

Racial Differences in the Prevalence and Outcomes of Atrial Fibrillation Among Patients Hospitalized With Heart Failure

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Background—The intersection of heart failure (HF) and atrial fibrillation (AF) is common, but the burden of AF among black patients with HF is poorly characterized. We sought to determine the prevalence of AF, characteristics, in-hospital outcomes, and warfarin use associated with AF in patients hospitalized with HF as a function of race.

Methods and Results—We analyzed data on 135 494 hospitalizations from January 2006 through January 2012 at 276 hospitals participating in the American Heart Association's Get With The Guidelines HF Program. Multivariable logistic regression models using generalized estimating equations approach for risk-adjusted comparison of AF prevalence, in-hospital outcomes, and warfarin use. In this HF population, 53 389 (39.4%) had AF. Black patients had markedly less AF than white patients (20.8% versus 44.8%, $P<0.001$). Adjusting for risk factors and hospital characteristics, black race was associated with significantly lower odds of AF (adjusted odds ratio 0.52, 95% CI 0.48 to 0.55, $P<0.0001$). There were no racial differences in in-hospital mortality; however, black patients had a longer length of stay relative to white patients. Black patients compared with white patients with AF were less likely to be discharged on warfarin (adjusted odds ratio 0.76, 95% CI 0.69 to 0.85, $P<0.001$).

Conclusions—Despite having many risk factors for AF, black patients, relative to white patients hospitalized for HF, had a lower prevalence of AF and lower prescription of guideline-recommended warfarin therapy. (*J Am Heart Assoc.* 2013;2:e000200 doi: 10.1161/JAHA.113.000200)

Key Words: anticoagulation • atrial fibrillation • heart failure • racial disparity • risk factors

Atrial fibrillation (AF) is the most common sustained arrhythmia in the United States with a prevalence of 2.7 to 6.1 million in 2010 and is expected to rise to between 5.6 and 12 million in 2050.¹ Similarly, heart failure (HF) is a burgeoning epidemic that currently affects ≈6.6 million US adults with an expected 25% increase in prevalence by 2030.¹ The intersection of AF and HF is an intricate pathophysiologic imbalance that results in worse morbidity and mortality than either separately. The black population has the highest risk of developing HF and, when present, has an earlier diagnosis and more often leads to hospitalization.² Despite a higher or similar occurrence of established risk factors associated with

the development of AF, studies have suggested a lower prevalence of AF in black patients relative to white patients.^{3–5} Less is known regarding the racial prevalence and outcomes of AF in patients with HF.

The goal of this study was 3-fold: in patients hospitalized with HF, (1) determine whether the prevalence of AF was lower in black patients compared with white patients and to evaluate racial differences in characteristics among those with AF, (2) evaluate the effect of race on in-hospital mortality and length of stay (LOS), and (3) assess the prescription of guideline-recommended warfarin therapy for eligible patients hospitalized with AF and HF as a function of race.

Methods

Get With The Guidelines-Heart Failure (GWTG-HF) is a voluntary registry- and hospital-based performance-improvement program for patients hospitalized with HF, and it has been previously described.^{6–8} Patients hospitalized with new or worsening HF as primary diagnosis or patients who developed significant HF symptoms such that HF was the primary discharge diagnosis were included. Patients were enrolled into the program regardless of their left ventricular function. Hospitals participating in this registry use a

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Web-based, point-of-care, patient management tool (PMT; Outcome Sciences Inc) to collect and submit clinical information on patients' in-hospital care and outcomes. Outcome Sciences, Inc serves as the data collection (through PMT) and coordination center for GWTG. The Duke Clinical Research Institute (DCRI) serves as the data analysis center and has an agreement to analyze the aggregate deidentified data for research purposes.

Trained personnel at participating sites abstract data on consecutive eligible patients using standardized definitions for all data fields and submit these data to the GWTG database. Using methodology similar to other national cardiovascular registries and randomized trials, race and ethnicity were collected for the purpose of evaluating subgroup differences. Admission and/or medical staff recorded race/ethnicity, usually as the patient was registered. Patients were assigned to race and ethnicity categories using options defined by the case report forms as follows: race—American Indian or Alaska Native, Asian, black or African American, Native Hawaiian or Pacific Islander, white, or unable to be determined; and ethnicity—Hispanic, yes, no, or unable to be determined.

All participating institutions were required to comply with local regulatory and privacy guidelines and to obtain approval from their institutional review board. Because data were used primarily at the local site for quality improvement, sites were granted a waiver of informed consent under the common rule. Computerized edit checks are performed and data quality monitored to ensure completeness and accuracy of reported data. Data included in GWTG-HF were demographic and clinical characteristics, comorbidities, previous therapies and procedures, contraindications to evidence-based therapies, LOS, and in-hospital procedures and outcomes.

Data collection on rhythm status for this analysis included the following definitions: preexisting AF (had a prior history of AF) and new diagnosis (diagnosis of AF at hospital presentation or during hospitalization and did not have a prior history of AF). Either of the above was characterized as "AF" for the purposes of this analysis.

