ORIGINAL RESEARCH

American Heart Association | American Stroke Association

Impact of Regional Systems of Care on Disparities in Care Among Female and Black Patients Presenting With ST-Segment–Elevation Myocardial Infarction

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***Background*—**The American Heart Association Mission: Lifeline STEMI (ST-segment–elevation myocardial infarction) Systems Accelerator program, conducted in 16 regions across the United States to improve key care processes, resulted in more patients being treated within national guideline goals (time from first medical contact to device: <90 minutes for direct presenters to hospitals capable of performing percutaneous coronary intervention; <120 minutes for transfers). We examined whether the effort reduced reperfusion disparities in the proportions of female versus male and black versus white patients.

***Methods and Results*—**In total, 23 809 patients (29.3% female, 82.3% white, and 10.7% black) presented with acute STEMI between July 2012 and March 2014. Change in the proportion of patients treated within guideline goals was compared between sex and race subgroups for patients presenting directly to hospitals capable of performing percutaneous coronary intervention (n=18 267) and patients requiring transfer (n=5542). The intervention was associated with an increase in the proportion of men treated within guideline goals that presented directly (58.7–62.1%, P=0.01) or were transferred (43.3–50.7%, P<0.01). An increase was also seen among white patients who presented directly (57.7–59.9%, P=0.02) or were transferred (43.9–48.8%, P<0.01). There was no change in the proportion of female or black patients treated within guideline goals, including both those presenting directly and transferred.

***Conclusion*—**The STEMI Systems Accelerator project was associated with an increase in the proportion of patients meeting guideline reperfusion targets for male and white patients but not for female or black patients. Efforts to organize systems of STEMI care should implement additional processes targeting barriers to timely reperfusion among female and black patients. **(*J Am Heart Assoc.* 2017;6:e007122. DOI: 10.1161/JAHA.117.007122.)**

Key Words: acute coronary syndrome • myocardial infarction • race • reperfusion • sex

The cornerstone of acute ST-segment–elevation myocardial infarction (STEMI) treatment is prompt coronary artery reperfusion to reduce morbidity and mortality. National guidelines call for primary percutaneous coronary intervention (PCI) within 90 minutes of paramedic arrival for patients who call 9-1-1 and are transferred directly to a hospital offering PCI (PCI-capable) and within 120 minutes of first medical contact (FMC) for patients requiring interhospital transfer.[1] Nevertheless, up to 50% of patients presenting with STEMI fail to meet national guideline goals for reperfusion therapy.[2–5] Furthermore, disparities in both the use and the timing of reperfusion therapy may exist in vulnerable patient populations, including women and minorities, particularly black patients.[6–11] However, little contemporary evidence exists to describe care gaps among such disparate groups, particularly on a national level.

The Regional Systems of Care Demonstration Project American Heart Association Mission: Lifeline STEMI Systems Accelerator program represented the largest effort in the United States to organize regional STEMI care. It significantly increased the proportion of patients treated within guideline goals and significantly reduced reperfusion times among hospitals implementing care processes compared with those

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An accompanying Data S1 is available at http://jaha.ahajournals.org/content/6/10/e007122/DC1/embed/inline-supplementary-material-1.pdf

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Clinical Perspective

What Is New?

- Women and black patients have longer ST-segment–elevation myocardial infarction (STEMI) treatment times compared with men and white patients.
- Establishment of regional systems of STEMI care has been shown to improve overall STEMI treatment times, but its impact on care disparities by sex and race is less clear.

What Are the Clinical Implications?

- Despite implementing regional systems of STEMI care across health systems in the United States, disparities in STEMI care persist among women and black patients.
- This study highlights the need to develop regional care efforts to implement additional processes to overcome barriers to care for women and black patients.

that did not.[12,13] Recent efforts to improve STEMI reperfusion times have identified systemic barriers to care resulting from a highly fragmented healthcare system as a primary impediment to the delivery of rapid reperfusion.[12,14–16] To address system-related delays, interventions were conducted with the goal of identifying regional gaps, barriers, and inefficiencies in STEMI care and to implement proven recommendations and protocols to improve quality and consistency of care. Key study interventions included organizing and training regional leadership, identifying barriers to care unique to each region, establishing common protocols for the diagnosis and treatment of patients with STEMI presenting to emergency medical services (EMS) personnel or hospitals lacking PCI facilities, conducting ongoing measurement of and feedback on performance in hospitals, and having regular reviews of performance with representatives of hospitals and EMS agencies.

Despite the success of these programs, little is known about the specific impact of rapidly implementing multiple STEMI regional networks on care disparities, including among female and black patients. The objective of this study was to determine the impact of implementing regional systems of STEMI care on the proportion of patients treated within reperfusion time guideline goals for female versus male and black versus white patients and to determine whether the intervention narrowed disparities between these groups.

