ORIGINAL RESEARCH

Fifteen-Year Trends in Management and Outcomes of Non–ST-Segment–Elevation Myocardial Infarction Among Black and White Patients: The ARIC Community Surveillance Study, 2000–2014

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***Background*—**Standardization of evidence-based medical therapies has improved outcomes for patients with non–ST-segment–elevation myocardial infarction (NSTEMI). Although racial differences in NSTEMI management have previously been reported, it is uncertain whether these differences have been ameliorated over time.

***Methods and Results*—**The ARIC (Atherosclerosis Risk in Communities) Community Surveillance study conducts hospital surveillance of acute myocardial infarction in 4 US communities. NSTEMI was classified by physician review, using a validated algorithm. From 2000 to 2014, 17 755 weighted hospitalizations for NSTEMI (patient race: 36% black, 64% white) were sampled by ARIC. Black patients were younger (aged 60 versus 66 years), more often female (45% versus 38%), and less likely to have medical insurance (88% versus 93%) but had more comorbidities. Black patients were less often administered aspirin (85% versus 92%), other antiplatelet therapy (45% versus 60%), β-blockers (85% versus 88%), and lipid-lowering medications (68% versus 76%). After adjustments, black patients had a 24% lower probability of receiving nonaspirin antiplatelets (relative risk: 0.76; 95% confidence interval, 0.71–0.81), a 29% lower probability of angiography (relative risk: 0.71; 95% confidence interval, 0.67–0.76), and a 45% lower probability of revascularization (relative risk: 0.55; 95% confidence interval, 0.50–0.60). No suggestion of a changing trend over time was observed for any NSTEMI therapy (*P* values for interaction, all >0.20).

***Conclusions*—**This longitudinal community surveillance of hospitalized NSTEMI patients suggests black patients have more comorbidities and less likelihood of receiving guideline-based NSTEMI therapies, and these findings persisted across the 15-year period. Focused efforts to reduce comorbidity burden and to more consistently implement guideline-directed treatments in this high-risk population are warranted. **(*J Am Heart Assoc*. 2018;7:e010203. DOI: 10.1161/JAHA.118.010203.)**

Key Words: guideline adherence • myocardial infarction • quality of care • race

In the United States, black adults have the highest burden of cardiovascular diseases, and this contributes to a wide disparity in life expectancy relative to white adults.[1,2] Some of this burden is attributable to the preponderance of cardiometabolic risk factors, such as diabetes mellitus, hypertension, obesity, and dyslipidemia among the black population.[3] However, other important factors, such as socioeconomics, contribute to these observed disparities in health.[3] In response, the American Heart Association (AHA) recently released a scientific statement emphasizing the need for new strategies to promote better cardiovascular health in the African American community.[1] Beyond variation in overall

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Clinical Perspective

What Is New?

- In this community-based surveillance of patients hospitalized with non–ST-segment–elevation myocardial infarction over a 15-year period, black patients were younger and had more medical comorbidities than white patients
- In comparison to white patients, black patients had less likelihood of receiving guideline-based non–ST-segment–elevation myocardial infarction therapies, including invasive angiography and revascularization.
- Racial differences in management persisted across the 15-year period.

What Are the Clinical Implications?

- Focused efforts are required to ameliorate the comorbidity burden in black communities by implementing population-based policies to influence health behavior.
- Measures for more consistent implementation of guideline-directed treatments in the black population are warranted.

risk factor and disease burden in the community, acute management of cardiovascular diseases, such as non–ST-segment–elevation myocardial infarction (NSTEMI), may also vary by race. Unlike ST-segment–elevation myocardial infarction (MI), which is primarily managed by protocol-driven strategies, management of NSTEMI may depend more heavily on the treating physician or health system.[4] Previous studies suggest lower utilization of invasive procedures in black patients and racial differences in medical management of NSTEMI.[3–11] Although these differences are well documented, it is unknown whether these disparities have been mitigated or have worsened over time. Most prior evaluations have relied on administrative claims data rather than direct chart abstraction,[12] and few have evaluated racial trends over time. *International Classification of Diseases (ICD)* coding practices have varied over time and also exhibit geographic heterogeneity. The ARIC (Atherosclerosis Risk in Communities) Community Surveillance study classifies NSTEMI by physician review and a standardized algorithm that has not changed since 1987, allowing a unique opportunity to investigate management trends among black and white patients hospitalized with NSTEMI.

Methods

ARIC Community Surveillance Study

The ARIC study's data and materials are publicly available.[13,14] Since 1987, the ARIC study has conducted community surveillance of hospitalizations for MI in 4 geographically defined regions of the United States (Forsyth County, North Carolina; Washington County, Maryland; Jackson, Mississippi; and 8 northwest suburbs of Minneapolis, Minnesota). All surveillance protocols were approved by local institutional review boards. Informed consent was not required because all data were anonymized by redacting personal identifiers. As described previously,[15,16] eligible hospitalizations were selected on the basis of age (35–74 years from 1987–2004 and 35–84 years from 2005 onward), residence in the community, and discharge *ICD, Ninth Revision, Clinical Modification (ICD-9)* codes 402, 410 to 414, 427, 428 and 518.4. Hospitalizations were selected by random sampling within strata of *ICD-9* codes and demographic groups based on race and sex. For the purposes of this analysis, hospital surveillance was limited to white and black patients discharged from January 1, 2000, to December 31, 2014.

Clinical Covariates and Demographic Data

Clinical and demographic data were collected from the hospital records by trained abstractors using physician notes, laboratory reports, patient histories, and discharge summaries. Patient race was abstracted from the medical history. *Diabetes mellitus* was defined as documented history of diabetes mellitus or glucose-lowering therapy use. *Hypertension* was defined as documented hypertension, systolic blood pressure ≥140 mm Hg, or diastolic blood pressure ≥90 mm Hg. Acute heart failure or pulmonary edema was abstracted if noted in the physical examination or chest radiography. Cardiogenic shock was recorded if documented at admission or within 24 hours of symptom onset. Ventricular fibrillation and cardiac arrest were recorded if documented in the progress notes, medical record, or discharge summary.