Study Population

From January 1, 2006, through January 13, 2012, we identified 164 044 patients from 286 hospitals in the GWTG-HF database. We excluded 5815 (3.5%) with missing information on AF history and diagnosis, 11 731 (7.2%) of Hispanic ethnicity, 4480 (2.7%) with no data on race, and 6524 (4.0%) with race other than black or white. For the purpose of this analysis, we included only patients who were recorded as non-Hispanic black (black) and non-Hispanic white (white). The final overall population included 135 494 patients from 276 hospitals. Among the 135 494 patients, we identified 53 389 patients with AF who were ultimately used

for comparing in-hospital mortality, LOS, and the prescription of warfarin at discharge by race.

Outcome Measures

The principal objective of the study was to assess AF prevalence and patient characteristics among black and white patients with AF hospitalized for HF. The outcomes of interest in the primary analyses included in-hospital mortality, LOS, and warfarin use at discharge in eligible patients with AF without documented contraindications or intolerance as a function of race. To determine the association between magnitude of stroke risk and warfarin use, patients were stratified by CHADS₂ (congestive heart failure, hypertension, age >75, diabetes mellitus, and prior stroke or transient ischemic attack) score.

Statistical Analysis

Sociodemographic factors, clinical variables, and hospital characteristics were compared between blacks and whites using Pearson χ^2 test for categorical variables and Wilcoxon rank sum test for continuous variables. Categorical and continuous variables were reported in percentages and median (25th and 75th percentiles) as appropriate. A multivariable logistic regression analysis was performed to examine independent predictors of AF in patients hospitalized for HF. Generalized estimating equations approach was used to account for clustering of patients within hospitals.⁹ Additionally, multivariable regression analyses using generalized estimating equations were performed in patients with AF to assess the relationships between race and the following outcomes: in-hospital mortality, LOS, and warfarin use at discharge. In the analyses, the type of AF (preexisting versus new diagnosis) and its interaction with race were tested to evaluate whether the relationship between race and outcomes differs across patients with preexisting AF and new diagnosis AF. Since there was no significant interaction between race and AF type (new diagnosis or preexisting), the relationship between race and outcomes was reported among all patients with AF inclusive of new diagnosis and preexisting patients. For anticoagulation, the analysis also adjusted for CHADS₂ risk stratification score to eliminate the influence of CHADS₂ score on the relationship between race and warfarin use. The analysis of warfarin at discharge included those individuals with appropriate eligibility. The following contraindications to warfarin use led to exclusion: allergy to warfarin, pregnancy, excess bleeding risk, excess fall risk, other medical contraindications, or patient reasons. We tested the interaction of race and gender on the prescription of warfarin at discharge based on prior analyses suggesting women with AF were less likely to receive oral anticoagulation for stroke prophylaxis. For LOS, log transformation was performed first because LOS

had a heavily rightward-skewed distribution, and then regression analysis was conducted for the log-transformed time variable that had an approximate normal distribution. Therefore, an exponentiation was performed to the estimates of race effect from the model and ratio of LOS between black and white race was reported. These multivariable analyses were adjusted for patient and hospital characteristics that may have affected the association of race with outcomes. Patient-level variables included demographics (age, gender), insurance status (Medicare, Medicaid, other including Veterans Administration, health maintenance organization, etc, and no insurance), medical history (chronic obstructive pulmonary disease [COPD] or asthma, diabetes, hyperlipidemia, hypertension, peripheral vascular disease [PVD], coronary artery disease [CAD], prior myocardial infarction [MI], presence of valvular heart disease [VHD], prior percutaneous coronary intervention [PCI], prior coronary artery bypass graft surgery, stroke or transient ischemic attack [TIA], anemia, implantable cardioverter-defibrillator [ICD] or pacemaker placement, end-stage renal disease, chronic renal insufficiency, depression, cigarette smoking in the past 12 months), HF etiology (ischemic or nonischemic), and admission vital signs (heart rate and systolic blood pressure [BP]). Hospital characteristics included in the models were number of beds, academic center and/or staffing by residents, and region of the country (midwest, northeast, west, and south). The confounder variables had less than 5% missing, and thus a simple imputation was done to replace the missing with the median value for a continuous variable and the dominant category for a categorical variable.

All *P* values were based on 2-sided tests and $\alpha=0.05$ was used to establish statistical significance of tests. We used SAS software version 9.2 (SAS Institute Inc, Cary, NC). All authors had access to the data and assume responsibility for the accuracy of the analysis.

