

**DISPARITIES IN ACCESS TO CARDIAC CARE AMONG
BALTIMORE CITY PATIENTS WITH
ACUTE MYOCARDIAL INFARCTION**

by

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List of Acronyms

AMI	Acute myocardial infarction
CABG	Coronary artery bypass graft
CATH	Catheterization
CHD	Coronary heart disease
FFS	Fee-for-service
HMO	Health maintenance organization
PCI	Percutaneous coronary intervention

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Introduction

Every year, approximately 600,000 people die of heart disease and roughly 720,000 people have a heart attack in the United States. It is still the leading cause of death in the nation across gender, racial and ethnic groups. In Maryland, the mortality rate for heart disease has decreased by 28.8 percent in the past decade. However, disparities in the mortality rate and utilization of cardiac care still persist by race, gender, insurance status, and location (Chen, Mann, & Hussein, 2012).

Baltimore City has one of the highest percentages of African American residents in the State of Maryland having experienced little or no improvement in terms of their health status. In 2010, the Baltimore City Health Department released the city's first Health Disparities Report Card, a comprehensive health assessment of various health indicators, such as heart disease, cancer, diabetes, infant mortality, and obesity. The overall final grade for the city was a D. This report clearly reaffirmed the persistent health disparities among racial and ethnic groups, particularly African Americans. Compared with whites, they fared worse on 21 out of 29 health indicators (Baltimore City Health Department, 2010).

The purpose of this study is to determine whether, among Baltimore City residents, there are differences in access to cardiac care based on sociodemographic characteristics. This care entails undergoing invasive cardiac procedures for treating coronary heart disease (CHD), specifically acute myocardial infarction (AMI), more commonly known as heart attacks. The sociodemographic characteristics include race, gender, insurance status based on primary payer, and jurisdiction based on place of residence. To gain insight into the effects of sociodemographic characteristics on patients with AMI in undergoing invasive cardiac procedures, retrospective analyses were conducted of recent hospital inpatient discharge data that answer the following research questions. In Baltimore City,

- 1) *are African American patients more or less likely than white patients to undergo invasive cardiac procedures when diagnosed with AMI?*
- 2) *what role does insurance status play among patients with AMI in receiving cardiac care?*
- 3) *how do patients with AMI compare against other Maryland patients with AMI in receiving cardiac care? Does location matter?*

Review of the Literature

Over the past two decades, an extensive body of research has emerged on the disparities in access to cardiac care based on socioeconomic characteristics, such as gender, insurance status, location, and race. These characteristics have been shown to be likely predictors of whether or not patients will undergo invasive cardiac procedures. The consistent finding has been that white men are the most likely to undergo cardiac procedures, and African American women are the least likely to do so (Giles et al., 1995).

The two most common procedures for CHD are coronary artery bypass graft (CABG), commonly known as "bypass surgery," and percutaneous coronary intervention (PCI), also

known as “stents.” A comparison of the effectiveness of these two procedures was made based on the mortality rates of Medicare beneficiaries using fee-for-service (FFS) Medicare claims data. The outcome showed that CABG resulted in lower mortality rates than PCI among patients with a number of different diagnoses, such as diabetes, heart failure, peripheral arterial disease, and tobacco use (Hlatky et al., 2013). Although CABG is more invasive and costly than PCI, this comparative effectiveness research recommended it as the preferred treatment option for patients, with the likelihood of a longer life expectancy and survival after the procedure.

Using hospital discharge data in Massachusetts and Maryland, Ayanian and Epstein (1991) assessed the differences between men and women in the use of cardiac procedures for coronary heart disease. All patients included in this study had principal diagnoses of myocardial infarction or unstable angina, angina pectoris, chronic ischemic heart disease, and nonrespiratory chest pain. They also included secondary diagnoses of congestive heart failure and diabetes mellitus. Compared to men, the women were older, insured, and more likely to be a minority with the principal diagnosis of unstable angina or chest pain rather than AMI. Even after adjusting for potential clinical and demographic confounding variables, Ayanian and Epstein found that men were more likely than women to undergo coronary angiography and revascularization procedures. The differences in the cardiac procedure rates based on gender suggested that women may not have been receiving the necessary procedures due to the indication that men are more likely to have CHD.

Is there a racial disparity in the use of PCI among patients with AMI? Prior research has focused on CABG. Casale and his colleagues (2007) analyzed hospital discharge data in Pennsylvania to determine whether racial and socioeconomic disparities existed in the use of primary PCI among patients with AMI. This study revealed that African Americans and low-income patients in Pennsylvania were less likely to undergo PCI and other cardiac procedures, such as cardiac catheterization (CATH), coronary intervention, and CABG. They found several apparent reasons for this racial and economic disparity in the use of PCI, including (1) disease severity, which may prohibit with the use of PCI, and (2) financial disincentives. However, there were no significant differences in the in-hospital mortality rate, notwithstanding the lower rates of PCI among African American or low-income patients.