Electrocardiography

The first, third, and last 12-lead ECGs over the course of hospitalization were obtained from the medical record and coded electronically at the Minneapolis ECG Reading Center.[17] For the purposes of this analysis, patients identified with ST-segment elevations were excluded.

Chest Pain

Presence of chest pain was abstracted from the medical record. Any mention of substernal pressure, tightness, or pain precipitated by exertion or excitement was considered evidence of chest pain of cardiac origin. Chest pain starting after hospitalization was considered evidence of hospital-onset MI, and cases were excluded from the analysis.

Acute MI Classification

As described previously,[16,17] events were classified by the ARIC study as *definite, probable, suspect*, or *no MI*, based on

ECG evidence (evolving diagnostic, diagnostic, evolving ST-T wave changes, equivocal, or absent/uncodable), presence of chest pain, and cardiac biomarkers (which were considered *abnormal* if ≥2× the upper limit of normal and *equivocal* if exceeding but <2× the upper limit of normal).[12] Classification criteria remained constant over the study period and is detailed in the ARIC Study surveillance manual.[18] To qualify as definite or probable NSTEMI, one of the following conditions in the absence of ST-segment elevation was required: 1) diagnostic ECG pattern and abnormal biomarkers, 2) cardiac pain and abnormal biomarkers, 3) cardiac pain and equivocal biomarkers with evolving ST-T wave pattern or diagnostic ECG pattern, or 4) abnormal biomarkers with evolving ST-T wave pattern.[16]

Biomarkers

Laboratory values for biomarkers of cardiac injury were recorded for the first 4 days of hospitalization. The laboratory-specified upper limit of normal was recorded, and biomarker values were abstracted chronologically, recording up to 3 measurements per day.

Medical Therapies

Medications were recorded if administered during the course of hospitalization or prescribed at hospital discharge. Aspirin required routine rather than pro re nata administration for abstraction. Nonaspirin antiplatelet therapy was recorded as a single category and included $P2Y_{12}$ inhibitors (cangrelor, clopidogrel, prasugrel, ticagrelor, ticlopidine), glycoprotein IIb/IIIa inhibitors (abciximab, eptifibatide, tirofiban, xemilofiban), phosphodiesterase type 3 inhibitors (cilostazol), phosphodiesterase type 5 inhibitors (dipyridamole), and protease-activated receptor 1 (PAR-1) antagonists (vorapaxar). β-Blockers included β_1 adrenergic antagonists. Angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers were recorded as a single category. Lipid-lowering agents included statins, niacin, and fibrates.

Procedures

Echocardiography, stress testing, angiography, and revascularization procedures were abstracted from the medical record. Echocardiography included transthoracic and transesophageal echocardiograms. Stress testing included exercise testing (treadmill or bicycle ergometer), stress echocardiography, cardiac stress magnetic resonance imaging, and nuclear stress tests. Revascularization included percutaneous coronary intervention or coronary artery bypass grafting surgery.

Mortality Outcomes

All-cause mortality outcomes were ascertained for all patients by linking hospitalizations with the National Death Index.

Statistical Analysis

All statistical analyses were carried out using SAS 9.4 (SAS Institute). Statistical tests and models accounted for the stratified sampling design and were weighted by the inverse of the sampling probability because sampling fractions varied across the sampling strata.[19] Continuous variables were assessed for normality and compared using the difference in least square means from weighted linear regression. Categorical variables were compared using Rao-Scott χ^2 tests. The relative probability of black versus white patients receiving NSTEMI medications (aspirin, other antiplatelets, β-blockers, and lipid-lowering medications) or undergoing invasive procedures (angiography and revascularization) were compared in yearly and in aggregate (2000–2014) analyses. Associations were derived from multivariable logistic regression, with odds ratios converted into relative risks and 95% confidence intervals.[20] Racial differences in posthospitalization mortality (28-day and 1-year) were analyzed with multivariable Cox regression. Modeling decisions were made a priori, with adjustment for variables routinely abstracted from the medical record. Models for NSTEMI therapies were adjusted for demographics (age, sex, geographic region, year of admission), and comorbidities and clinical course (diabetes mellitus, acute heart failure or pulmonary edema, cardiogenic shock, and ventricular fibrillation or cardiac arrest). Models for mortality outcomes were additionally adjusted for medications (aspirin, other antiplatelet agents, β-blockers, angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers, and lipid-lowering agents) and revascularization. Annual trends in medical management were visualized by plotting the adjusted relative probabilities of black versus white patients receiving recommended therapies[21] each year from 2000 to 2014. Significant changes in annual relative probabilities across 2000–2014 were analyzed by modeling the multiplicative interaction between race and calendar year of hospital admission.

Several sensitivity analyses were also conducted. Racial differences in NSTEMI management were compared within each of the 4 ARIC communities and among patients known to have medical insurance. We also conducted a sensitivity analysis excluding patients with previous MI because guideline-directed therapies may have been initiated before the hospital visit under surveillance. Because the ARIC Community Surveillance study uses a standardized, physician-adjudicated definition of NSTEMI that has not changed

Table 1. Baseline Characteristics of Black and White Patients Hospitalized With NSTEMI; ARIC Community Surveillance Study, 2000–2014