Results

Baseline Characteristics of Patients Hospitalized for HF

Of the 135 494 patients hospitalized with HF in this analysis, 53 389 (39.4%) had AF. As shown in Table 1, compared with white patients with AF, black patients with AF were younger, had higher body mass index (BMI), and had similar gender distribution. Black patients with AF had a higher prevalence of hypertension, diabetes mellitus, COPD or asthma, HF, smoking, anemia, renal insufficiency, or dialysis dependence, relative to white patients. Black patients with AF were more likely to have a history of stroke or TIA. Conversely, proportionate to white patients, black patients with AF had less CAD or prior MI, PVD, and VHD. At admission, black

patients had higher heart rates, and BP but similar brain natriuretic peptide (BNP) levels relative to white patients. Black patients had a significantly lower median left ventricular ejection fraction (LVEF) (35% versus 45%) and a greater proportion with LVEF <40% (54% versus 38%, $P<0.0001$). Black patients with AF were slightly more likely than white patients to undergo cardioversion during their hospitalization (2.9% versus 2.4%, $P=0.05$). Black patients without AF (23 989) differed from black patients with AF (6301). Notably, black patients without AF were younger, had a higher prevalence of diabetes, but had less CAD or prior MI, HF, VHD, COPD, or asthma and had fewer strokes or TIAs. At admission, black patients without AF had higher median heart rates (87 versus 83 bpm), systolic (148 versus 135 mm Hg) and diastolic (84 versus 78 mm Hg) BP, and higher BNP levels (Table 1). Similar to the comparison of black patients with and without AF, white patients with AF differed from those without AF most pronounced in the younger age of those without AF.

In the study population, 20.8% of black patients and 44.8% of white patients had AF. In a multivariable analysis of all patients hospitalized for HF, adjusting for patient factors (age, gender, type of insurance, past medical history of COPD or asthma, diabetes mellitus, hyperlipidemia, hypertension, PVD, prior stroke/TIA, ICD, prior HF, anemia, pacemaker, dialysis, renal insufficiency, depression ischemic heart disease, smoking history, systolic BP, and heart rate on admission) and hospital characteristics (region, bed size, and teaching/resident status), black patients had a lower odds of AF compared to white patients (adjusted odds ratio [aOR] 0.52, 95% CI 0.48 to 0.55) (Table 2). Age was a strong predictor of AF in the multivariable model, and black patients were considerably younger than white patients. Thus, to further examine the effect of age on the lower prevalence of AF in black patients, we performed an age-stratified analysis of AF prevalence in black patients compared with white patients. At every age group, black patients had a significantly lower prevalence of AF relative to white patients (Appendix A).

Hospital Outcomes and Warfarin Use Among Patients Hospitalized for HF

After adjusting for patient and hospital factors, black race was not significantly associated with lower in-hospital mortality (aOR 0.79, 95% CI 0.61 to 1.02, $P=0.08$). However, black race was associated with a longer LOS (aOR 1.04, 95% CI 1.01 to 1.07, $P=0.007$) (Table 3). Among eligible patients with AF hospitalized for HF and no contraindication to warfarin therapy (pregnancy, excess bleeding or fall risk, allergy to warfarin, or other documented contraindications), 68.6% were discharged on warfarin. Adjusting for patient and hospital factors, black patients were less likely to be prescribed warfarin at discharge (aOR 0.76, 95% CI 0.69 to 0.85, $P<0.0001$)