Methods

Study Design and Population

This study analyzed data collected over 7 calendar quarters from July 1, 2012 (2012 quarter 3), through March 31, 2014 (2014 quarter 1), as part of the STEMI Systems Accelerator project. The design and methods for this study have been published.[17] In brief, the STEMI Systems Accelerator project was a nationwide effort to organize and implement STEMI reperfusion therapy in 16 regions across the United States and included 484 hospitals and 1253 EMS agencies. The enrollment criteria for each region included the following: (1) 70% of PCI-capable hospitals in the region were participating in the National Cardiovascular Data Registry's ACTION Registry–Get With The Guidelines (AR-G) program; (2) there was defined organization of regional leadership; (3) common protocols were established for the diagnosis and treatment of patients with STEMI presenting to EMS personnel or hospitals lacking PCI facilities; (4) there was agreement to enter patients into the AR-G for 6 consecutive quarters; and (5) regional leadership participated in a 2-day national training session directed by study faculty reviewing current evidence, guidelines, and approaches to regional STEMI care. The following 16 of 21 regions that applied for participation in the project met enrollment criteria by the baseline data collection quarter and were included: Atlanta, GA; Columbus, OH; Denver, CO; Hartford, CT; Houston, TX; Kern County, CA; Louisville, KY; New York, NY; northern New Jersey; Oklahoma City, OK; Philadelphia, PA; Pittsburgh, PA; St. Louis, MO; San Antonio, TX; Tampa, FL; and Wilkes-Barre/Scranton, PA.

Regional interventions were based on Mission: Lifeline established approaches and drew on specific resources that effectively augmented regional organization in prior experience (Data S1).[18] Each region established common protocols, including common criteria for establishing the diagnosis of STEMI, activating a catheterization laboratory with a single phone or radio call, treating the patient with simple initial regimens, and transporting the patient by preidentified mechanisms. Common protocols were implemented, and ongoing performance measurement and feedback were conducted and reflected in quarterly hospital STEMI treatment reports.

Each region identified a quarter (quarters 3 or 4 of 2012 or quarter 1 of 2013) as the baseline quarter (Q1) from which to assess subsequent temporal trends in outcomes. All patients with ongoing ischemic symptoms lasting for >10 minutes but <12 hours, with ECG-diagnosed ST-segment elevation, and treated with primary PCI were included. Patients were included in the direct presenter group if they presented to a PCI-capable hospital (capable of performing PCI 24/7) either by EMS transport or self-transport. Patients were included in the transfer group if they presented to a hospital without PCI capabilities and were subsequently transferred to a PCI-capable hospital. Analysis was performed on the overall population represented by all 16 regions.

Study Outcome

The primary outcome of this study was the percentage of patients meeting guideline goals for FMC-to-device time. The outcome was analyzed by sex and race in each of the 7 quarters.

Statistical Analyses

Analyses were conducted to determine the change in the percentage of patients (female versus male and black versus white) meeting guideline goals for 6 quarters (after the baseline quarter). Descriptive statistics for continuous variables were presented as medians (25th and 75th percentiles). The Cochran–Armitage test for trend was used to assess changes in rates over time. Categorical variables are presented as frequencies with percentages. Baseline characteristics were compared using the Wilcoxon rank sum test for continuous variables and the Pearson χ^2 or Fisher exact test, as appropriate, for categorical variables. In-hospital mortality was analyzed using the logistic regression model with generalized estimating equations to account for clustering of patients within each hospital. Mixed-effects models were used to estimate the effect of sex and race on the dependent variable of FMC-to-device time and the interaction between sex or race and intervention.

All statistical tests were conducted at the nominal 0.05 significance level. Statistical analyses were performed with SAS version 9.2 or higher (SAS Institute). The project was reviewed by the Duke University institutional review board and classified as exempt.

Results

Patient Characteristics and Presentation

A total of 23 809 patients presented with acute STEMI from July 2012 through March 2014. The population was 70.7% male, 29.3% female, 82.3% white, and 10.7% black. Overall, 77% of patients were in the direct presenter group and 23% were in the transfer group. Of the 23 809 patients, 20 797 were treated by primary PCI within 12 hours of symptom onset and were included in the primary outcome analysis. Patient demographics, medical history, presenting clinical characteristics, and in-hospital complications are shown in Tables 1 and 2.

Women were significantly older and had significantly more comorbidities, including hypertension, chronic lung disease, diabetes mellitus, and prior heart failure, compared with men. Women were also more likely to have Medicare or Medicaid insurance. Women had a longer delay between symptom onset and FMC and were more likely to arrive by EMS transport rather than self-transport. Women who were transferred had a significantly longer door-in to door-out time compared with men. Women also had significantly more in-hospital complications, including in-hospital death, congestive heart failure, and major bleeding.

Black patients had significantly higher rates of diabetes mellitus and hypertension and were more likely to be uninsured compared with white patients. Among those transferred, black patients had significantly longer door-in to door-out times. Among direct presenters, black patients had higher rates of in-hospital complications including cardiogenic shock and congestive heart failure, whereas complication rates were similar for black and white patients in the transfer group. In-hospital mortality was similar for black and white patients.