	Black Patients (n=6343)	White Patients (n=11 412)	*P* Value
Demographics			
Age, y	60±0.3	66±0.2	<0.0001
Female	2834 (45)	4324 (38)	<0.0001
Geographic location			
Forsyth County, NC	2507 (40)	4647 (41)	<0.0001
Jackson, MS	3113 (49)	1025 (9)	
Minneapolis, MN	624 (10)	3664 (32)	
Washington, MD	99 (2)	2077 (19)	
Medical insurance*	4427 (88)	7887 (93)	<0.0001
Year of hospitalization	2009±0.1	2008±0.1	<0.0001
Medical history			
Current smoker	2299 (36)	3286 (29)	<0.0001
Diabetes mellitus	3169 (50)	4258 (37)	<0.0001
Chronic kidney disease†	1980 (38)	2579 (29)	<0.0001
Prior MI	1890 (30)	3615 (32)	0.3
Prior angioplasty	1326 (21)	2880 (25)	0.001
Prior CABG	726 (11)	2399 (21)	<0.0001
Valvular heart disease/ cardiomyopathy	1718 (27)	2225 (20)	<0.0001
Stroke	1002 (16)	1162 (10)	<0.0001
Hospital visit			
Chest pain	5110 (81)	9477 (83)	0.07
Elevated enzymes (>2× ULN)	6332 (99.8)	11 242 (98.5)	<0.0001
ST-segment depression	4135 (65)	7168 (63)	0.1
Ventricular fibrillation/ cardiac arrest	341 (5)	791 (7)	0.02
Acute pulmonary edema/heart failure	2595 (41)	3302 (29)	<0.0001
Cardiogenic shock	143 (2)	407 (4)	0.0009
Weekend admission	1627 (26)	2928 (26)	1.0
Transferred to/from other hospital	71 (1)	914 (8)	<0.0001

Data are shown as mean±SEM or n (%). ARIC indicates Atherosclerosis Risk in Communities; CABG, coronary artery bypass grafting; MI, myocardial infarction; NSTEMI, non–ST-segment–elevation myocardial infarction; ULN, upper limit of normal.
*Medical insurance not routinely abstracted before 2005 and based on a subset (n=13 505) of patients.
†Serum creatinine not routinely abstracted before 2005. Chronic kidney disease defined by estimated glomerular filtration rate <45 mL/min/1.73 m^2 by the Chronic Kidney Disease Epidemiology Collaboration equation, in a subset (n=14 309) of patients with available creatinine assessments or receipt of hemodialysis.

since 1987, we were able to examine trends over time; however, discrepancies may exist between the ARIC classification of NSTEMI and the treating physician's diagnosis. Consequently, we also examined racial differences in patients classified with definite NSTEMI (excluding cases of probable NSTEMI), in patients discharged with a primary *ICD-9* code of 410 to 414, and in the subset of patients not presenting with acute heart failure or pulmonary edema.

Results

All presented results are weighted by the inverse of the sampling probability.[19] From January 1, 2000, to December 31, 2014, 8060 hospitalizations for definite or probable NSTEMI were sampled by the ARIC Community Surveillance study, corresponding to 17 755 weighted events. Of these, 36% of the patients were black. As shown in Table 1, black patients were younger (aged 60 versus 66 years) and more often female (45% versus 38%) but less likely to have medical insurance (88% versus 93%). History of diabetes mellitus (50% versus 37%), chronic kidney disease (38% versus 29%), and stroke (16% versus 10%) were more prevalent among black patients, but history of prior MI was comparable to white patients (30% versus 32%). During the hospital stay, acute pulmonary edema or congestive heart failure was more common in black patients (41% versus 29%). In contrast, cardiogenic shock (2% versus 4%) and ventricular fibrillation or cardiac arrest were less common (5% versus 7%). Overall, black patients were less likely than white patients to be transferred to or from another hospital (1% versus 8%). As shown in Table S1, comparisons of demographic factors, comorbidities, and in-hospital clinical courses were consistent when analyzed at 5-year intervals of 2000–2004, 2005–2009, and 2010–2014.

In the aggregate, black patients were less often administered aspirin (85% versus 92%), nonaspirin antiplatelet therapy (45% versus 60%), β-blockers (85% versus 88%), and lipid-lowering medications (68% versus 76%) and were less likely to undergo invasive angiography (45% versus 61%) or revascularization (25% versus 45%; Figure 1). However, black patients were more commonly administered angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers (67% versus 61%) and were more often imaged by echocardiography during the hospitalization (67% versus 58%). The percentage of patients undergoing stress testing was comparable for both races (7% for both). Although the proportion of black patients varied across the 4 ARIC communities, similar race-specific patterns in NSTEMI management were observed in all communities (Table S2). Guideline-directed medications were more balanced between races in patients undergoing coronary revascularization (n=6700; Table S3).

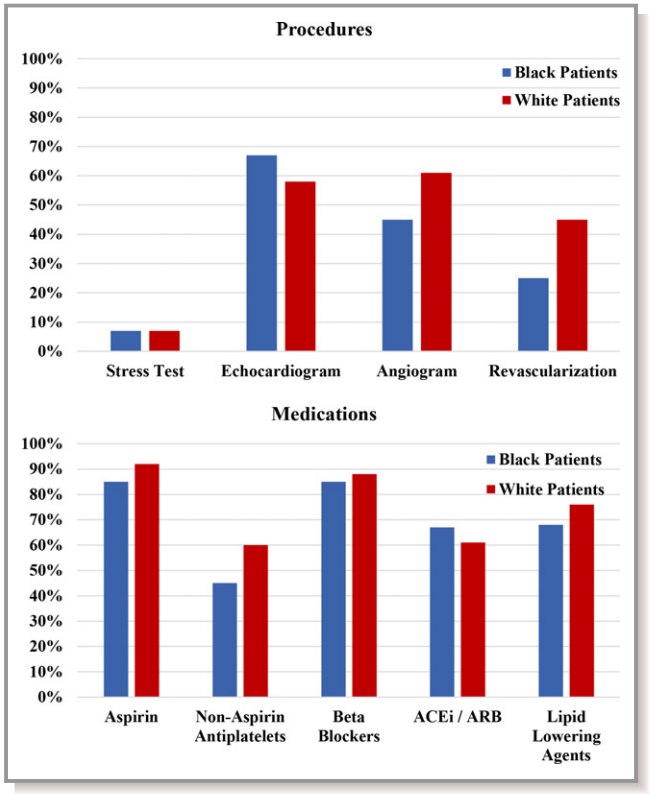

Figure 1. Distributions of various guideline-directed medications and therapies, stratified by black and white patients hospitalized with non–ST-segment–elevation myocardial infarction. ACEi indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin II receptor blocker.