Table 1. Patient and Hospital Characteristics

Variable	White Patients With AF (47 088)	Black Patients With AF (6301)	P Value*	Black Patients Without AF (23 989)	P Value†	White Patients Without AF (58 116)	P Value‡
Age, y	80.0 (72.0, 86.0)	69.0 (58.0, 79.0)	<0.001	60.0 (50.0, 72.0)	<0.001	75 (64, 84)	<0.001
Male	49.9	51.2	0.136	50.9	0.816	48.6	<0.001
Insurance			<0.001		<0.001		<0.001
No insurance/ not documented/unknown	1.2	4.6		10.5		3.3	
Medicare	68.2	49.4		36.8		59.6	
Medicaid	4.2	20.8		21.9		6.9	
Other	25.2	21.7		25.5		27.9	
BMI, [§] kg/m ²	27 (23, 32)	29 (24, 36)	<0.001	29 (24, 36)	0.418	28 (23, 34)	<0.001
EF, %	45 (30, 55)	35 (20, 53)	<0.001	31 (20, 52)	0.025	40 (25, 55)	<0.001
EF <40%	38.4	54.5	<0.001	57.1	<0.001	44.4	<0.001
Medical history of							
Anemia	20.3	21.5	0.024	16.9	<0.001	18.4	<0.001
Atrial flutter	3.5	6.4	<0.001	1.3	<0.001	1.2	<0.001
CAD	52.0	37.8	<0.001	33.8	<0.001	52.5	0.111
COPD or asthma	31.6	33.1	0.020	27.7	<0.001	30.6	<0.001
CVA/TIA	16.9	19.1	<0.001	12.6	<0.001	13.6	<0.001
Diabetes	36.6	42.6	<0.001	45.8	<0.001	43.3	<0.001
Heart failure	69.5	75.9	<0.001	64.4	<0.001	59.7	<0.001
Hyperlipidemia	46.7	43.6	<0.001	37.4	<0.001	47.0	0.363
Hypertension	72.7	83.2	<0.001	83.5	0.608	72.9	0.583
ICD	10.8	19.1	<0.001	13.2	<0.001	9.3	<0.001
IHD	60.7	46.2	<0.001	40.3	<0.001	61.8	<0.001
Pacemaker	20.5	15.2	<0.001	6.8	<0.001	11.3	<0.001
PVD	13.6	9.3	<0.001	7.5	<0.001	13.8	0.530
Prior CABG	19.0	9.3	<0.001	6.6	<0.001	16.3	<0.001
Prior MI	20.1	16.5	<0.001	14.2	<0.001	23.1	<0.001
Prior PCI	11.5	7.5	<0.001	6.8	0.062	12.5	<0.001
Renal insufficiency	21.1	24.5	<0.001	23.8	0.228	20.8	0.250
Smoking	9.6	19.6	<0.001	30.2	<0.001	18.0	<0.001
Valvular heart disease	20.2	16.9	<0.001	8.2	<0.001	12.0	<0.001
Vital signs and laboratory data at admission							
Heart rate, bpm	81 (70, 97)	83 (71, 100)	<0.001	87 (75, 100)	<0.001	81 (70, 95)	<0.001
Systolic blood pressure, mm Hg	132 (115, 151)	135 (116, 156)	<0.001	148 (125 to 172)	<0.001	139 (119, 160)	<0.001
Diastolic blood pressure, mm Hg	72 (62, 84)	78 (67, 91)	<0.001	84 (72 to 99)	<0.001	73 (63, 85)	<0.001
BNP, [‡] pg/mL	726 (374, 1390)	758 (287, 1699)	0.582	956 (374 to 2100)	<0.001	862 (404, 1759)	<0.001
Hemoglobin, [‡] g/dL	11.8 (10.5, 13.2)	11.7 (10.3, 13.1)	<0.001	11.9 (10.4 to 13.4)	<0.001	11.9 (10.5, 13)	<0.001
Sodium, [‡] mEq/L	138 (135, 140)	139 (136, 141)	<0.001	139 (136 to 141)	0.334	138 (135, 140)	<0.001
Creatinine, [‡] mg/dL	1.3 (1.0, 1.8)	1.4 (1.1, 2.0)	<0.001	1.4 (1.1 to 2.1)	0.631	1.3 (1.0, 1.8)	0.611
Blood urea nitrogen, [‡] mg/dL	27 (19, 40)	24 (17, 38)	<0.001	22 (15, 35)	<0.001	25 (17, 38)	<0.001

Continued

Table 1 Continued

Variable	White Patients With AF (47 088)	Black Patients With AF (6301)	P Value*	Black Patients Without AF (23 989)	P Value†	White Patients Without AF (58 116)	P Value‡
In-hospital procedures							
Cardioversion	2.4	2.9	0.053	0.3	<0.001	0.3	<0.001
Pacemaker	1.1	0.6	<0.001	0.4	0.049	0.6	<0.001
ICD implantation	2.4	2.7	0.180	3.6	0.001	4.0	<0.001
PCI or PCI with stent	1.0	0.5	<0.001	1.1	<0.001	1.6	<0.001
Hospital characteristics							
Hospital bed size	375 (243 to 581)	472 (342 to 617)	<0.001	470 (330 to 617)	<0.001	372 (240, 575)	<0.001
Trainees [¶]	53.8	61.8	<0.001	63.4	<0.001	51.0	<0.001
Academic hospital ^{¶¶}	55.5	80.8	<0.001	76.7	<0.001	52.3	<0.001
Region			<0.001		<0.001		<0.001
West	11.8	4.9		5.5		12.7	
South	23.9	29.0		34.9		29.0	
Midwest	26.7	22.5		21.8		26.2	
Northeast	37.7	43.5		37.8		32.2	

Values are presented as % or median (25th, 75th percentiles). P values are based on Pearson χ^2 tests for all categorical row variables. AF indicates atrial fibrillation; BMI, body mass index; BNP, brain natriuretic peptide; CABG, coronary artery bypass graft surgery; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; CVA, cerebrovascular accident; EF, ejection fraction; ICD, implantable cardioverter-defibrillator; IHD, ischemic heart disease; PCI, percutaneous intervention; PVD, peripheral vascular disease; TIA, transient ischemic attack.

*P value comparing black and white patients with AF.

**P value comparing black patients with and without AF.

***P value comparing white patients with and without AF.

†23% missing data.

‡Laboratory values had missing data between 21% and 36%.

¶14.8% missing data.

¶¶11.8% missing data.

(Table 3). We assessed the interaction between race and gender and its effect on warfarin use at discharge. The interaction between race and gender was significant (aOR 1.17, 95% CI 1.02 to 1.35, $P=0.02$), driven by white men having a greater odds of warfarin prescription at discharge relative to white women. Both black men and women hospitalized for HF with AF were less likely to be discharged on warfarin than were their white counterparts (women: aOR 0.83, 95% CI 0.74 to 0.93; men: aOR 0.71, 95% CI 0.62 to 0.80).