Direct Presenter Group

In each quarter, a higher proportion of men were treated within guideline goals compared with women. The proportion of women presenting directly to a PCI-capable hospital that met guideline goals for FMC-to-device time (<90 minutes) did not change (53.5% in Q1 to 54.2% in Q7, P=0.26). However, the proportion of directly presenting men treated within guideline goals increased significantly from 58.7% in Q1 to 62.1% in Q7 (P=0.01) (Figure 1). The sex and intervention interaction terms were not significant.

In each quarter, a higher proportion of white patients were treated within guideline goals compared with black patients. The proportion of black patients in the direct presenter group meeting guideline goals did not change (54.0% in Q1 to 56.0% in Q7, P=0.43). However, the proportion of white patients in the direct presenter group meeting guideline goals increased modestly but significantly from 57.7% in Q1 to 59.9% in Q7 (P=0.02) (Figure 2). The race and intervention interaction terms were not significant.

Transfer Group

Among transfers in all regions over 7 calendar quarters, the proportion of women who were transferred to a PCI-capable hospital meeting guideline goals for FMC-to-device time (<120 minutes) did not change over the course of the intervention (42.8% in Q1 to 36.5% in Q7, P=0.53). The proportion of transferred male patients meeting guideline goals significantly increased from 43.3% in Q1 to 50.7% in Q7 (P<0.01) (Figure 1). The sex and intervention interaction terms were not significant.

The proportion of black patients in the transfer group treated within guideline goals decreased, although this was not statistically significant (42.9% in Q1 to 32.3% in Q7, P=0.54). The proportion of white patients in the transfer group meeting guideline goals significantly increased from

Table 1. Patient Characteristics by Sex

	Direct Presenter			Transfers		
	Male	Female	*P* Value	Male	Female	*P* Value
Demographics	n=12 813	n=5454		n=4021	n=1521	
Age, y			<0.001			<0.001
Median	59	66		58	64	
Q1–Q3	51–67	56–78		51–66	54–75	
Race, n (%)			0.114			0.651
White	10 485 (81.8)	4500 (82.5)		3349 (83.3)	1266 (83.2)	
Black	1428 (11.1)	617 (11.3)		362 (9.0)	146 (9.6)	
Other	900 (7.0)	337 (6.2)		310 (7.7)	109 (7.2)	
Insurance, n (%)						
Private/HMO	7194 (56.1)	2806 (51.4)	<0.001	2254 (56.1)	855 (56.2)	0.013
Medicare	3860 (30.1)	2593 (47.5)	<0.001	1223 (30.4)	690 (45.4)	<0.001
Medicaid	1030 (8.0)	729 (13.4)	<0.001	339 (8.4)	197 (13.0)	<0.001
None	2328 (18.2)	650 (11.9)	<0.001	703 (17.5)	188 (12.4)	<0.001
Other	2362 (18.4)	1358 (24.9)	<0.001	755 (18.8)	303 (19.9)	0.333
Medical history, n (%)						
Hypertension	8139 (63.5)	3924 (71.9)	<0.001	2507 (62.3)	1047 (68.8)	<0.001
Current/recent smoker	5262 (41.1)	1998 (36.6)	<0.001	1794 (44.6)	656 (43.1)	0.330
Dyslipidemia	4483 (35.0)	1973 (36.2)	0.114	1334 (33.2)	497 (32.7)	0.200
Chronic lung disease	605 (4.7)	470 (8.6)	<0.001	234 (5.8)	127 (8.3)	<0.001
Diabetes mellitus	3170 (24.7)	1746 (32.0)	<0.001	921 (22.9)	491 (32.3)	<0.001
Prior MI	1661 (13.0)	574 (10.5)	<0.001	438 (10.9)	142 (9.3)	0.303
Prior heart failure	370 (2.9)	261 (4.8)	<0.001	103 (2.6)	54 (3.6)	0.017
Prior PCI	1833 (14.3)	612 (11.2)	<0.001	475 (11.8)	143 (9.4)	0.057
Prior CABG	515 (4.0)	170 (3.1)	0.003	175 (4.4)	35 (2.3)	0.001
Presentation						
Arrival mode						
EMS transport	8002 (62.5)	3763 (69.0)	<0.001	NA	NA	
Self-transport	4811 (37.5)	1691 (31.0)	<0.001	NA	NA	
Door-in to door-out time, min						<0.0001
Median	NA	NA		60	65	
Q1–Q3	NA	NA		41–97	45–112	
Symptom onset to FMC, min			<0.001			<0.001
Median	60	70		86	100	
Q1–Q3	29.0–152.0	30.0–184.0		45.0–188.0	50.5–250.0	
ED time (min), n (%)			<0.001			0.694
≤20	2385 (18.6)	779 (14.3)		410 (10.2)	160 (10.5)	
>20 to ≤30	2073 (16.2)	766 (14.0)		184 (4.6)	72 (4.7)	
>30 to ≤45	2904 (22.7)	1145 (21.0)		614 (15.3)	236 (15.5)	
>45	4376 (34.2)	2012 (36.9)		536 (13.3)	184 (12.1)	
Shock, n (%)	1026 (8.0)	502 (9.2)	0.008	307 (7.6)	158 (10.4)	<0.001
Heart failure, n (%)	776 (6.1)	481 (8.8)	<0.001	278 (6.9)	139 (9.1)	0.005