After accounting for demographics, year of admission, and comorbidities and clinical course, black patients had a 24% lower probability of receiving nonaspirin antiplatelet therapy, a 9% lower probability of receiving lipid-lowering agents, a 6% lower probability of receiving aspirin, a 29% lower probability of undergoing angiography, and a 45% lower probability of revascularization, when aggregated across 2000–2014 (Figure 2). Racial differences in NSTEMI management persisted in several sensitivity analyses (Tables S4–S8). When subdivided by ARIC community, the risk-adjusted probability of receiving an invasive strategy remained consistently lower for black patients, although some heterogeneity across geographic regions was evident (Table S9).

The annual percentages of black and white patients receiving evidence-based NSTEMI therapies are shown in Figure 3. When analyzed across 5-year intervals (2000–2004, 2005–2009, and 2010–2014), the risk-adjusted relative probabilities of evidence-based NSTEMI therapies remained consistently lower for black compared with white patients (Table 2). No suggestion of a changing trend over time was observed for any NSTEMI therapy (*P* values for interaction, all >0.20).

Overall, 480 deaths occurred in hospital, 1187 deaths occurred within 28 days, and 2619 deaths occurred within 1 year of hospitalization. Unadjusted all-cause mortality was comparable for black and white patients, whether in hospital (2% versus 3%), at 28 days (6% versus 7%), or at 1 year of follow-up (15% for each). After adjustments for demographics, year of admission, comorbidities and clinical course, medications, and revascularization, the postdischarge hazard of death was comparable for black relative to white patients, both at 28 days (hazard ratio: 1.10; 95% confidence interval, 0.83–1.45) and 1 year (hazard ratio: 1.05; 95% confidence interval, 0.85–1.32).

Discussion

In this community-based surveillance of patients hospitalized with NSTEMI from 2000 to 2014 black patients (1) were more likely to be younger and female and to have more comorbidities than white patients, (2) were less likely to receive evidence-based NSTEMI therapies (ie, aspirin, lipid-lowering agents, and nonaspirin antiplatelets), and 3) were less likely to undergo invasive angiography and revascularization. Unfortunately, despite standardization of evidence-based therapies, persistent differences were observed over the15-year period from 2000 to 2014, with no significant changes in trends over time. However, postdischarge mortality was similar for black and white patients, as was administration of medical therapies among the subset undergoing coronary revascularization.

Racial comparisons of patients presenting with NSTEMI have previously been described and are largely consistent with the population from the ARIC Community Surveillance study.[3,11] The younger age at presentation for black patients likely stems from the earlier onset of cardiovascular risk factors.[1,22,23] In support of this, we observed more prevalent smoking, diabetes mellitus, chronic kidney disease, and history of stroke in black patients presenting with NSTEMI. Similarly, a higher prevalence of cardiovascular comorbidities was reported in black patients from 400 US hospitals participating in the Can Rapid Risk Stratification of Unstable Angina Patients Suppress Adverse Outcomes With Early Implementation of the ACC (American College of Cardiology)/AHA Guidelines (CRUSADE) registry.[11] Higher rates of cardiovascular disease and fatal coronary heart disease in black patients were also noted in the REGARDS (Reasons for Geographic and Racial Differences in Stroke) cohort.[24] Of concern is a recent analysis from the ARIC Cohort study that reported widening racial differences in coronary risk factors for individuals from the general population who were followed longitudinally from 1987 to 2013.[25]

In the ARIC Community Surveillance study, black patients underwent invasive procedures less frequently and were less likely to receive evidence-based NSTEMI medications—findings that are consistent with multiple prior studies.[3–11]