What are further possible explanations for these differences? Condon and his colleagues (2008) explored some possible factors for racial and ethnic differences in the treatment of patients with AMI in the metropolitan area of Augusta, Georgia. Using reimbursement data in Georgia, their study showed that the likelihood of receiving cardiac care was higher if the patient was male, white, or had private insurance or self-pay, while it was lower if the patient was female, African American, or had government insurance or was uninsured. There was no difference between urban and rural residents. This reinforced the long-held assumption that patients with private insurance are more likely than those with government insurance to receive cardiac care. The authors found the following possible reasons for these differences: (1) uninsured patients are sicker and younger when diagnosed with first-episode AMI and are less likely to have received routine preventive care; (2) poor lifestyle choices and family history of cardiovascular disease; (3) a higher proportion of working poor residents without health coverage; (4) and residents facing cultural barriers in accessing health care services.

Are African Americans more or less likely to be referred for cardiac care by a physician? Gregory, LaVeist, and Simpson (2006) investigated white and African American patients from three community hospitals in Baltimore City following American College of Cardiology guidelines. Based on medical record abstractions along with patient and physician interviews,

they found that whites were more likely than African Americans to be referred for cardiac care after controlling for age, education, socioeconomic status, and insurance status. The potential reasons found by the authors for a lack of referrals included social determinants (health literacy, family stressors, and patient preferences), health encounters (physician medicine and rehabilitation consultations, as well as education about options), and health system factors (insurance and facility location).

For patients who have received referrals for CHD, were they necessary, beneficial, and appropriate? In New York State hospitals, Hannan and his colleagues (2014) assessed whether diagnostic cardiac CATH treatments for patients with CHD were deemed appropriate, uncertain, or inappropriate. This study used an Appropriateness Use Criteria for diagnostic cardiac CATHs that was developed as a CHD assessment tool based on clinical characteristics, patient characteristics, and risk factors. The results showed that one quarter of these treatments were deemed inappropriate due to lack of stress test information. This had no relation to hospital volume or inappropriateness for PCI

It is well documented that minorities are more likely than whites to die from preventable illnesses and diseases, especially CHD. What is the role of insurance status in the likelihood of undergoing cardiac procedures and explaining the racial health disparities between whites and minorities, especially African Americans in poor, urban communities? Ng, Brotman, Lau, and Young (2012) compared the mortality rates between privately insured and underinsured patients, including those with Medicaid and the uninsured, in hospitalizations for AMI, atherosclerosis, and stroke. For patients hospitalized for AMI, there was a strong association between the underinsured and higher mortality rates, while race was insignificant. This study does imply that privately insured patients are more likely than Medicaid and uninsured patients to receive better access to cardiac care. This finding is significant, given that the expansion of health coverage through the Affordable Care Act can potentially reduce and eliminate racial health disparities in terms of access to cardiac care for treating CHD. The role of insurance status is increasingly important given the expansion of Medicaid and private health plans available through health insurance exchanges. The differences in cardiac care among privately insured, Medicare, Medicaid, and uninsured hospitalized patients present a challenge in terms of ensuring adequate access to quality health care.

Using a national database of hospital inpatient stays, Hasan, Orav, and Hicks (2010) analyzed in-hospital mortality rates, length of stay, and cost per hospitalization for three common conditions—AMI, stroke, and pneumonia—among working-age adults to determine whether disparities existed in access to care based on insurance status. This study used three categories for insurance status: privately insured, uninsured, and Medicaid. For the three medical conditions, the findings revealed that uninsured and Medicaid patients had higher in-hospital mortality rates than privately insured patients. Medicaid patients also had longer lengths of stay for these conditions, which in turn was more costly per hospitalization. This study reinforced the finding that privately insured patients are more likely than Medicaid and uninsured patients to have access to health care and better outcomes.

In looking at government insurance, Guadagnoli and his colleagues (2000) found the use of coronary angiography in Medicare beneficiaries higher for those patients with traditional FFS coverage than for those enrolled in managed care plans, also called health maintenance organizations (HMOs), which are known for cost containment. This variation between two payer models within Medicare reveals different practices for authorizing procedures. It also shows that those enrolled in managed care plans might not be receiving proper access to cardiac care

compared to those enrolled in FFS coverage. The trend towards managed care plans does raise concerns about whether there is a tradeoff between cost containment and quality of care.

The growth of managed care is often associated with reductions in services. Volpp and Buckley (2004) examined the relationship between outcomes and treatment patterns for AMI patients and changes in HMO penetration. For patients with AMI, this study indicated that higher HMO penetration translated into lower rates of cardiac procedures with no effect on in-hospital mortality.

Sloan, Rankin, Whellan, and Conover (2000) did a study on Tennessee Medicaid patients who had moved from a traditional FFS plan to a managed care program called TennCare. They found that the rates of coronary revascularization procedures performed on TennCare AMI patients were on par with privately insured patients. However, there were differences between those enrolled in TennCare and traditional Medicaid and those enrolled in private insurance plans when receiving a revascularization procedure with regard to two specific procedures: coronary angioplasty and coronary bypass surgery. In the end, their study showed that the implementation of TennCare represented a shift towards managed care, allowing more people to be covered who otherwise would have been denied or remained uninsured.

LaPar and his colleagues (2011) found that after CABG surgery, Medicaid and uninsured patients had worse outcomes than patients with Medicare or private insurance. Medicaid and uninsured patients had CABG during urgent/emergent admissions, while those with Medicare or private insurance tended to have CABG during elective admissions. In addition, low-income Medicaid patients tended to be sicker with a high likelihood of in-hospital mortality and had longer lengths of stay at hospitals, making them more costly compared to other payer groups. This study showed that there is a strong correlation between insurance status and health outcomes, as well as insurance status and socioeconomic status.