Continued

Table 1. Continued

	Direct Presenter			Transfers		
	Male	Female	*P* Value	Male	Female	*P* Value
Reperfusion candidate, n (%)	12 330 (96.2)	5098 (93.5)	<0.001	3811 (94.8)	1423 (93.6)	0.075
Heart rate			0.002			0.002
Median	79	80		78	80	
Q1–Q3	66–93	66–96		65–93	68–96	
Systolic BP, mm Hg			<0.001			0.087
Median	140	138		143	142	
Q1–Q3	119–161	114–160		122–163	120–161	
Complications, n (%)						
In-hospital death	671 (5.2)	465 (8.5)	<0.001	188 (4.7)	118 (7.8)	<0.001
Stroke	78 (0.6)	57 (1.0)	0.002	35 (0.9)	16 (1.1)	0.530
Cardiogenic shock	948 (7.4)	502 (9.2)	0.625	282 (7.0)	139 (9.1)	0.008
Congestive heart failure	714 (5.6)	429 (7.9)	<0.001	232 (5.8)	113 (7.4)	0.023
Major bleeding	451 (3.5)	336 (6.2)	<0.001	133 (3.3)	100 (6.6)	<0.001

BP indicates blood pressure; CABG, coronary artery bypass grafting; ED, emergency department; EMS, emergency medical services; FMC, first medical contact; HMO, health maintenance organization; MI, myocardial infarction; NA, not assessed; PCI, percutaneous coronary intervention; Q, quarter.

43.9% in Q1 to 48.8% in Q7 (*P*<0.01) (Figure 2). In each quarter, a higher proportion of white patients were reperfused within guideline goals compared with black patients. The race and intervention interactions term were not significant.

Discussion

Establishment of regional systems of STEMI care has been shown to improve STEMI treatment times and is a class I recommendation in the American College of Cardiology Foundation and American Heart Association STEMI management guidelines.[1,19] In this study, implementing systems of STEMI care across multiple regions was associated with a significant increase in the proportion of male and white patients meeting guideline goals for FMC-to-device times among both direct presenters and transfers that was not evident for female or black patients, highlighting important contemporary care gaps that remain in the United States despite regional efforts.

Disparities in the management of STEMI by sex have been documented previously.[6–9,11] A study of 2.5 million patients in the National Registry of Myocardial Infarction database demonstrated that women were significantly less likely to receive reperfusion therapy compared with men.[11] Although the use of primary PCI for STEMI remained imbalanced in the current study, differences between men and women have significantly narrowed, particularly following intervention (Q1: 91.1% in men versus 84% in women, *P*<0.01; Q6 and Q7: 91.5% in men versus 87.1% in women, *P*<0.01). Furthermore, prior studies have shown that women who do receive reperfusion therapy have longer overall ischemic times and door-to-balloon times compared with men.[6,7,9] This study extends these prior findings by consistently demonstrating that a higher proportion of men were reperfused within guideline goals compared with women despite a national effort to organize STEMI care across multiple STEMI networks.

Despite the success of programs organizing regional systems of STEMI care, the impact of these programs on disparities in reperfusion therapy by sex is not well characterized. To our knowledge, the only other study to examine this is the RACE (Reperfusion of Acute Myocardial Infarction in North Carolina Emergency Departments) study, a statewide systems of STEMI care project conducted in North Carolina, which demonstrated that women had significant improvement in door-to-device times although not to a greater extent than men.[6] The considerably larger and heterogeneous population of the STEMI Systems Accelerator project, which was implemented across multiple systems of care in the United States, allowed for more widespread characterization of the impact of organizing STEMI care in vulnerable patient populations. In contrast to the results of the RACE study, the intervention in this study benefited men but not women. The difference in findings may be explained by the use of the more contemporary FMC-to-device time (incorporating prehospital system delays) rather than door-to-device time or by heterogeneity in both patient population and regional differences over time.