Warfarin Use and Risk Stratification in Patients Hospitalized for HF

The American College of Cardiology (ACC)/American Heart Association (AHA)/Physician Consortium AF and Atrial Flutter Performance Measures¹⁰ call for assessment and documentation of thromboembolic risk factors. Thus, we examined the relationship between risk factors for stroke and prescription of warfarin at discharge using the CHADS₂ scheme.¹¹ The mean CHADS₂ score for the overall AF population was 3.1. Black patients (2.96) had a statistically significant but not clinically relevant lower mean CHADS₂ score than white patients (3.07, $P<0.0001$) hospitalized with HF. Ninety-four percent of white patients and 93% of black patients had a

CHADS₂ score ≥ 2 . Adjusting for CHADS₂ score and patient and hospital factors, black patients were less likely than white patients to be prescribed warfarin at discharge (aOR 0.76, 95% CI 0.69 to 0.85, $P<0.0001$). The higher prescription of warfarin at discharge was present and significant in patients with CHADS₂ scores 1 to 5 (Table 4). As seen in Figure 1, among white patients, there was a risk treatment mismatch in that higher CHADS₂ score was associated with lower prescription of warfarin at discharge. This mismatch was not as evident in black patients.

Combination Warfarin/Antiplatelet Therapy

In patients hospitalized for HF with AF, 16% of black and 14% of white individuals were discharged on aspirin. Triple therapy with aspirin, clopidogrel, and warfarin was infrequent and did not vary according to race. Overall, 10% of patients hospitalized for HF with AF were discharged without aspirin, clopidogrel, or warfarin (Figure 2).

Discussion

Using GWTG-HF, a large, national, multicenter clinical practice registry of patients hospitalized with HF, we examined racial

Table 2. Characteristics Associated With Atrial Fibrillation

Characteristic	OR (95% CI)	P value
Age (per 10-y increase)	1.40 (1.38 to 1.42)	<0.001
Sex (female vs male)	0.82 (0.79 to 0.85)	<0.001
Race (black vs white)	0.52 (0.48 to 0.55)	<0.001
Medical history		
Anemia	1.00 (0.97 to 1.03)	0.895
CVA/TIA	1.26 (1.20 to 1.32)	<0.001
Depression	0.96 (0.92 to 1.00)	0.078
Diabetes	0.87 (0.84 to 0.89)	<0.001
Dialysis	0.77 (0.71 to 0.84)	<0.001
Heart failure	1.43 (1.38 to 1.48)	<0.001
Hyperlipidemia	1.00 (0.97 to 1.04)	0.767
Hypertension	1.02 (0.98 to 1.06)	0.337
ICD	1.11 (1.05 to 1.18)	<0.001
Ischemic heart disease	0.85 (0.82 to 0.88)	<0.001
Pacemaker	1.70 (1.63 to 1.78)	<0.001
Peripheral vascular disease	0.96 (0.93 to 1.00)	0.046
Pulmonary	1.15 (1.10 to 1.19)	<0.001
Renal insufficiency	0.96 (0.92 to 1.00)	0.080
Smoker	0.69 (0.67 to 0.72)	<0.001
Vital signs		
Heart rate at admission (per 10-unit increase)	1.10 (1.09 to 1.11)	<0.001
Systolic BP at admission (per 10-unit increase)	0.92 (0.92 to 0.93)	<0.001
Hospital variables		
Hospital bed size (per 500 units)	1.16 (1.04 to 1.29)	0.006
Hospital teaching/residents	1.07 (0.97 to 1.18)	0.157
Hospital region: west vs northeast	0.88 (0.76 to 1.01)	0.072
Hospital region: south vs northeast	0.75 (0.66 to 0.84)	<0.001
Hospital region: midwest vs northeast	0.86 (0.75 to 0.97)	0.018

BP indicates blood pressure; CVA, cerebrovascular accident; ICD, implantable cardioverter-defibrillator; OR, odds ratio; TIA, transient ischemic attack.

differences in the prevalence, characteristics, hospital outcomes, and prescription of warfarin at discharge among patients with AF. Our study has the following major findings. First, black patients hospitalized for HF had a significantly lower prevalence of AF than white patients. Black patients with AF have different clinical characteristics compared with white patients. Despite having a different clinical profile and longer LOS, black patients hospitalized for HF with AF have similar in-hospital mortality relative to white patients. Finally,

despite national guideline recommendations and an ACC/AHA performance measure for anticoagulation at discharge, warfarin use remains suboptimal and there are significant racial disparities in the prescription of warfarin at discharge among at-risk eligible patients hospitalized for HF.