Methods

The Health Services Cost Review Commission is an independent state agency responsible for collecting and maintaining patient-level case mix data, such as hospital inpatient discharge information containing medical record abstracts of clinical demographic and billing data in Maryland. Since 1977, the agency has also set rates for hospital services. Currently, Maryland is the only state in the nation to retain an all-payer hospital system through a federal waiver with approval from the Centers for Medicare and Medicaid Services. This unique system has led to substantial cost savings by reimbursing all payers at the same rate for hospital services, including Medicare, Medicaid, and private insurers. Ideally, the all-payer system eliminates financial barriers and implies that a Maryland resident hospitalized for AMI should receive equal access to cardiac care regardless of location.

This study uses Maryland's patient-level hospital inpatient discharge data for 2012, the most recent data available at the time of this writing. The retrospective analyses are limited to patients who lived in Maryland at the time of admission in 2012 with a principal diagnosis and/or up to 14 secondary diagnosis codes of AMI (ICD-9-CM 410.0–410.9). Access to cardiac care is defined as a patient with AMI undergoing one of the following three cardiac procedures based on the primary procedure code and up to 14 secondary procedure codes: coronary artery angiography (also known as coronary arteriography and cardiac CATH) (ICD-9-CM 37.21–37.23, 88.50–88.58), CABG (ICD-9-CM 36.10–36.19), and PCI (ICD-9-CM 36.00–36.06).

The main focus of this study is to determine whether the sociodemographic characteristics of AMI patients in the city of Baltimore are likely predictors for undergoing invasive cardiac procedures. The dependent variables include whether or not the patient had one of three cardiac procedures: CATH, CABG, and PCI. The independent variables are race, age, gender, insurance status, and jurisdiction.

For age, patients chosen for the study were at least 18 years of age or older and were categorized into five groups: 18–39, 40–49, 50–64, 65–74, and 75+. For race, patients were excluded who were not listed as white or African American, as they comprised a small percentage of patients. Since African Americans constituted 70 percent of the minority population in Maryland, this made for a more statistically significant dichotomous comparison between African Americans and whites (Chen, Mann, & Hussein, 2012). For insurance status, there were seven categorical groups based on the patient's primary payer: Medicare, Medicaid, private (Blue Cross, Commercial Insurance), Medicare-HMO, Medicaid-HMO, private-HMO, and other (for example, no charge, self-pay, worker's compensation). For place of residence, there were eight groups based on the Baltimore metropolitan area and similar population size and demographics: Anne Arundel, Baltimore City, Baltimore County, Harford, Howard, Montgomery, Prince George's, and Other, which included the rest of the counties in Maryland. Howard served as a proxy for an affluent surrounding county in the Baltimore metropolitan area, and Prince George's served as a proxy for an affluent county with a majority African American population.

There were two logistic regression models conducted to calculate the odds ratios of AMI patients undergoing invasive cardiac procedures. The first model was conducted with covariates of race by gender and insurance status adjusted by age as likely predictors of AMI patients in Baltimore City undergoing each of the three cardiac procedures. The categorical covariates were race by gender and insurance status. The reference groups were white, male, and Medicare. The second model included covariates from the previous model as well as jurisdiction, another categorical covariate, to investigate fully the association of location with other sociodemographic characteristics and access to cardiac care based on the use of each of the three invasive procedures. The reference groups were white, male, Medicare, and Baltimore City. The unit of analysis was a hospital discharge.

Results

In 2012, there were over 16,000 discharges of patients with AMI in Maryland. Only 13,681 patients with AMI met the criteria for this study. Of these 13,681 patients, 2,099 were residing in Baltimore City. Table 1 presents a summary of the sociodemographic characteristics for these patients by race. Clearly illustrated is a dichotomous comparison between white and African American patients with AMI in Baltimore City for analyzing other sociodemographic characteristics.

By race, 63.6 percent of patients were African American and 36.2 percent were white. By gender, 51.8 percent were males and 48.2 percent were females. Combining race and gender, more white males were diagnosed with AMI than white females, but it was evenly split between African American males and females, although African American females were hospitalized with AMI at a slightly higher rate than African American males. By age, the majority was 50 and over; however, African American patients tended to be younger than whites. The mean age of a white patients was 68.31 and that of African American patients was 63.76. By insurance status,

the majority of patients had Medicare, followed by private insurance, an HMO through Medicare or Medicaid, and Medicaid. However, whites were more likely to be covered by private insurance, while African Americans were more likely to be covered by Medicaid.