Similar to women, black patients are also less likely to receive reperfusion therapy compared with white patients,

Table 2. Patient Characteristics by Race

	Direct Presenter			Transfers		
	White	Black	*P* Value	White	Black	*P* Value
Demographics	n=14 985	n=2045		n=4615	n=508	
Age, y			<0.001			0.776
Median	61	60		60	60	
Q1–Q3	53–71	52–70		52–69	51–69	
Sex, n (%)			0.896			0.531
Male	10 485 (70.0)	1428 (69.8)		3349 (72.6)	362 (71.3)	
Female	4500 (30.0)	617 (30.2)		1266 (27.4)	146 (28.7)	
Insurance, n (%)						
Private/HMO	8434 (56.3)	968 (47.3)	<0.001	2625 (56.9)	258 (50.8)	0.591
Medicare	5337 (35.6)	718 (35.1)	<0.001	1609 (34.9)	171 (33.7)	<0.001
Medicaid	1414 (9.4)	224 (11.0)	<0.001	448 (9.7)	45 (8.9)	0.740
None	2307 (15.4)	414 (20.2)	<0.001	728 (15.8)	98 (19.3)	0.041
Other	2970 (19.8)	477 (23.3)	<0.001	857 (18.6)	112 (22.0)	0.058
Medical history, n (%)						
Hypertension	9766 (65.2)	1452 (71.0)	<0.001	2907 (63.0)	347 (68.3)	0.019
Current/recent smoker	5997 (40.0)	826 (40.4)	0.750	2046 (44.3)	201 (39.6)	0.040
Dyslipidemia	5211 (34.8)	721 (35.3)	0.024	1540 (33.4)	154 (30.3)	0.005
Chronic lung disease	916 (6.1)	96 (4.7)	0.035	323 (7.0)	17 (3.3)	0.043
Diabetes mellitus	3913 (26.1)	653 (31.9)	<0.001	1137 (24.6)	150 (29.5)	0.017
Prior MI	1800 (12.0)	261 (12.8)	0.069	494 (10.7)	40 (7.9)	0.777
Prior heart failure	488 (3.3)	85 (4.2)	0.010	131 (2.8)	11 (2.2)	0.983
Prior PCI	1991 (13.3)	265 (13.0)	0.687	523 (11.3)	47 (9.3)	0.656
Prior CABG	580 (3.9)	52 (2.5)	0.008	182 (3.9)	16 (3.1)	0.878
Presentation						
Arrival mode						
EMS transport	9510 (63.3)	1456 (71.2)	<0.001	NA	NA	
Self-transport	5475 (36.7)	589 (28.8)	0.869	NA	NA	
Door-in–door-out time, min						<0.001
Median	NA	NA		60	73	
Q1–Q3	NA	NA		41–97	43–129	
Symptom onset–FMC, min			0.983			0.036
Median	63	61		88	106	
Q1–Q3	30.0–161.0	30.0–170.0		47.0–196.0	51.0–254.0	
ED time (min), n (%)			0.353			<0.001
≤20	2594 (17.3)	323 (15.8)		391 (8.5)	62 (12.2)	
>20–≤30	2307 (15.4)	323 (15.8)		186 (4.0)	70 (13.8)	
>30–≤45	3362 (22.4)	430 (21.0)		584 (12.7)	116 (22.8)	
>45	5268 (35.2)	724 (35.4)		553 (12.0)	134 (26.4)	
Shock, n (%)	1228 (8.2)	190 (9.3)	0.094	391 (8.5)	51 (10.0)	0.237
Heart failure, n (%)	948 (6.3)	163 (8.0)	0.005	345 (7.5)	37 (7.3)	0.878
Reperfusion candidate, n (%)	14 321 (95.6)	1913 (93.5)	0.006	4363 (94.5)	467 (91.9)	0.019

Continued

Table 2. Continued

	Direct Presenter			Transfers		
	White	Black	*P* Value	White	Black	*P* Value
Heart rate			0.002			0.027
Median	80	80		79	80	
Q1–Q3	66–94	67–96		65–93	68–95	
Systolic BP, mm Hg			0.990			0.749
Median	140	140		143	140	
Q1–Q3	118–161	118–160		122–163	121–164	
Complications, n (%)						
In-hospital death	905 (6.0)	138 (6.7)	0.210	247 (5.4)	32 (6.3)	0.372
Stroke	102 (0.7)	23 (1.1)	0.028	41 (0.9)	5 (1.0)	0.803
Cardiogenic shock	1152 (7.7)	186 (9.1)	0.027	330 (7.2)	47 (9.3)	0.086
Congestive heart failure	901 (6.0)	152 (7.4)	0.013	267 (5.8)	32 (6.3)	0.644
Major bleeding	632 (4.2)	103 (5.0)	0.088	194 (4.2)	15 (3.0)	0.175

BP indicates blood pressure; CABG, coronary artery bypass grafting; ED, emergency department; EMS, emergency medical services; FMC, first medical contact; HMO, health maintenance organization; MI, myocardial infarction; NA, not assessed; PCI, percutaneous coronary intervention; Q, quarter.

and those who are treated by primary PCI have longer reperfusion times.[10,11,20,21] Differences between black and white patients in the use of primary PCI in this study was redemonstrated in the preintervention group (89.3% in white versus 84.9% in black patients in Q1, *P*=0.01) but were no longer present following intervention (90.6% in white versus 88.2% in black patients in Q6 and Q7, *P*=0.14). Consistent with prior findings, this study also showed that black patients had longer reperfusion times compared with white patients.[10,21]

Although implementing regional systems of STEMI care improves reperfusion times and the proportion of patients reperfused within guideline goals, this study demonstrates that sex and race disparities in STEMI care persist despite intervention. Consequently, the intervention did not eliminate barriers to care among female and black patients. This study highlights future opportunities to further improve the impact of implementing regional systems of STEMI care by incorporating additional care processes that address treatment barriers unique to female and black patients. Reasons for sex- and race-related disparities in STEMI care have been described previously.

