as the percentage of all eligible patient achievement measures attained at a site. Sites ranked in descending order by composite opportunity score.

Table 1:

GWTG-AFIB Achievement and Quality Measures and Patient-Level Attainment by Arrhythmia Type

Achievement Measures	**Overall (N=80,951)***	**AF (N=72,665)***	**AFL (N=8,286)***	**P-Value†**
AM1: ACE-I/ARB or ARNI Prescribed Prior to Discharge (When LVEF <40)	7,230 (72.9%)	6,287 (73.1%)	943 (72.0%)	0.43
AM2: Beta Blocker Prescribed Prior to Discharge (When LVEF <40)	9,341 (95.5%)	8,127 (95.5%)	1,214 (95.7%)	0.70
AM3: CHA_2DS_2-VASc Risk Score Documented Prior to Discharge	42,246 (66.8%)	37,950 (67.1%)	4,296 (63.6%)	<0.001
AM4: FDA Approved Anticoagulation Prescribed Prior to Discharge	53,504 (94.6%)	47,741 (94.6%)	5,763 (95.0%)	0.13
AM5: PT/INR Planned Follow-Up Documented Prior to Discharge for Warfarin Treatment	13,868 (88.4%)	12,388 (88.1%)	1,480 (91.0%)	<0.001
AM6: Statin at Discharge in AF Patients with CAD, CVA/TIA, PVD, or Diabetes	28,357 (79.3%)	25,220 (79.1%)	3,137 (81.5%)	<0.001
Quality Measures				
QM1: Aldosterone Antagonist Prescribed Prior to Discharge (When LVEF <35)	2,356 (29.3%)	2,081 (29.7%)	275 (26.4%)	0.028
QM2: Anticoagulation Therapy Education	42,822 (72.8%)	38,086 (72.7%)	4,736 (74.2%)	0.008
QM3: AF Patient Education	53,454 (68.1%)	47,929 (68.0%)	5,525 (68.8%)	0.11
QM4: Discharge Heart Rate ≤ 110 bpm	72,214 (98.9%)	64,757 (98.9%)	7,457 (98.7%)	0.042
QM5: Smoking Cessation Advice or Counseling	6,985 (89.1%)	6,020 (89.0%)	965 (89.5%)	0.62
QM6: Warfarin at Discharge for Valvular AF or AFL Patients	1,751 (69.7%)	1,443 (69.2%)	308 (72.3%)	0.21
QM7: Avoidance of Inappropriate Prescription of Antiarrhythmic Drugs to Patients with Permanent AF‡	10,229 (65.3%)	10,229 (65.3%)	-	-
QM8: Avoidance of Inappropriate Prescription of Dofetilide or Sotalol to Patients with ESRD or on Dialysis	1,381 (93.2%)	1,218 (93.1%)	163 (94.2%)	0.59
QM9: Avoidance of Inappropriate Prescription of Direct Thrombin or Factor Xa inhibitor to Patients with a Mechanical Heart Valve	1,182 (86.6%)	962 (86.1%)	220 (88.7%)	0.28
QM10: Avoidance of Inappropriate Prescription of Antiplatelet and Oral Anticoagulation Therapy to Patients without CAD, CVA/TIA, PVD	36,916 (81.3%)	33,334 (81.7%)	3,582 (77.4%)	<0.001
QM11: Avoidance of Inappropriate Prescription of Nondihydropyridine Calcium Channel Antagonist (When LVEF <40)	9,192 (87.2%)	7,968 (86.9%)	1,224 (88.8%)	0.061
Overall Scores				
Composite Opportunity Score§ (mean±SD)	80.2%±29.0%	80.3%±29.0%	79.2%±29.0%	<0.001
Defect-Free Score‖	43,639 (60.0%)	39,330 (60.4%)	4,309 (57.0%)	<0.001

ACE-I: angiotensin-converting enzyme inhibitor, AF: atrial fibrillation, AFL: atrial flutter, AM: achievement measure, ARB: angiotensin receptor blocker, ARNI: angiotensin receptor-neprilysin inhibitors, CAD: coronary artery disease, CVA: cerebrovascular accident, ESRD: end-stage renal disease, FDA: US Food & Drug Administration, INR: international normalized ratio, LVEF: left ventricular ejection fraction, PT: prothrombin time, PVD: peripheral vascular disease, QM: Quality measure.

*Not all patients eligible for each measure. Percentages calculated from eligible denominators.

†AF and AFL groups compared using Pearson's chi-squared tests for categorical variables and Wilcoxon-rank sum test for continuous variables.

‡ Antiarrhythmic drugs avoided in 91.9% of eligible patients without persistent AF (i.e., permanent or long-standing persistent only). Amiodarone was not considered an inappropriate antiarrhythmic.