Table 2 shows the cardiac procedure rates for CABG, PCI, and CATH by gender, age, insurance status, and race of AMI patients in Baltimore City. The mean cardiac procedure rates were 4.4 percent for CABG, 7.7 percent for PCI, and 47.6 percent for CATH. By gender, men were twice as likely as women to receive CABG, and they were also more likely to receive the PCI and CATH procedures. The cardiac procedure rates for these three invasive procedures were

Table 1. Sociodemographic Characteristics of Patients with AMI in Baltimore City by Race

CHARACTERISTICS		RACE		
		WHITE (N=759)	AFRICAN AMERICAN (N=1340)	TOTAL (N=2099)
		36.2%	63.6%	100%
GENDER	Male	420 55.3%	668 49.9%	1088 51.8%
	Female	339 44.7%	672 50.1%	1011 48.2%
AGE	Mean (SD)	68.31 (15)	63.76 (15.4)	65.14 (15.409)
	18-39	20 2.6%	49 3.7%	69 3.3%
	40-49	51 6.7%	183 13.7%	234 11.1%
	50-64	228 30.0%	478 35.7%	706 33.6%
	65-74	177 23.3%	272 20.3%	449 21.4%
	75+	283 37.3%	358 26.7%	641 30.5%
INSURANCE STATUS	Medicare	444 58.5%	641 47.8%	1085 51.7%
	Medicaid	44 5.8%	112 8.4%	156 7.4%
	Private	93 12.3%	129 9.6%	222 10.6%
	Medicare - HMO	37 4.9%	132 9.9%	169 8.1%
	Medicaid - HMO	32 4.2%	149 11.1%	181 8.6%
	Private - HMO	56 7.4%	59 4.4%	115 5.5%

	Other	53 7.0%	118 8.8%	171 8.1%
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greater for those with private insurance or private-HMO compared to those with Medicare or Medicaid coverage. Patients with private insurance (7.7 percent) or private-HMO (7.0 percent) were twice as likely than Medicare patients (4.0 percent) to receive CABG. CABG rates were higher if the patient’s age was between 50–74, while PCI rates were higher if a patient’s age was between 40–64. CATH rates were the highest in all age groups except the 75+ age group. By

Table 2. Cardiac Procedure Rates of Patients with AMI

CHARACTERISTICS		PROCEDURES		
		CABG (4.4%)	PCI (7.7%)	CATH (47.6%)
		(Mean)		
GENDER				
	Male	5.9%	8.4%	50.4%
	Female	2.9%	7.0%	44.6%
AGE				
	18-39	7.2%	7.2%	50.7%
	40-49	3.0%	13.2%	51.7%
	50-64	5.4%	8.4%	58.9%
	65-74	6.5%	6.2%	51.9%
	75+	2.2%	6.1%	30.3%
INSURANCE STATUS				
	Medicare	4.0%	6.3%	41.1%
	Medicaid	3.8%	9.6%	49.4%
	Private	7.7%	9.5%	61.7%
	Medicare - HMO	3.0%	8.9%	46.2%
	Medicaid - HMO	3.3%	8.3%	48.6%
	Private - HMO	7.0%	9.6%	67.0%
	Other	4.7%	9.9%	56.1%
RACE				
	White	5.4%	8.3%	47.3%
	African American	3.9%	7.4%	47.8%

race, white patients were more likely than African American patients to undergo CABG. For PCI, the rates were 8.3 percent for whites and 7.4 percent for African Americans. For CATH, the rates were 47.3 percent for whites and 47.8 percent for African Americans. Overall, except for CATH, white patients with AMI were more likely than African American patients to receive invasive cardiac procedures in Baltimore City.

Table 3 presents a statewide summary of sociodemographic characteristics of patients with AMI by jurisdiction. This summary reveals that men were more likely than women to be hospitalized with AMI. Based on the mean age, most patients with AMI were from Montgomery County. Baltimore County, Montgomery County, and Other counties (the rest of Maryland) had

Table 3. Sociodemographic Characteristics of Patients with AMI in Maryland by Jurisdiction

CHARACTERISTICS	JURISDICTION								
	Baltimore City N= 2099 (15.3%)	Baltimore County N= 2784 (20.3%)	Howard N=444 (3.2%)	Anne Arundel N=1287 (9.4%)	Harford N=810 (5.9%)	Montgomery N=1032 (7.5%)	Prince George's N=1377 (10.1%)	Other (Rest of MD) N=3848 (28.1%)	Statewide N=13681 (100%)
GENDER									
MALE	1088 51.8%	1460 52.4%	245 55.2%	703 54.6%	464 57.3%	532 51.6%	723 52.5%	2101 54.6%	7316 53.5%
FEMALE	1011 48.2%	1324 47.6%	199 44.8%	584 45.4%	346 42.7%	500 48.4%	654 47.5%	1747 45.4%	6365 46.5%
AGE									
MEAN	65.41	70.89	69.79	68.14	67.91	72.41	67.84	69.55	69.01
(SD)	(15.41)	(14.79)	(14.61)	(14.68)	(14.67)	(14.98)	(15.04)	(14.96)	(15.08)
18-39	69 3.3%	42 1.5%	3 .7%	20 1.6%	20 2.5%	18 1.7%	49 3.6%	68 1.8%	289 2.1%
40-49	234 11.1%	172 6.2%	35 7.9%	107 8.3%	57 7.0%	58 5.6%	107 7.8%	308 8.0%	1078 7.9%
50-64	706 33.6%	750 26.9%	129 29.1%	408 31.7%	252 31.1%	238 23.1%	396 28.8%	1043 27.1%	3922 28.7%
65-74	449 21.4%	573 20.6%	86 19.4%	276 21.4%	194 24.0%	212 20.5%	327 23.7%	826 21.5%	2943 21.5%
75+	641 30.5%	1247 44.8%	191 43.0%	476 37.0%	287 35.4%	506 49.0%	498 36.2%	1603 41.7%	5449 39.8%
INSURANCE STATUS									
MEDICARE	1085 51.7%	1720 61.8%	259 58.3%	734 57.0%	466 57.5%	649 62.9%	786 57.1%	2478 64.4%	8177 59.8%
MEDICAID	156 7.4%	110 4.0%	14 3.2%	27 2.1%	9 1.1%	14 1.4%	60 4.4%	70 1.8%	460 3.4%
PRIVATE	222 10.6%	394 14.2%	101 22.7%	222 17.2%	170 21.0%	165 16.0%	198 14.4%	663 17.2%	2135 15.6%
MEDICARE - HMO	169 8.1%	171 6.1%	3 .7%	45 3.5%	12 1.5%	17 1.6%	39 2.8%	70 1.8%	526 3.8%
MEDICAID – HMO	181 8.6%	68 2.4%	9 2.0%	49 3.8%	25 3.1%	22 2.1%	48 3.5%	111 2.9%	513 3.7%
PRIVATE – HMO	115 5.5%	209 7.5%	44 9.9%	118 9.2%	79 9.8%	117 11.3%	154 11.2%	227 5.9%	1063 7.8%
OTHER	171 8.1%	112 4.0%	14 3.2%	92 7.1%	49 6.0%	48 4.7%	92 6.7%	229 6.0%	807 5.9%
RACE									
WHITE	759 36.2%	2171 78.0%	370 83.3%	1072 83.3%	720 88.9%	809 78.4%	378 27.5%	3369 87.6%	9648 70.5%
AFRICAN AMERICAN	1340 63.8%	613 22.0%	74 16.7%	215 16.7%	90 11.1%	223 21.6%	999 72.5%	479 12.4%	4033 29.5%