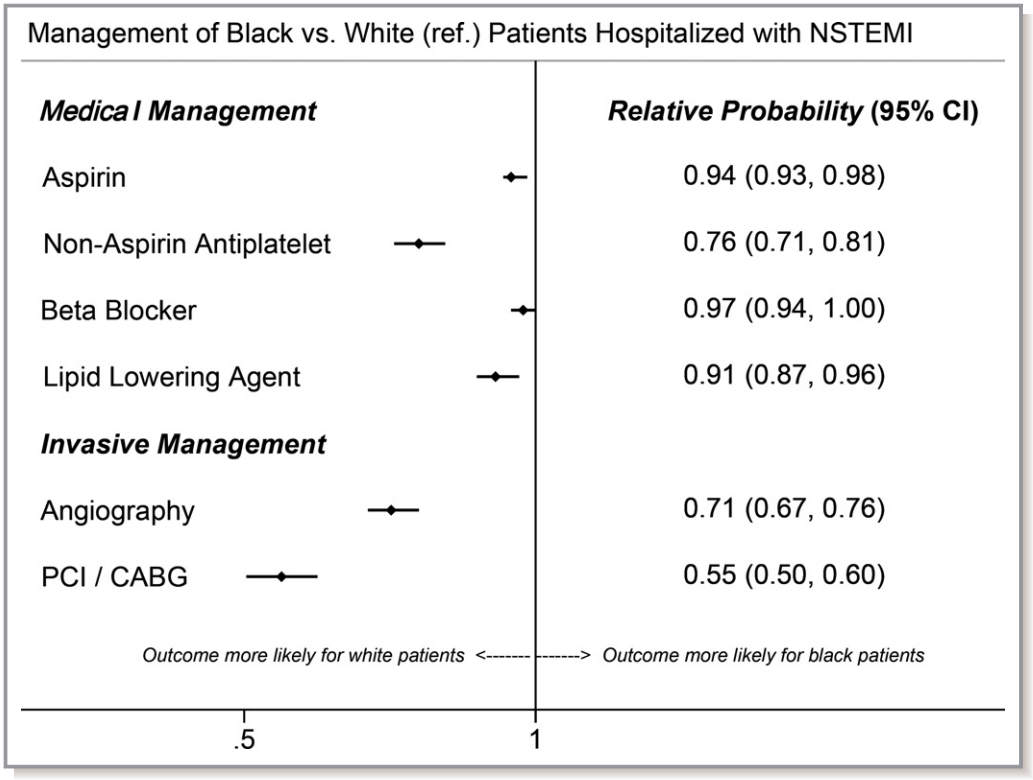

Figure 2. Risk-adjusted relative probabilities of black vs white patients receiving various evidenced-based therapies for non–ST-segment–elevation myocardial infarction (NSTEMI). Models adjusted for demographics (age, sex, hospital geographic location [Forsyth County, NC; Jackson, MS; Minneapolis, MN; Washington County, MD] and year of admission) and comorbidities and clinical course (diabetes mellitus, acute heart failure/pulmonary edema, cardiogenic shock, and ventricular fibrillation/cardiac arrest]. CABG indicates coronary artery bypass grafting; CI, confidence interval; PCI, percutaneous coronary intervention.

However, the prolonged follow-up in the ARIC Community Surveillance study uniquely allows an evaluation of contemporary trends, which are useful for assessing the impact of quality initiatives. Unfortunately, the differences in nonaspirin antiplatelet therapy, lipid-lowering medications, invasive angiography, and revascularization seem to have persisted from 2000 to 2014. The underlying reasons for the observed racial differences in NSTEMI management are likely multifactorial. Black patients may compose a sicker population, a category less likely to undergo an invasive strategy and for which evidence-based treatments are systematically underutilized.[23,26,27] However, the associations in the ARIC Community Surveillance study remained significant after accounting for comorbid conditions and in-hospital clinical course.

Another potential explanation for the disparity in guideline-directed therapies may be greater incidence of type 2 MI in black patients, given their greater comorbidity burden. However, racial differences in NSTEMI management remained after excluding patients with acute heart failure or pulmonary edema, when limiting the analysis to patients with definite NSTEMI, and for those with a primary discharge *ICD-9* code of 410–414. We also observed that black patients were less often insured than white patients. This may have affected clinical decision making by both the patients and the physicians, although the lower utilization of NSTEMI therapies persisted in a sensitivity analysis limited to patients with known medical insurance. Another explanation for the observed differences in NSTEMI management may be that black populations are concentrated in geographic areas with lower access to care than their white counterparts. Although access to percutaneous and surgical revascularization has continued to expand in recent years, geographical imbalances remain.[28] However, we observed a consistent pattern of racial differences in NSTEMI management across the 4 ARIC communities.

Although these differences in use of evidence-based therapies and utilization of invasive strategy are concerning, the rates of postdischarge mortality among black and white patients did not differ. Whether this is attributable to equalization of care following discharge is uncertain. An analysis of 443 hospitals participating in Get With The Guidelines–Coronary Artery Disease program reported a reduction or elimination of racial and ethnic differences in post-MI care.[29] The ARIC Community Surveillance study,