§ Percentage of all eligible achievement measures (AM1-AM6) attained

// Patients who attained all eligible achievement measures (AM1-AM6)

Table 2:

Baseline Characteristics by Sites' Defect-Free Score Quartile

Demographics	**Overall (N=80951)**	**Quartile 1 (N=20034)**	**Quartile 2 (N=20693)**	**Quartile 3 (N=20005)**	**Quartile 4 (N=20219)**	**P-Value***
Age, years (mean±SD)	69.9±13.2	70.3±13.1	69.7±13.5	71.3±13.0	68.1±12.9	<0.001
Female	38,028 (47.0%)	9,552 (47.7%)	9,893 (47.8%)	9,340 (46.7%)	9,243 (45.7%)	<0.001
Race/Ethnicity						<0.001
White	66,695 (83.9%)	16,557 (86.3%)	15,935 (78.8%)	17,296 (86.9%)	16,907 (83.6%)	
Black	5,697 (7.2%)	1,080 (5.6%)	1,330 (6.6%)	1,185 (6.0%)	2,102 (10.4%)	
Hispanic	4,258 (5.4%)	808 (4.2%)	2,012 (10.0%)	672 (3.4%)	766 (3.8%)	
AF History						
CHA_2DS_2-VASc score (mean±SD)	3.6±1.8	3.7±1.8	3.6±1.9	3.7±1.8	3.5±1.8	<0.001
Labile INR	1,880 (2.8%)	417 (2.8%)	272 (1.6%)	794 (5.1%)	397 (2.1%)	0.054
AF Type						
First Detected AF	14,323 (19.7%)	3,670 (20.5%)	3,637 (19.9%)	3,643 (19.8%)	3,373 (18.7%)	<0.001
Paroxysmal AF	31,242 (43.0%)	7,308 (40.8%)	7,909 (43.2%)	7,743 (42.1%)	8,282 (45.9%)	
Persistent AF	13,446 (18.5%)	2,532 (14.1%)	2,980 (16.3%)	3,277 (17.8%)	4,657 (25.8%)	
Permanent/Long-Standing Persistent AF	5,319 (7.3%)	1,234 (6.9%)	1,185 (6.5%)	2,124 (11.6%)	776 (4.3%)	
Unable to Determine	8,335 (11.5%)	3,181 (17.7%)	2,595 (14.2%)	1,597 (8.7%)	962 (5.3%)	
AFL Type						
Typical AFL	2,869 (34.6%)	705 (33.4%)	734 (30.7%)	574 (35.4%)	856 (39.5%)	<0.001
Atypical AFL	1,289 (15.6%)	256 (12.1%)	318 (13.3%)	196 (12.1%)	519 (23.9%)	
Unable to Determine	4,128 (49.8%)	1,148 (54.4%)	1,335 (55.9%)	851 (52.5%)	794 (36.6%)	
Prior AF Procedures						
Cardioversion	17,480 (23.2%)	3,603 (20.5%)	4,325 (23.1%)	3,567 (19.1%)	5,985 (29.6%)	<0.001
Ablation	9,541 (12.7%)	1,938 (11.0%)	2,632 (14.1%)	1,953 (10.4%)	3,018 (14.9%)	<0.001
AF Procedures (Current Encounter)						
Cardioversion	25,075 (32.8%)	6,470 (33.2%)	6,137 (31.7%)	4,876 (26.2%)	7,592 (40.3%)	<0.001
AF Ablation	9,901 (13.0%)	1,753 (9.0%)	2,362 (12.2%)	2,503 (13.4%)	3,283 (17.4%)	<0.001
AFL Ablation	4,522 (5.9%)	974 (5.0%)	1,409 (7.3%)	982 (5.3%)	1,157 (6.1%)	0.045
Medical History						
COPD	13,425 (16.6%)	3,412 (17.0%)	3,426 (16.6%)	3,454 (17.3%)	3,133 (15.6%)	0.002