the highest prevalence of Medicare patients with AMI. Howard and Harford counties had the highest prevalence of privately insured patients with AMI. Baltimore City had the highest percentage of patients with Medicare and Medicaid through an HMO, while Montgomery and Prince George’s counties had the highest percentages of patients with private insurance-HMO. By race, Prince George’s County (72.5 percent) had the highest percentage of African American patients with AMI followed by Baltimore City (63.8 percent).

The statewide cardiac procedure rates of patients with AMI in Maryland are presented in Table 4. They were 4.4 percent for CABG, 7.2 percent for PCI, and 40.6 percent for CATH. Howard County had the highest CABG rate (8.6 percent), while Montgomery and Prince George’s counties had the lowest CABG rates (2.0 percent and 1.6 percent, respectively). PCI rates were the highest in Anne Arundel and Montgomery counties (8.9 percent and 9.8 percent, respectively), and the lowest in Howard County and Other (5.0 percent and 6.0 percent, respectively). Baltimore City had the highest CATH rate (47.6 percent), while Montgomery County and Other had the lowest (34.1 percent and 37.7 percent, respectively).

The first logistic regression model is displayed in Table 5. For CABG, white and African American female patients were the least likely to undergo this invasive cardiac procedure. Insurance status did not have an effect on whether or not an AMI patient underwent this procedure. For PCI, none of the sociodemographic characteristics were significant predictors. For CATH, younger patients with private insurance with or without an HMO were more likely to utilize this cardiac procedure.

The second logistic regression model is displayed in Table 6 with the inclusion of jurisdiction to compare Baltimore City AMI patients with other jurisdictions. For CABG, African American female patients were again the least likely to undergo this invasive cardiac procedure in

Table 4. Cardiac Procedure Rates of Patients with AMI in Maryland by Jurisdiction

JURISDICTION	CARDIAC PROCEDURES		
	CABG	PCI	CATH
Baltimore City	93 4.4%	162 7.7%	999 47.6%
Baltimore County	166 6.0%	192 6.9%	1208 43.4%
Howard	38 8.6%	22 5.0%	172 38.7%
Anne Arundel	72 5.6%	115 8.9%	503 39.1%
Harford	28 3.5%	54 6.7%	334 41.2%
Montgomery	21 2.0%	101 9.8%	352 34.1%
Prince George’s	22 1.6%	110 8.0%	538 39.1%
Other (Rest of MD)	167 4.3%	232 6.0%	1449 37.7%

Statewide	607 4.4%	988 7.2%	5555 40.6%
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comparison to white males followed by white females and African American males. Insurance status was not significant. However, location mattered, with a higher likelihood of undergoing the procedure if residing in Anne Arundel and Howard counties and less so if residing in Prince George’s County and Other.

For PCI, African American and white female patients were the least likely to undergo this procedure followed by African American males. Patients with no insurance or other coverage and private insurance with or without an HMO were more likely to undergo PCI. By jurisdiction, AMI patients in Baltimore County, Harford, and Prince George’s were more likely than those residing in Baltimore City to receive this procedure. For CATH, African American females, white females, and African American males were the least likely to undergo this procedure in comparison to white males. Insurance status was a significant predictor of CATH for younger patients with Medicare-HMO, private insurance, private-HMO, or Other. Younger patients with AMI in Baltimore and Howard counties had a higher likelihood of undergoing CATH.