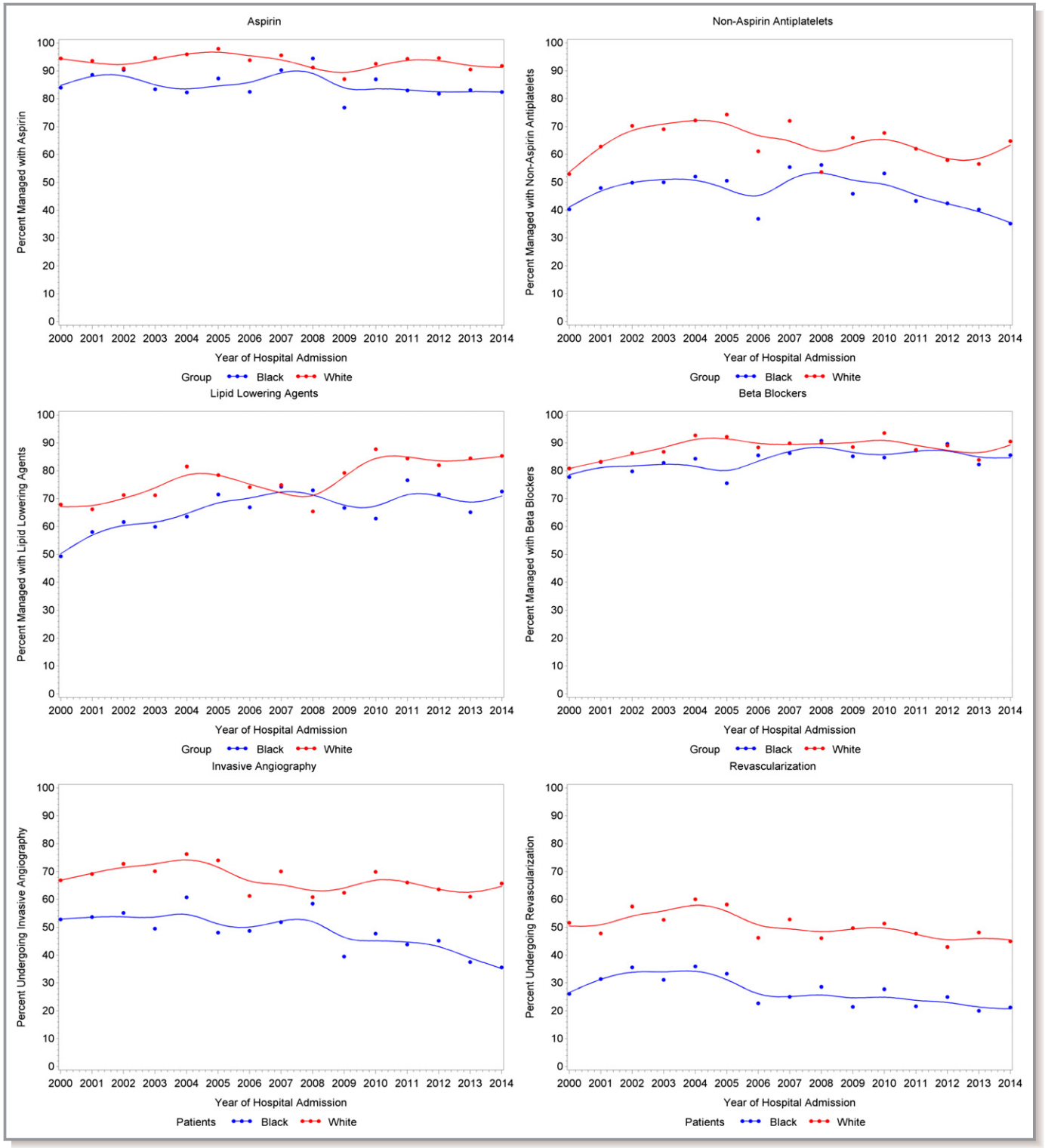

Figure 3. Annual percentages of black and white patients receiving various evidenced-based therapies for non–ST-segment–elevation myocardial infarction. Annual percentages are limited to patients aged 35 to 74 years.

however, does not follow patients after discharge except for all-cause mortality outcomes, and we were unable to examine racial differences in post-MI care. Encouragingly, among the patients undergoing coronary revascularization, medications were similarly administered, regardless of race. This likely reflects national standardization of postrevascularization care, supporting the role of protocol-driven care for the mitigation of racial disparities in NSTEMI management.[30]

Table 2. Risk-Adjusted Relative Probabilities of Black vs White Patients Receiving Various Therapies for NSTEMI: ARIC Community Surveillance Study, 2000–2014

NSTEMI Therapies	2000–2004 RR (95% CI)	2005–2009 RR (95% CI)	2010–2014 RR (95% CI)	Trend* *P* Value
Medical management				
Aspirin	0.93 (0.90–0.99)	0.96 (0.92–1.02)	0.96 (0.92–1.02)	0.7
Nonaspirin antiplatelet	0.76 (0.69–0.86)	0.78 (0.71–0.86)	0.75 (0.68–0.84)	0.3
β-Blocker	0.99 (0.93–1.09)	0.97 (0.93–1.04)	0.96 (0.93–1.02)	0.9
Lipid-lowering agent	0.80 (0.75–0.88)	0.99 (0.91–1.10)	0.92 (0.86–0.99)	0.4
Invasive management				
Angiography	0.75 (0.70–0.83)	0.76 (0.69–0.84)	0.67 (0.61–0.74)	0.8
Revascularization	0.60 (0.53–0.680	0.55 (0.48–0.64)	0.52 (0.46–0.60)	0.7

Models adjusted for demographics [age, sex, hospital geographic location (Forsyth County, NC; Jackson, MS; Minneapolis, MN; Washington County, MD) and year of admission] and comorbidities and clinical course (diabetes mellitus, acute heart failure/pulmonary edema, cardiogenic shock, and ventricular fibrillation/cardiac arrest). ARIC indicates Atherosclerosis Risk in Communities; CI, confidence interval; NSTEMI, non–ST-segment–elevation myocardial infarction; RR, relative risk.
*Annual trends derived from aggregate risk-adjusted model (2000–2014), testing the multiplicative interaction between race and calendar year of admission.

The Centers for Medicare and Medicaid Services Hospital Inpatient Quality Reporting program measures and publicly reports quality of care for acute coronary syndromes, which has led to improved outcomes for patients regardless of race.[31] Nevertheless, measures focused on tackling the disproportionately high cardiovascular disease burden among black patients and the lower utilization of evidence-based therapies are needed. Dedicated industry-based and federal efforts, such as the PLATINUM Diversity study, have gained momentum recently in identifying evidence-based interventions to improve clinical outcomes of racial- and ethnic-minority patients.[32] Recent reports suggest the burden of cardiovascular disease may be ameliorated by improving socioeconomic status in black communities.[33] In addition, ample evidence suggests that population-based strategies to influence health behavior may improve cardiovascular risk in the black population.[1] These strategies should include a population approach to improve physical activity, diet, and smoking habits.[34]

Our study has several limitations. The ARIC Community Surveillance study is localized to 4 US communities and may not be generalizable to the entire nation. The majority (89%) of black patients included in the ARIC Community Surveillance study were sampled from North Carolina and Mississippi. Clinical data were limited by availability in the medical record and abstraction priority. Granular data regarding angiographic outcomes were not available for analysis. Serum creatinine and medical insurance status were not routinely abstracted until 2005 and were missing for 31% and 19% of the hospitalizations, respectively. The fact that we did not observe any racial differences in long-term all-cause mortality is reassuring; however, we were not able to compare other important longitudinal outcomes, such as recurrent MI, need for revascularization, or cardiovascular death. Our study also has several noteworthy strengths. The ARIC Community Surveillance study provides large multiyear surveillance of 4 diverse US communities. Clinical and laboratory values were meticulously collected by certified abstractors following standardized protocols. NSTEMI was classified using consistent criteria based on standardized physician review of the medical record, thus allowing an analysis of trends spanning several decades. Mortality outcomes were verified by the National Death Index. These protocols support greater standardization of these observational data.

Conclusion

In this community-based surveillance of black and white patients hospitalized with NSTEMI from 2000 to 2014, black patients were younger, had more medical comorbidities, and were less likely to undergo revascularization or be discharged on evidence-based medications. Despite measures to standardize NSTEMI care, differences have persisted between black and white patients during this time interval. Overall reduction in comorbidity burden and consistent implementation of guideline-directed strategies are crucial to mitigate racial disparities in NSTEMI management.