A large HF population offers a unique opportunity to assess the prevalence of AF by race. Our finding of 52% lower odds of AF in black patients with HF compared with white patients represents one of the largest reported racial differences in the prevalence of AF. Except for age, black patients in our analysis had higher rates of risk factors for AF such as hypertension, diabetes mellitus, COPD or asthma, HF, and higher body mass indices. Traditional AF risk factors have largely been derived from racially/ethnically homogeneous populations and may not be generalizable. Moreover, while risk factors for AF are well known, they do not explain all the attributable risk.^{12,13} The emerging field of AF genetics may provide insight into AF risk. A recent study found that European genetic ancestry increased AF risk among blacks in 2 different cohorts.¹⁴ Based on the hypothesis that racial differences in AF prevalence may involve genetic factors, Schnabel et al¹⁵ conducted a widespread gene analysis in white individuals and African Americans to identify common variants (single nucleotide polymorphisms [SNPs]) associated with AF. SNP rs4845625 in the IL6R gene was associated with AF in white patients but did not reach statistical significance in African American patients.¹⁵ The known chromosome 4 locus near PITX2 in whites also was associated with AF in African Americans. This study should be considered hypothesis generating and provide the rationale for including African American patients in additional genetic analyses associated with AF. Whether genetic, environmental, or a combination, there are likely protective mechanisms in blacks or factors that increase AF susceptibility in white patients.

To our knowledge, this is the first analysis to specifically assess racial differences in hospital outcomes for patients hospitalized for HF with AF. AF is associated with higher mortality and longer hospitalizations among patients hospitalized for HF.¹⁶ We found that among individuals hospitalized for HF, black patients with AF had a trend toward lower in-hospital mortality compared with white patients and had a longer LOS than whites independent of hospital characteristics or comorbid conditions. The rising costs associated with hospitalizations for AF and HF make decreasing LOS while reducing rehospitalization rates an important hospital performance indicator.

Patients with HF and AF, as evidenced by the recommendation for anticoagulation from the Heart Failure Society of America and ACC/AHA, are at increased risk for stroke. Despite the absence of contraindications to warfarin, all patients with HF and a disproportionately lower percentage of black patients may be less often treated with this guideline

Table 3. Hospital Outcomes by Race

Clinical Outcomes	Black Patients	White Patients	Adjusted OR, 95% CI	P value
Black vs white				
In-hospital mortality, %	2.6	4.1	0.79 (0.61 to 1.02)	0.076
LOS, * d	5 (3 to 8)	4 (3 to 7)	1.04 (1.01 to 1.07) [†]	0.007
Warfarin use at discharge, %	65.0	69.1	0.76 (0.69 to 0.85)	<0.001

Adjusted for patient and hospital characteristics. LOS indicates length of stay; OR, odds ratio reported for outcomes in-hospital mortality and warfarin use at discharge.

*Median (25th, 75th percentile).

[†]Multivariable regression model analyzed logarithm transformed LOS, and adjusted ratio of LOS was reported.

Table 4. Anticoagulation Use by CHADS₂ Score Stratified by Race

Variable	Adjusted OR, 95% CI	P value
Black vs white		
CHADS ₂ =1	0.61 (0.44 to 0.86)	0.005
CHADS ₂ =2	0.70 (0.60 to 0.82)	<0.001
CHADS ₂ =3	0.77 (0.67 to 0.89)	<0.001
CHADS ₂ =4	0.77 (0.62 to 0.96)	0.022
CHADS ₂ =5	0.69 (0.54 to 0.89)	0.003
CHADS ₂ =6	1.07 (0.67 to 1.68)	0.786

Adjusted for patient and hospital characteristics. CHADS₂ indicates congestive heart failure, hypertension, age >75, diabetes mellitus, prior stroke or transient ischemic attack; OR, odds ratio.

recommended therapy.^{17,18} Since 2005, the ACC/AHA guidelines for the management of chronic HF have advocated the use of warfarin for stroke prophylaxis in patients with paroxysmal or persistent AF (Class I recommendation; Level of evidence A).^{19,20} After adjusting for patient and hospital factors, black patients in our study remained 24% less likely to receive warfarin at discharge compared with white patients. The Reasons for Geographical Differences in Stroke Study (REGARDS) investigators assessed AF awareness and warfarin use in 432 individuals (88 black individuals). Compared with white patients, black patients were less aware of their AF diagnosis and treated less often with Warfarin (OR 0.28, 95% CI 0.13 to 0.60).¹⁸

Similar to other studies, we observed a risk paradox with low rates of warfarin use among patients at highest risk for