Table 5. Odds-Ratios of Cardiac Procedures Among Patients with AMI in Baltimore City

CARDIAC PROCEDURE	VARIABLES	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
								Lower	Upper
CABG	WHITE MALE			11.385	3	.010			
	AFRICAN AMERICAN MALE	-.381	.264	2.085	1	.149	.683	.407	1.146
	WHITE FEMALE	-.865	.375	5.313	1	.021	.421	.202	.879
	AFRICAN AMERICAN FEMALE	-.924	.303	9.315	1	.002	.397	.219	.719
	MEDICARE			5.517	6	.479			
	MEDICAID	-.327	.483	.458	1	.499	.721	.280	1.859
	PRIVATE	.458	.331	1.920	1	.166	1.581	.827	3.023
	MEDICARE - HMO	-.215	.483	.199	1	.656	.806	.313	2.079
	MEDICAID - HMO	-.381	.491	.604	1	.437	.683	.261	1.787
	PRIVATE - HMO	.302	.432	.490	1	.484	1.353	.580	3.154
OTHER	-.145	.439	.110	1	.740	.865	.366	2.042	

CARDIAC PROCEDURE	VARIABLES	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
								Lower	Upper
	AGE	-.010	.009	1.303	1	.254	.990	.972	1.007
	CONSTANT	-1.919	.694	7.650	1	.006	.147		
PCI	WHITE MALE			3.898	3	.273			
	AFRICAN AMERICAN MALE	-.399	.225	3.159	1	.076	.671	.432	1.042
	WHITE FEMALE	-.414	.281	2.162	1	.141	.661	.381	1.148
	AFRICAN AMERICAN FEMALE	-.313	.224	1.960	1	.162	.731	.472	1.133
	MEDICARE			2.664	6	.850			
	MEDICAID	.254	.331	.587	1	.443	1.289	.673	2.469
	PRIVATE	.246	.285	.747	1	.388	1.279	.732	2.236
	MEDICARE - HMO	.399	.301	1.761	1	.185	1.491	.827	2.689
	MEDICAID - HMO	.096	.341	.079	1	.779	1.101	.564	2.149
	PRIVATE - HMO	.228	.364	.392	1	.531	1.256	.616	2.563
	OTHER	.287	.321	.798	1	.372	1.332	.710	2.500
	AGE	-.010	.007	2.221	1	.136	.990	.976	1.003
	CONSTANT	-1.660	.540	9.444	1	.002	.190		
CATH	WHITE MALE			2.970	3	.396			
	AFRICAN AMERICAN MALE	-.163	.130	1.590	1	.207	.849	.659	1.095
	WHITE FEMALE	-.247	.152	2.623	1	.105	.781	.580	1.053
	AFRICAN AMERICAN FEMALE	-.163	.129	1.586	1	.208	.850	.659	1.095
	MEDICARE			23.658	6	.001			
	MEDICAID	-.186	.191	.951	1	.330	.830	.572	1.207
	PRIVATE	.424	.164	6.665	1	.010	1.528	1.107	2.108
	MEDICARE - HMO	.216	.169	1.632	1	.201	1.241	.891	1.730
	MEDICAID - HMO	-.280	.187	2.243	1	.134	.755	.523	1.090
	PRIVATE - HMO	.613	.220	7.765	1	.005	1.846	1.199	2.840
	OTHER	.089	.186	.228	1	.633	1.093	.759	1.574
	AGE	-.025	.004	39.288	1	.000	.975	.968	.983
	CONSTANT	1.608	.310	26.948	1	.000	4.994		

Table 6. Odds-Ratios of Cardiac Procedures Among Patients with AMI in Maryland

CARDIAC PROCEDURE	VARIABLES	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
								Lower	Upper
CABG	WHITE MALE			48.751	3	.000			
	WHITE FEMALE	-.587	.104	31.890	1	.000	.556	.454	.682
	AFRICAN AMERICAN MALE	-.570	.146	15.334	1	.000	.565	.425	.752
	AFRICAN AMERICAN FEMALE	-.720	.155	21.737	1	.000	.487	.359	.659
	MEDICARE			9.789	6	.134			