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SUPPLEMENTAL MATERIAL

Table S1. Characteristics of black and white patients hospitalized with non ST-segment elevation myocardial infarction. The Atherosclerosis Risk in Communities (ARIC) Surveillance Study, 2000 – 2014.

Characteristic	2000 - 2004			2005 - 2009			2010 - 2014		
	Black	**White**		**Black**	**White**		**Black**	**White**	
	N=1302	N=2863	*P-Value*	N=1697	N=4036	*P-Value*	N=3344	N=4514	*P-Value*
Demographics									
Age	58 ± 0.5	62 ± 0.3	<0.0001	60 ± 0.5	68 ± 0.4	<0.0001	60 ± 0.4	67 ± 0.4	<0.0001
Women	545 (42%)	898 (31%)	<0.0001	778 (46%)	1579 (39%)	0.007	1511 (45%)	1848 (41%)	0.04
Geographic region			<0.0001			<0.0001			<0.0001
Forsyth, NC	423 (33%)	1056 (37%)		655 (39%)	1626 (40%)		1429 (43%)	1965 (44%)	
Jackson, MS	776 (60%)	340 (12%)		847 (50%)	366 (9%)		1490 (45%)	319 (7%)	
Minneapolis, MN	88 (7%)	933 (33%)		160 (9%)	1377 (34%)		375 (11%)	1353 (30%)	
Washington, MD	14 (1%)	533 (19%)		35 (2%)	666 (17%)		50 (1%)	877 (19%)	
Health Insurance*	---	---		1433 (85%)	3723 (95%)	<0.0001	3016 (90%)	4235 (94%)	0.002
Medical History									
Current smoker	558 (43%)	956 (33%)	0.0003	563 (33%)	1014 (25%)	0.001	1178 (35%)	1316 (29%)	0.007
Diabetes mellitus	573 (44%)	945 (33%)	<0.0001	897 (53%)	1549 (38%)	<0.0001	1699 (51%)	1763 (39%)	<0.0001
Chronic kidney disease†	---	---		651 (38%)	1222 (31%)	0.005	1235 (37%)	1245 (28%)	<0.0001
Prior angioplasty	161 (12%)	581 (20%)	0.0002	386 (23%)	1071 (27%)	0.1	779 (23%)	1228 (27%)	0.06
Prior CABG	140 (11%)	541 (19%)	<0.0001	205 (12%)	951 (24%)	<0.0001	381 (11%)	907 (20%)	<0.0001
Prior myocardial infarction	350 (27%)	970 (34%)	0.006	449 (26%)	1238 (31%)	0.08	1092 (33%)	1406 (31%)	0.5
Cardiomyopathy / valvular heart disease	276 (21%)	405 (14%)	0.001	381 (22%)	822 (20%)	0.4	1061 (32%)	998 (22%)	<0.0001
Stroke	179 (14%)	253 (9%)	0.003	256 (15%)	376 (9%)	0.0002	567 (17%)	533 (12%)	0.004
Hospital Visit									
Chest pain	1093 (84%)	2461 (86%)	0.4	1361 (80%)	3373 (84%)	0.2	2657 (80%)	3643 (81%)	0.6
ST-T segment depression	846 (65%)	1771 (62%)	0.2	1191 (70%)	2639 (65%)	0.07	2099 (63%)	2758 (61%)	0.5
Ventricular fibrillation	94 (7%)	229 (8%)	0.5	92 (5%)	304 (8%)	0.09	154 (5%)	258 (6%)	0.2
Cardiogenic shock	23 (2%)	90 (3%)	0.02	41 (2%)	122 (3%)	0.5	79 (2%)	195 (4%)	0.01
Acute heart failure / pulmonary edema	465 (36%)	790 (28%)	0.001	645 (38%)	1257 (31%)	0.01	1485 (44%)	1255 (28%)	<0.0001
Transferred	19 (1%)	333 (12%)	<0.0001	34 (2%)	409 (10%)	<0.0001	19 (0.6%)	172 (4%)	<0.0001

Weekend admission	336 (26%)	704 (25%)	0.6	439 (26%)	1006 (25%)	0.1	852 (25%)	1218 (27%)	0.5
Length of stay (days)	7.0 ± 0.4	8.0 ± 1.6	0.7	9.4 ± 1.9	6.0 ± 0.4	0.1	6.6 ± 0.5	5.3 ± 0.2	0.009

*Medical insurance status not routinely abstracted prior to 2005.
†Serum creatinine not routinely abstracted prior to 2005. Chronic kidney disease defined by estimated glomerular filtration rate <45 mL/min/1.73m^2 by Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula
Abbreviations: CABG = coronary artery bypass graft.

Table S2. **Medical management of black and white patients hospitalized with NSTEMI from 2000 - 2014, stratified by ARIC community.**

Outcome	Forsyth		Jackson		Minnesota		Washington	
	Blacks	Whites	Blacks	Whites	Blacks	Whites	Blacks	Whites
Medical Management								
Aspirin	88%	93%	82%	88%	90%	94%	81%	89%
Non-Aspirin Antiplatelets	42%	57%	47%	57%	41%	62%	64%	63%
Lipid Lowering Agents	72%	76%	65%	67%	67%	80%	67%	73%
Beta Blockers	85%	88%	84%	80%	87%	92%	74%	85%
ACEi / ARBs	68%	61%	67%	63%	70%	61%	57%	58%
Invasive Management								
Angiography	43%	64%	48%	55%	41%	63%	47%	55%
Revascularization	25%	48%	24%	39%	23%	47%	34%	40%

Table S3. **Various medications and procedures administered to black and white patients undergoing coronary revascularization during hospitalization for NSTEMI (N=6,700).**

Medications	**Black Patients**	**White Patients**
Aspirin	98%	98%
Non-Aspirin Antiplatelet	87%	87%
Lipid Lowering Agent	89%	90%
Beta Blockers	94%	96%
ACEi / ARB	75%	68%
Procedures		
Echocardiogram	67%	52%
Stress Test	3%	3%