Women have been shown to have longer reperfusion times compared with men for numerous reasons, including atypical symptoms and lack of chest discomfort, ECG with lower magnitude of ST-segment elevation, greater likelihood of a missed prehospital diagnosis of STEMI, longer delay between ECG acquisition and activation of the catheterization team, higher incidence of presentation to a non-PCI hospital, and higher risk of interhospital transfer resulting in delay of transfer.[8,9,22–26] Delay in seeking medical care is also more frequent among women for several reasons, including less knowledge about symptoms of STEMI, advanced age, greater likelihood to contact their physician initially, and greater likelihood of living alone or being widowed.[27] In this study, it is plausible that symptom presentation among women contributed to a longer delay in obtaining an ECG and confounded the diagnosis, which may be reflected in longer emergency department dwell times. In addition, a longer delay between symptom onset and FMC as well as older age and more comorbidities may explain the sicker initial presentation of women, with higher rates of cardiogenic shock and heart failure on presentation. Finally, women had significantly longer door-in to door-out times. The current intervention did not include education to specifically address atypical presentation in certain populations, including women and older adults. Additional education, particularly of EMS agencies, on the presentation in women and training to obtain an ECG even for atypical symptoms can allow for earlier diagnosis. In addition, providers should be educated to activate the catheterization team for a diagnostic ECG despite atypical symptoms. Finally, further analysis to understand why women have longer transfer times is necessary.

Race-related disparities have been attributed predominantly to differences in the care delivered at hospitals that treat a higher proportion of minorities as well as income and type of insurance.[10,21,28] In this study, black patients were more likely to be uninsured, and this may have contributed to differential care compared with white patients. Future endeavors should compare outcomes of hospitals that treat a higher proportion of black patients with other hospitals within the region to examine whether there are differences in