CARDIAC PROCEDURE	VARIABLES	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
								Lower	Upper
CARDIAC PROCEDURE	MEDICAID	.156	.233	.451	1	.502	1.169	.741	1.845
	PRIVATE	.377	.206	3.344	1	.067	1.459	.973	2.186
	MEDICARE - HMO	-.211	.268	.619	1	.431	.810	.479	1.369
	MEDICAID - HMO	.217	.164	1.750	1	.186	1.242	.901	1.713
	PRIVATE - HMO	.306	.179	2.930	1	.087	1.359	.957	1.930
	OTHER	.306	.179	2.930	1	.087	1.359	.957	1.930
	BALTIMORE CITY			63.812	7	.000			
	BALTIMORE COUNTY	.175	.144	1.474	1	.225	1.192	.898	1.582
	HOWARD	.386	.114	11.416	1	.001	1.472	1.176	1.841
	ANNE ARUNDEL	.726	.189	14.769	1	.000	2.067	1.427	2.994
	HARFORD	.250	.146	2.952	1	.086	1.285	.965	1.709
	MONTGOMERY	-.289	.209	1.917	1	.166	.749	.497	1.128
	PRINCE GEORGE'S	-.717	.236	9.280	1	.002	.488	.308	.774
	OTHER (REST OF MD)	-.810	.239	11.518	1	.001	.445	.279	.710
	AGE	-.011	.004	9.089	1	.003	.989	.981	.996
CONSTANT	-2.150	.296	52.583	1	.000	.117			
PCI	WHITE MALE			51.510	3	.000			
	WHITE FEMALE	-.507	.086	35.127	1	.000	.602	.509	.712
	AFRICAN AMERICAN MALE	-.233	.104	5.028	1	.025	.792	.646	.971
	AFRICAN AMERICAN FEMALE	-.626	.118	28.308	1	.000	.535	.425	.673
	MEDICARE			43.954	6	.000			
	MEDICAID	.333	.182	3.373	1	.066	1.396	.978	1.993
	PRIVATE	.284	.107	7.080	1	.008	1.329	1.078	1.639
	MEDICARE - HMO	.341	.176	3.763	1	.052	1.406	.996	1.985
	MEDICAID - HMO	.142	.191	.549	1	.459	1.152	.792	1.676
	PRIVATE - HMO	.422	.126	11.197	1	.001	1.526	1.191	1.954
	OTHER	.808	.129	39.302	1	.000	2.243	1.742	2.888
	BALTIMORE CITY			31.884	7	.000			
	BALTIMORE COUNTY	.290	.116	6.238	1	.013	1.337	1.064	1.678
	HOWARD	.187	.103	3.316	1	.069	1.205	.986	1.473
	ANNE ARUNDEL	-.208	.230	.812	1	.367	.813	.517	1.276
	HARFORD	.391	.120	10.611	1	.001	1.479	1.169	1.871
	MONTGOMERY	.055	.157	.121	1	.728	1.056	.776	1.438
	PRINCE GEORGE'S	.581	.127	20.986	1	.000	1.788	1.394	2.293
OTHER (REST OF MD)	.380	.132	8.274	1	.004	1.462	1.129	1.893	
AGE	-.009	.003	9.836	1	.002	.991	.985	.997	
CONSTANT	-2.068	.237	76.033	1	.000	.126			
CATH	WHITE MALE			97.879	3	.000			
	WHITE FEMALE	-.362	.044	66.643	1	.000	.697	.639	.760
	AFRICAN AMERICAN	-.311	.060	26.658	1	.000	.733	.651	.825

CARDIAC PROCEDURE	VARIABLES	B	S.E.	Wald	df	Sig.	Exp(B)	95.0% C.I. for EXP(B)	
								Lower	Upper
	MALE								
	AFRICAN AMERICAN FEMALE	-.468	.060	60.103	1	.000	.626	.556	.705
	MEDICARE			129.941	6	.000			
	MEDICAID	-.193	.106	3.318	1	.069	.825	.671	1.015
	PRIVATE	.393	.059	44.722	1	.000	1.482	1.320	1.663
	MEDICARE - HMO	.422	.094	20.288	1	.000	1.525	1.269	1.832
	MEDICAID - HMO	-.277	.103	7.164	1	.007	.758	.619	.929
	PRIVATE - HMO	.477	.074	41.059	1	.000	1.611	1.393	1.865
	OTHER	.340	.083	16.556	1	.000	1.404	1.192	1.654
	BALTIMORE CITY			91.755	7	.000			
	BALTIMORE COUNTY	.462	.062	54.883	1	.000	1.587	1.404	1.793
	HOWARD	.320	.053	35.988	1	.000	1.377	1.240	1.529
	ANNE ARUNDEL	.029	.108	.075	1	.785	1.030	.834	1.272
	HARFORD	.008	.069	.013	1	.909	1.008	.881	1.154
	MONTGOMERY	.069	.082	.710	1	.399	1.072	.912	1.258
	PRINCE GEORGE'S	-.080	.077	1.078	1	.299	.923	.793	1.074
	OTHER (REST OF MD)	.139	.073	3.673	1	.055	1.150	.997	1.326
	AGE	-.028	.002	288.022	1	.000	.972	.969	.975
	CONSTANT	1.516	.132	131.056	1	.000	4.554		

Discussion

Through localized Baltimore City and generalized statewide data, this study extensively investigated the sociodemographic characteristics of Maryland in order to understand the disparities in access to cardiac care among patients with AMI. In Baltimore City, the majority of African American patients with AMI had Medicare or Medicaid with or without HMO, substantially decreasing the likelihood of their undergoing the CABG, PCI, or CATH procedures. This was more apparent with the underutilization of cardiac care among African American female patients. The majority of white patients with AMI also had Medicare. However, those with private insurance with or without HMO were more likely to undergo invasive cardiac procedures. Patients with private insurance were more likely to receive cardiac care than Medicare patients.

It is important to note that race and gender among patients with AMI in Baltimore City did not have as strong an effect as expected in predicting access to cardiac care, except for CABG. This might be attributed to the fact that the majority population served by Baltimore City hospitals is African American. Yet African American patients with AMI were less likely to undergo CABG than white patients at these hospitals (Caillier, 2006). Insurance status was also not significant, except for CATH in patients with private insurance versus those with Medicare or Medicaid.

The weak effects of race, gender, and insurance status indicate that disparities among Baltimore City residents are lessened if they are exposed to similar health risks or living under

similar conditions in an urban setting (LaVeist et al., 2011). The utilization of CATH was high regardless of insurance status, because it is the preliminary step for diagnosing and screening for CHD before undergoing PCI or CABG. This does suggest that private insurers are more likely to authorize the most invasive cardiac procedures than Medicare and Medicaid based on the cardiac procedure rate of CATH. In general, patients with AMI in Baltimore City had better access to cardiac care than other jurisdictions in Maryland that might explain the low effects of race, gender, and insurance status.