Table S4. **Risk-adjusted* relative probabilities of various NSTEMI therapies among black vs. white (ref.) patients known to have health insurance (N=12,314).**

Medical Management	RR (95% CI)
Aspirin	0.94 (0.92 – 0.98)
Non-Aspirin Antiplatelets	0.74 (0.69 – 0.80)
Lipid Lowering Agents	0.94 (0.89 – 1.01)
Beta Blockers	0.99 (0.95 – 1.03)
ACEi / ARBs	1.10 (1.02 – 1.20)
Invasive Management	
Angiography	0.68 (0.63 – 0.74)
Revascularization	0.52 (0.47 – 0.57)

*Models adjusted for demographics [age, sex, hospital geographic location (Forsyth County, NC; Jackson, MS; Minneapolis, MN; Washington County, MD) and year of admission], comorbidities and clinical course [diabetes, acute heart failure / pulmonary edema, cardiogenic shock, and ventricular fibrillation / cardiac arrest].

Table S5. **Risk-adjusted* relative probabilities of various NSTEMI therapies among black vs. white (ref.) patients not presenting with acute heart failure / pulmonary edema (N=11,858).**

Medical Management	RR (95% CI)
Aspirin	0.95 (0.93 – 0.98)
Non-Aspirin Antiplatelets	0.79 (0.75 – 0.84)
Lipid Lowering Agents	0.90 (0.86 – 0.94)
Beta Blockers	0.96 (0.93 – 0.99)
ACEi / ARBs	1.10 (1.03 – 1.19)
Invasive Management	
Angiography	0.78 (0.74 – 0.81)
Revascularization	0.61 (0.57 – 0.65)

*Models adjusted for demographics [age, sex, hospital geographic location (Forsyth County, NC; Jackson, MS; Minneapolis, MN; Washington County, MD) and year of admission], comorbidities and clinical course [diabetes, cardiogenic shock, and ventricular fibrillation / cardiac arrest].

Table S6. **Risk-adjusted* relative probabilities of various NSTEMI therapies among black vs. white (ref.) patients presenting with first-occurring acute myocardial infarction (N=12,250).**

Medical Management	RR (95% CI)
Aspirin	0.93 (0.90 – 0.98)
Non-Aspirin Antiplatelets	0.72 (0.68 – 0.79)
Lipid Lowering Agents	0.88 (0.83 – 0.93)
Beta Blockers	0.95 (0.92 – 0.99)
ACEi / ARBs	1.12 (1.05 – 1.22)
Invasive Management	
Angiography	0.69 (0.65 – 0.74)
Revascularization	0.55 (0.51 – 0.60)

*Models adjusted for demographics [age, sex, hospital geographic location (Forsyth County, NC; Jackson, MS; Minneapolis, MN; Washington County, MD) and year of admission], comorbidities and clinical course [diabetes, cardiogenic shock, and ventricular fibrillation / cardiac arrest].

Table S7. **Risk-adjusted* relative probabilities of various NSTEMI therapies among black vs. white (ref.) patients classified with definite NSTEMI (N=9,688).**

Medical Management	RR (95% CI)
Aspirin	0.96 (0.93 – 1.00)
Non-Aspirin Antiplatelets	0.78 (0.72 – 0.83)
Lipid Lowering Agents	0.93 (0.88 – 1.00)
Beta Blockers	1.00 (0.96 – 1.04)
ACEi / ARBs	1.12 (1.04 – 1.22)
Invasive Management	
Angiography	0.74 (0.69 – 0.79)
Revascularization	0.55 (0.51 – 0.60)

*Models adjusted for demographics [age, sex, hospital geographic location (Forsyth County, NC; Jackson, MS; Minneapolis, MN; Washington County, MD) and year of admission], comorbidities and clinical course [diabetes, acute heart failure / pulmonary edema, cardiogenic shock, and ventricular fibrillation / cardiac arrest].

Table S8. **Risk-adjusted* relative probabilities of various NSTEMI therapies among black vs. white (ref.) patients discharged with ICD-9 codes 410-414 (N=9,165).**

Medical Management	RR (95% CI)
Aspirin	0.99 (0.98 – 1.01)
Non-Aspirin Antiplatelets	0.90 (0.86 – 0.94)
Lipid Lowering Agents	0.97 (0.94 – 1.01)
Beta Blockers	0.99 (0.97 – 1.02)
ACEi / ARBs	1.08 (1.02 – 1.14)
Invasive Management	
Angiography	0.90 (0.87 – 0.94)
Revascularization	0.72 (0.63 – 0.78)

*Models adjusted for demographics [age, sex, hospital geographic location (Forsyth County, NC; Jackson, MS; Minneapolis, MN; Washington County, MD) and year of admission], comorbidities and clinical course [diabetes, cardiogenic shock, and ventricular fibrillation / cardiac arrest].

Table S9. Risk-adjusted* relative probabilities of invasive strategy among black vs. white (ref.) patients hospitalized with non ST-segment elevation myocardial infarction, stratified by geographic region. The Atherosclerosis Risk in Communities Surveillance Study, 2000 – 2014.

Invasive Strategy	**Forsyth, NC** *RR (95% CI)*	**Jackson, MS** *RR (95% CI)*	**Minneapolis, MN** *RR (95% CI)*	**Washington, MD†** *RR (95% CI)*
Angiography	0.65 (0.60 – 0.70)	0.87 (0.79 – 0.96)	0.45 (0.38 – 0.56)	0.73 (0.60 – 0.97)
Revascularization	0.52 (0.47 – 0.57)	0.61 (0.53 – 0.70)	0.45 (0.37 – 0.56)	0.72 (0.54 – 1.05)

*Models adjusted for demographics [age, sex, and year of admission], comorbidities and clinical course [diabetes, acute heart failure / pulmonary edema, cardiogenic shock, and ventricular fibrillation / cardiac arrest].

†Estimates from Washington, MD based on a small sample size (n=99) of black patients