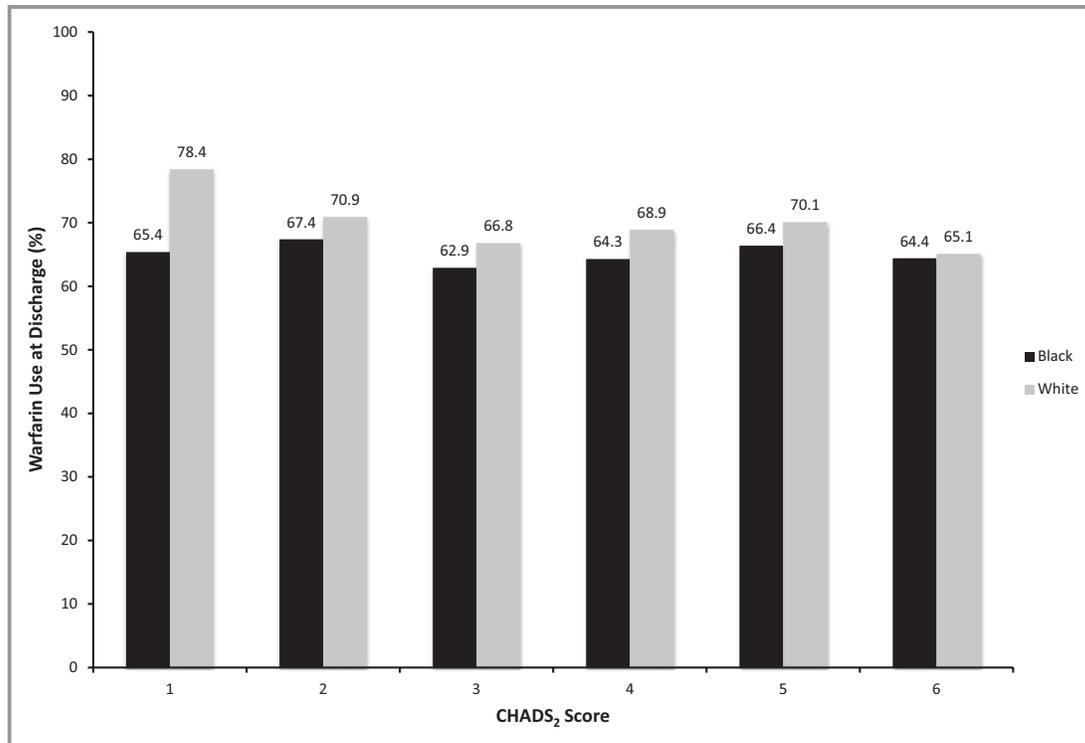


Figure 1. Warfarin use at discharge by race and CHADS₂ score. Warfarin use at discharge among patients hospitalized for HF with AF as a function of race. AF indicates atrial fibrillation; CHADS₂, congestive heart failure, hypertension, age >75, diabetes mellitus, and prior stroke or transient ischemic attack; HF, heart failure.

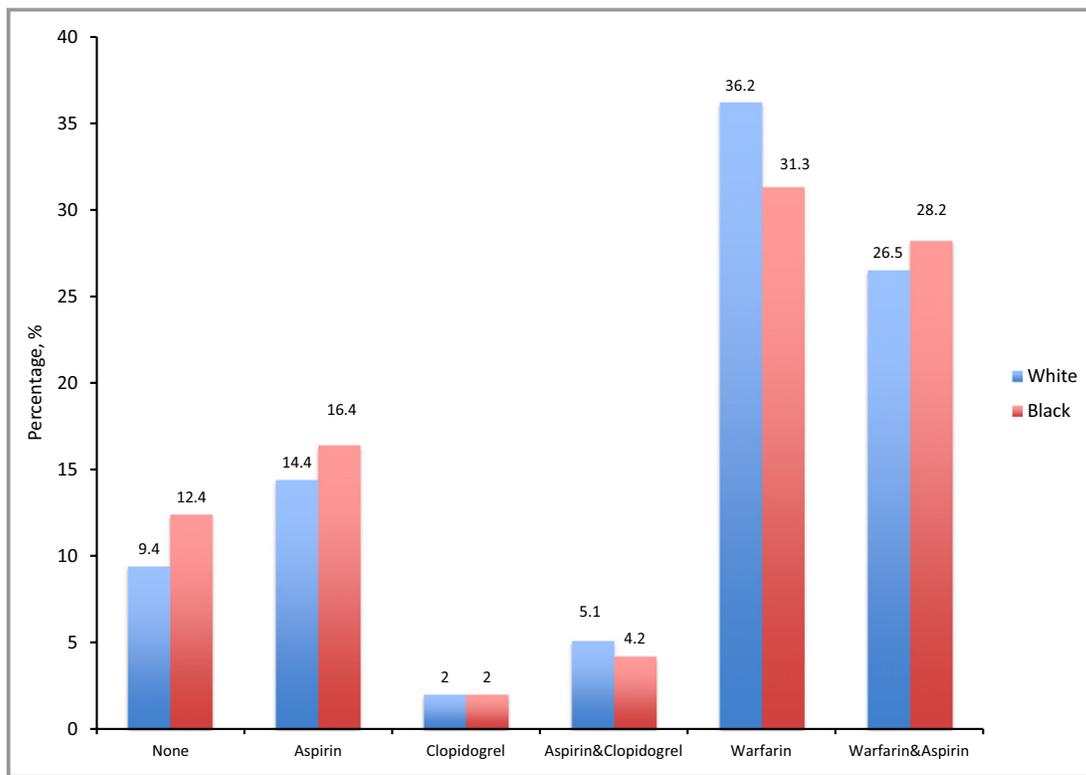


Figure 2. Antithrombotic therapy at discharge by race.