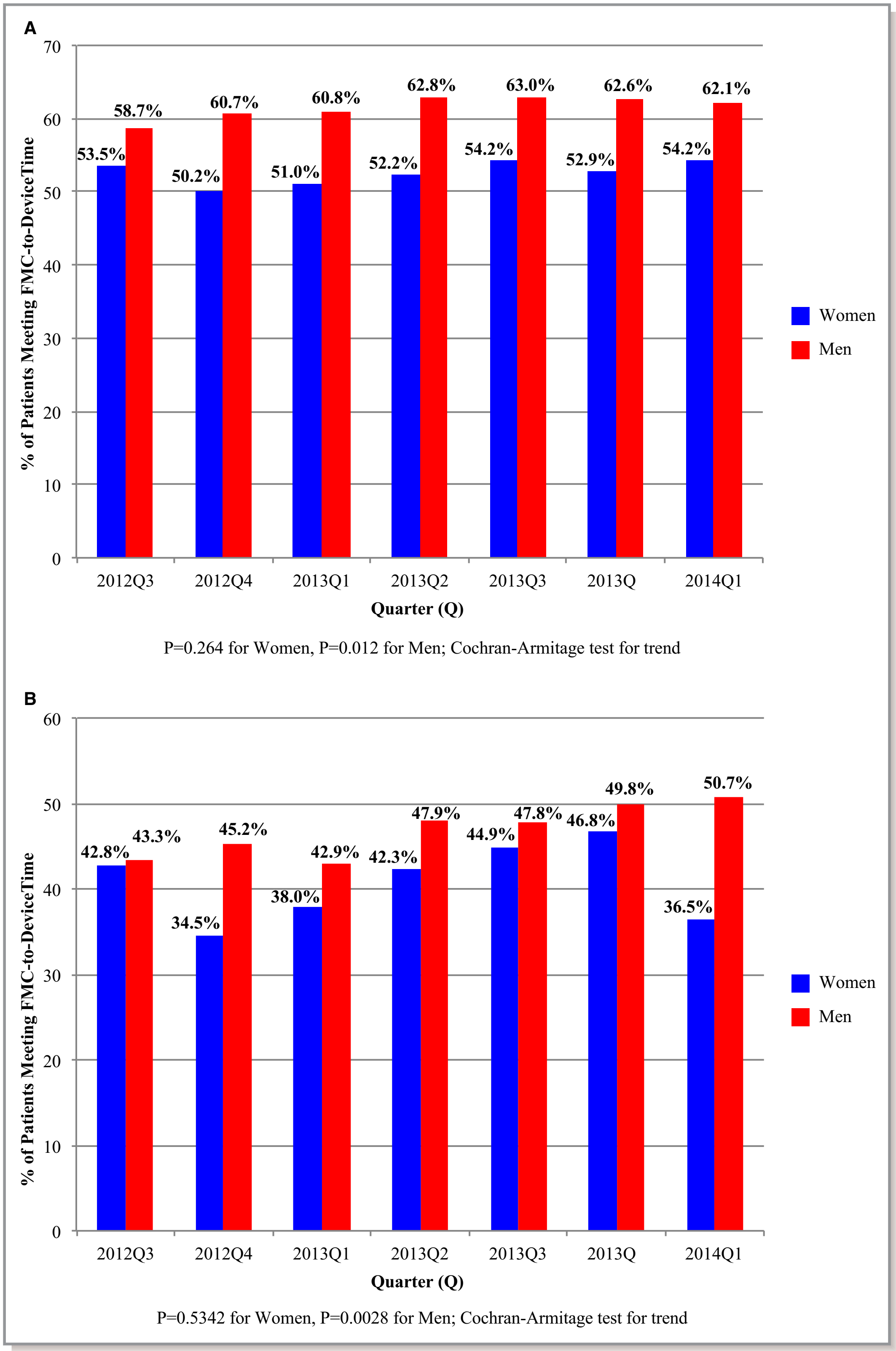

Figure 1. Percentage of patients meeting guideline goals for FMC-to-device time by quarter and sex. Patients arrived directly at hospitals capable of performing percutaneous coronary intervention (A) or were transferred (B). FMC indicates first medical contact.