Demographics	**Overall (N=80951)**	**Quartile 1 (N=20034)**	**Quartile 2 (N=20693)**	**Quartile 3 (N=20005)**	**Quartile 4 (N=20219)**	**P-Value***
CAD	22,430 (27.8%)	5,569 (27.8%)	5,534 (26.8%)	5,856 (29.3%)	5,471 (27.2%)	0.64
CKD Stage III or Greater (eGFR <60†)	27,797 (38.6%)	6,709 (39.8%)	6,828 (38.9%)	7,312 (40.2%)	6,948 (35.8%)	<0.001
Diabetes	22,281 (27.6%)	5,386 (26.9%)	5,880 (28.5%)	5,615 (28.1%)	5,400 (26.8%)	0.67
Dialysis	1,180 (1.5%)	235 (1.2%)	418 (2.0%)	155 (0.8%)	372 (1.8%)	0.046
Heart Failure	21,361 (26.4%)	4,922 (24.6%)	5,460 (26.4%)	5,035 (25.2%)	5,944 (29.5%)	<0.001
LVEF < 40	10,685 (14.5%)	2,662 (14.9%)	2,630 (14.2%)	2,456 (14.1%)	2,937 (15.0%)	0.79
Hypertension	60,828 (75.3%)	14,820 (74.0%)	15,617 (75.6%)	14,983 (74.9%)	15,408 (76.5%)	<0.001
Obstructive Sleep Apnea	14,178 (17.5%)	3,219 (16.1%)	3,195 (15.5%)	3,119 (15.6%)	4,645 (23.1%)	<0.001
Peripheral Vascular Disease	4,683 (5.8%)	1,212 (6.1%)	1,278 (6.2%)	1,228 (6.1%)	965 (4.8%)	<0.001
Prior Major Bleeding	7,713 (11.5%)	1,786 (11.9%)	2,473 (15.4%)	1,324 (7.8%)	2,130 (11.0%)	<0.001
Prior MI	7,731 (9.6%)	1,937 (9.7%)	1,844 (8.9%)	1,868 (9.3%)	2,082 (10.3%)	0.009
Prior PCI	8,910 (11.0%)	2,448 (12.2%)	2,370 (11.5%)	1,886 (9.4%)	2,206 (11.0%)	<0.001
Prior Stroke or TIA	10,373 (12.8%)	2,432 (12.1%)	2,558 (12.4%)	2,763 (13.8%)	2,620 (13.0%)	<0.001
Smoker (current)	8,062 (10.0%)	2,078 (10.4%)	1,968 (9.5%)	1,809 (9.0%)	2,207 (11.0%)	0.17
Patient Insurance						
Private/HMO/Other	30,012 (43.6%)	6,486 (40.3%)	9,979 (56.0%)	6,303 (38.6%)	7,244 (39.0%)	<0.001
Medicaid	7,102 (10.3%)	1,278 (7.9%)	1,755 (9.8%)	1,556 (9.5%)	2,513 (13.5%)	
Medicare	15,494 (22.5%)	4,145 (25.8%)	3,056 (17.1%)	4,378 (26.8%)	3,915 (21.1%)	
Medicare through Private/HMO/Other	14,657 (21.3%)	3,925 (24.4%)	2,402 (13.5%)	3,772 (23.1%)	4,558 (24.5%)	
Hospital Characteristics						
Academic/Teaching Hospital	59,518 (86.3%)	10,461 (72.1%)	16,730 (92.7%)	13,410 (82.2%)	18,917 (94.2%)	<0.001
Rural Location	5,582 (8.1%)	780 (5.4%)	881 (4.9%)	3,921 (24.0%)	0 (0.0%)	<0.001
Hospital Size (Beds)						
25–49	38 (0.1%)	0 (0.0%)	0 (0.0%)	38 (0.2%)	0 (0.0%)	<0.001
50–99	1,048 (1.5%)	167 (1.2%)	881 (4.9%)	0 (0.0%)	0 (0.0%)	
100–199	8,937 (13.0%)	1,149 (7.9%)	427 (2.4%)	5,270 (32.3%)	2,091 (10.4%)	
200–299	9,961 (14.4%)	3,187 (22.0%)	1,268 (7.0%)	2,909 (17.8%)	2,597 (12.9%)	
300–399	9,679 (14.0%)	3,049 (21.0%)	2,754 (15.3%)	0 (0.0%)	3,876 (19.3%)	
400–499	9,484 (13.8%)	1,913 (13.2%)	4,087 (22.7%)	2,902 (17.8%)	582 (2.9%)	
500+	29,794 (43.2%)	5,038 (34.7%)	8,621 (47.8%)	5,198 (31.9%)	10,937 (54.5%)	

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Demographics	Overall (N=80951)	Quartile 1 (N=20034)	Quartile 2 (N=20693)	Quartile 3 (N=20005)	Quartile 4 (N=20219)	P-Value*
Admission Year ‡						
2013	529	116 (21.9%)	232 (43.9%)	4 (0.8%)	177 (33.5%)	<0.001
2014	4,466	984 (22.0%)	1,896 (42.5%)	1,111 (24.9%)	475 (10.6%)	
2015	11,040	2,624 (23.8%)	3,411 (30.9%)	3,049 (27.6%)	1,956 (17.7%)	
2016	15,630	3,808 (24.4%)	3,947 (25.3%)	3,687 (23.6%)	4,188 (26.8%)	
2017	19,308	5,492 (28.4%)	4,410 (22.8%)	4,246 (22.0%)	5,160 (26.7%)	
2018	20,970	4,912 (23.4%)	5,066 (24.2%)	5,028 (24.0%)	5,964 (28.4%)	
2019	9,008	2,098 (23.3%)	1,731 (19.2%)	2,880 (32.0%)	2,299 (25.5%)	

Values are written as mean±SD or n (%). AF: atrial fibrillation, AFL: atrial flutter, CAD: coronary artery disease, CKD: chronic kidney disease, COPD: chronic obstructive pulmonary disease, eGFR: estimate glomerular filtration rate, HMO: health maintenance organization, INR: internal normalized ratio, LVEF: left ventricle ejection fraction, MI: myocardial infarction, PCI: percutaneous coronary intervention, TIA: transient ischemic attack.

* Tested for trend as a monotone association across defect-free score quartiles using 1) Cochran-Mantel-Haenszel Statistics based on rank score were used for categorical variables and 2) the Jonckheere-Terpstra test for continuous/ordinal variables.

† Units are measured in mL/min per 1.73 m^2

‡ Row percentages are reported