stroke based on the CHADS₂ index.^{17,21} In the most recent update to the American College of Chest Physician Evidence-Based Clinical Practice Guidelines for managing AF, intermediate (CHADS₂ 1) and high risk (CHADS₂ ≥2) individuals should be treated with oral anticoagulation (Grade 1B and 1A, respectively).²² Despite a median CHADS₂ score of 3.0 and 93% of black patients with CHADS₂ score ≥2, only 65% were prescribed warfarin for AF. Given the significant risk of thromboembolic stroke associated with AF, the lower prescription of warfarin among eligible black patients is concerning and warrants further exploration. A potential explanation for this disparity is the concern for intracranial hemorrhage (ICH) among blacks. Black patients have a 2-fold higher risk of stroke relative to white patients²³ partially attributable to ischemic strokes. ICH accounts for 20% to 30% of strokes in black patients and only 10% to 15% in white patients.²⁴ Moreover, black patients hospitalized for HF with AF treated with warfarin are at higher risk of ICH than similarly treated white patients.²³ Warfarin decreases the risk of thromboembolic stroke by 50% to 60% at the expense of doubling the risk of ICH. Additionally, black patients in GWTG-HF had higher BP on admission and were more often discharged with suboptimal BP control (Appendix B). BP remains one of the strongest independent predictors for ICH. This ideology may have contributed to the disparity yet is unlikely to explain it fully.

In most instances, the risk of thromboembolic stroke associated with AF outweighs that of ICH.^{25,26} The role of patient preference as an explanation for racial differences in anticoagulation is unknown and should be explored in future analyses. These issues notwithstanding, this disparity in the context of a quality improvement initiative suggests the need for more intensive investigation to understand the reasons for lower anticoagulation in blacks and solutions to provide higher-quality equitable care.

Limitations

Although the GWTG-HF registry provides detailed data to assess the characteristics and treatment patterns of patients hospitalized with HF, our analysis has several limitations. Data were obtained from patients enrolled in a voluntary quality improvement initiative, and the characteristics and treatment patterns may not reflect those of the general HF population with AF not cared for in these hospitals. However, findings from other HF registries and analyses suggest that participants in quality improvement registries have similar characteristics and in-hospital outcomes to that of nonparticipating individuals and that data from this registry may be representative of data on a national level.²⁷ Although we controlled for many variables in our analyses, measured and unmeasured residual confounding may remain, such as those related to

bleeding risk. We had no longitudinal data to ascertain how the overall low prescription of warfarin at discharge and the racial disparity affected patient outcomes. Finally, there were no direct measures of socioeconomic status or bias in GWTG-HF; thus, the contribution of certain elements affecting similar or disparate health care can only be inferred but not proved with these data. This study was not a prospective randomized trial, and residual measured and unmeasured confounders may have influenced outcomes.

Conclusions

Black patients hospitalized for HF have many risk factors for AF but have a lower prevalence of AF compared with white patients. Black and white patients with HF and AF had similar in-hospital outcomes. Overall, guideline recommended warfarin for patients with AF remains inadequate, and black patients at significant thromboembolic risk were less often prescribed warfarin at discharge than whites. Future studies should continue to explore explanations for the lower prevalence of AF in black patients and examine policies that can both increase oral anticoagulation for all indicated patients and eliminate racial disparities in anticoagulation use.

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Appendix A. Racial difference in atrial fibrillation prevalence, age-adjusted

Variable	AF Prevalence		Adjusted OR (95% CI)	P Value
	Black	White		
Black vs white				
Age <60 y	13.2	22.1	0.57 (0.51 to 0.64)	<0.001
60 to 69 y	22.1	35.6	0.54 (0.49 to 0.60)	<0.001
70 to 79 y	27.9	46.5	0.49 (0.45 to 0.52)	<0.001
80 to 89 y	33.1	53.5	0.47 (0.42 to 0.53)	<0.001
≤90 y	29.1	53.7	0.37 (0.31 to 0.44)	<0.000

Values expressed as %. AF indicates atrial fibrillation; OR, odds ratio.

Appendix B. Quality of heart failure Care as a function of race

Heart Failure Quality Metrics	White Patients (n=105 204)	Black Patients (n=30 290)	P Value
Performance measures			
Discharge instructions	90.5	91.6	0.017
Smoking history and cessation counseling	96.6	97.0	0.512
Anticoagulation for atrial fibrillation	69.1	65.0	<0.001
Blood pressure <140/90 at discharge	81.3	78.3	<0.001
Aldosterone antagonist for LVSD at discharge	29.4	31.4	0.036
Hydralazine/isordil for blacks at discharge	—	25.1	—
ICD counseling or ICD placed/prescribed at discharge for ejection fraction ≤35%	50.4	53.2	0.019
Achievement measures			
ACEI/ARB for LVSD	90.2	91.9	0.009
Evidence-based β-blocker for LVSD	74.2	77.6	<0.001
Ejection fraction assessment	98.0	99.0	<0.001

Values are presented as %. ACEI indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; ICD, implantable cardioverter-defibrillator; LVSD, left ventricular systolic dysfunction.

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