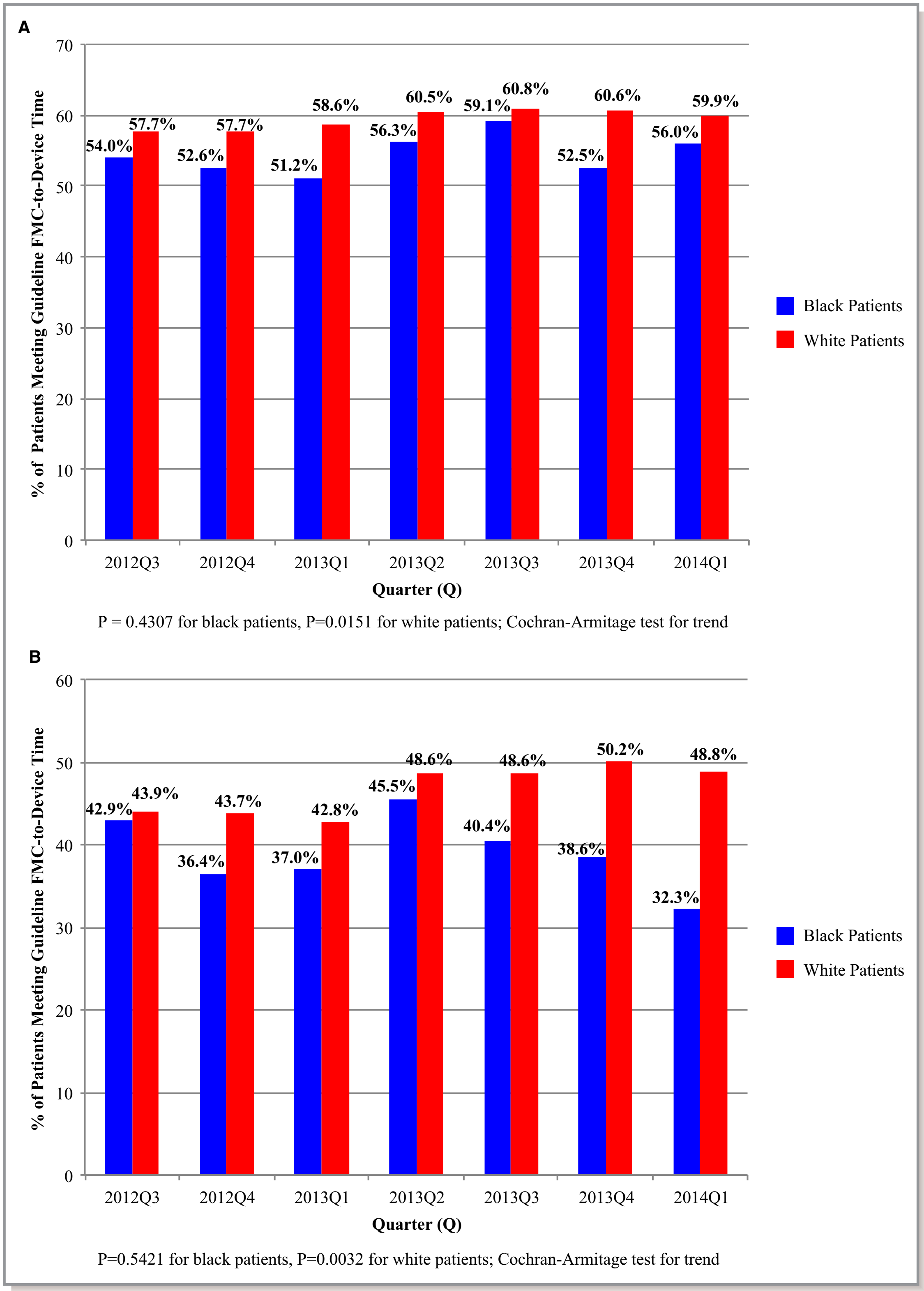

Figure 2. Percentage of patients meeting guideline goals for FMC-to-device time by quarter and race. Patients arrived directly at hospitals capable of performing percutaneous coronary intervention (A) or were transferred (B). FMC indicates first medical contact.

care. Although common protocols should mitigate differences in care regardless of race, hospitals treating more black patients may face additional barriers that hinder the ability to execute these protocols. Hospitals vary substantially not only in overall door-to-balloon times but also in key hospital-level subintervals, including door-to-ECG, ECG-to-lab, and lab-to-balloon times.[29] Comparing these subintervals among hospitals treating minorities may help to more precisely identify areas in need of improvement. Furthermore, EMS agencies are funded on a local basis, and those servicing lower socioeconomic and underserved areas lack adequate resources, personnel, or training to successfully implement desired interventions, thus leading to delays in care.[30] Ensuring adequate funding will be important to establish uniform application. In addition, this study showed that the greatest disparity in reperfusion times was among black patients in the transfer group: Only 32.3% of black patients met guideline goals compared with 48.8% of white patients. Furthermore, the door-in to door-out time was 13 minutes longer for black patients (P<0.001). This identifies race-related differences in interhospital transfers as a key area in need of further research and improvement. Finally, quarterly performance reports provided to each hospital could include outcomes by sex and race to provide feedback on the impact of implementing sex- and race-specific care processes.

To our knowledge, this is the only multiregion study to determine the impact of implementing regional systems of STEMI care on female and black patients. Although effectuating care processes improves reperfusion times of an overall population, this study demonstrates a differential impact of the intervention based on sex and race. The current study showed a significant increase in the proportion of male and white patients treated within guideline goals that was not evident for female or black patients. This highlights the persistent disparity in STEMI care among female and black patients and the importance of ongoing regional care efforts to implement additional processes to target and eliminate barriers to care delaying reperfusion times in female and black patients.

Limitations

This study has some limitations. Because of the observational nature of measurements, the relationships between the implementation of the STEMI Systems Accelerator project and treatment times and outcomes are subject to confounding, including cointervention. Quality-improvement efforts by participating hospitals and EMS agencies may have contributed to the outcomes. In addition, the willingness of enrolled hospitals to participate in the AR-G program may indicate a greater focus on quality improvements and thus may limit reproducibility at other hospitals.

Conclusion

A national STEMI regionalization program was associated with an increase in the proportions of male and white patients who are reperfused within guideline goals for FMC-to-device time that was not evident for female or black patients. These results highlight future opportunities to further narrow treatment differences among disparate populations.

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Disclosures

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Supplemental Material

Data S1.

Study Interventions

1. Bring together leading regional health care providers and institutions in a collaborative fashion.
2. Identify and establish regional leadership in emergency cardiac care that includes key physicians and administrators in emergency medicine and cardiology.
3. Appoint 2 national faculty members per region to serve as advisors and neutral brokers of competition in partnership with the local AHA staff. Faculty members bring expertise in regional STEMI system organization, implementation of regional process changes, and utilization of outcomes data to drive improved system performance.
4. Establish regional commitment to STEMI care improvement from all stakeholders: EMS providers, ED physicians, EMS administrators, non-PCI hospital and PCI hospital administrators, state and local government agencies, and professional organizations.
5. Conduct a comprehensive regional evaluation of current STEMI care, including a geographical map of the region with PCI and non-PCI hospitals.
6. Hold regional leader and national faculty pre-intervention conference calls to recruit and plan regional education meeting.
7. Conduct and facilitate a regional meeting to launch the effort with both national faculty and regional leaders to harness representation from all entities and multidisciplinary teams caring for the STEMI patient (EMS, non-PCI hospital, PCI hospital, administration, physicians, nurses, paramedics, quality-improvement officials).
8. Develop consensus-based standardized protocols for EMS and transfer-in patients in accordance with national professional guidelines to address local needs.

9. Discuss specific local STEMI case examples that follow patients from first medical contact to device activation in the PCI hospital.
10. Review quarterly regional STEMI care data with feedback from the NCDR and regional AHA Mission: Lifeline teams.

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Impact of Regional Systems of Care on Disparities in Care Among Female and Black Patients Presenting With ST–Segment–Elevation Myocardial Infarction

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