The statewide sociodemographic characteristics of patients with AMI provided broader generalized findings showing that the patient's place of residence mattered as well as race, gender, and insurance status in determining proper cardiac care. The effects of race and gender were realized with the underutilization of cardiac care among African American female patients for all of the three invasive cardiac procedures. White female patients were also unlikely to receive cardiac care at a just slightly higher rate than African American females, and men were more likely to receive the most invasive cardiac procedures, reaffirming the significant effect of gender (Freund et al., 2012). This means that African American and white female patients are less likely to be referred for cardiac care by a physician.

By jurisdiction, patients with AMI were more likely to receive cardiac care in the Baltimore metropolitan area (such as Montgomery and Prince George's counties, which had the lowest cardiac procedure rates) than in the Washington, DC metropolitan area. Patients with AMI in Maryland were most likely to undergo PCI over CABG. By insurance status, patients with private insurance with or without an HMO were more likely to undergo cardiac procedures, while Medicare or Medicaid patients served as a significant predictor for not undergoing any cardiac procedures (Freund et al., 2012). The gap between private and public coverage in access to cardiac care persists even under the state's unique all-payer system. This does necessitate further investigation to determine whether there are biases and financial disincentives to providing care for Medicare or Medicaid patients, which comprised the majority of patients with AMI in Maryland.

Policy Implications and Recommendations

The retrospective analyses in this study illustrate the ongoing disparities in access to cardiac care among patients with AMI in Baltimore City and Maryland, consistent with existing literature. It is encouraging that patients with AMI in Baltimore City had better access to cardiac care relative to other patients with AMI in Maryland than expected based on sociodemographic characteristics. Policymakers in Baltimore City and at the state level should pursue interventions that target vulnerable and underserved populations with CHD who are unlikely to receive cardiac care, such as African American and white women. The interventions might encompass a health literacy strategy for women, particularly African American women, that focuses on prevention, disease management, and improvement of outcomes following cardiac procedures (Kamble & Boyd, 2008).

The health literacy strategy would improve communication and increase awareness and understanding at the patient and provider level. This could be accomplished through cultural competency and sensitivity training for providers and education on CHD prevention and health promotion for patients. In turn, this approach might increase referral rates for cardiac care to further allow researchers and policymakers to evaluate outcomes following invasive cardiac procedures (Gregory, LaVeist, & Simpson, 2006). By understanding both utilization and referral

patterns for cardiac care, policymakers would be able to improve the allocation of health care resources more effectively. They would be able to target distressed neighborhoods in Baltimore City and other jurisdictions such as Prince George's, which reported the lowest cardiac procedure rates.

The reality is that ongoing disparities in access to cardiac care over the past two decades show the challenges of tackling the leading cause of death in the nation. The underutilization of cardiac procedures among women, especially African American women, is alarming, as this strongly implies that racial and gender biases exist, with the unlikelihood of being referred for cardiac care based on necessity. Policymakers should develop and implement interventions that specifically target women, especially African American women, with any indication of heart disease, while further investigating racial and gender disparities in access to cardiac care.

In addressing the gap between private and public insurance coverage for access to cardiac care, policymakers should investigate the underlying factors resulting in the low utilization rates of cardiac procedures among Medicare and Medicaid patients, since the majority of patients with AMI are covered under these government insurance programs. The ongoing disparity between whether patients have private or public coverage and whether patients undergo cardiac procedures is disconcerting given the implementation of health care reform that suggests physicians continue to be influenced by insurance status in terms of their unwillingness to provide care for those patients with public coverage (Wenneker, Weissman, & Epstein, 1990). To put it simply, the availability of insurance does not ensure equal access to cardiac care even under an all-payer system that reimburses hospital services to all insurers, public or private. The role of insurance status appears to continue to be pivotal as to whether a patient with AMI receives cardiac care.

During this critical time of implementing health care reform, it is important to note that, based on this study, those who enrolled in private health plans through the state's health insurance exchange, called Maryland Health Connection, may receive better access to cardiac care than those enrolled as part of the Medicaid expansion. But the reliance on HMOs in both public and private coverage might exacerbate the disparities in access to cardiac care (Carlisle, Leake, & Shapiro, 1997). Further study will be necessary to assess the impact of Medicaid expansion and/or private health plans through Maryland Health Connection on access to cardiac care for the uninsured and underinsured in the state.

Future Research

The next step to understanding fully the disparities in access to cardiac care among patients with AMI is to conduct retrospective analyses on other potential patient and hospital characteristics that may influence the utilization of cardiac care. These include admission status (elective, emergent, or urgent); clinical characteristics (diabetes, high blood pressure, smoking); discharge status; median income levels by zip code; size of hospital; type of hospital; and patient outcomes (in-hospital mortality, length of stay, procedure costs). These analyses would address the limitations of relying solely on sociodemographic characteristics to address disparities in access to cardiac care and shift towards quality of care in understanding the effectiveness of cardiac care among patients with AMI.

Due to similar majority African American population size, there should also be a regional comparison between patients with AMI in Baltimore City and Prince George's County. The cardiac procedure rates were considerably lower in Prince George's County, which suggests that

racial and gender disparities exist in hospitals that serve majority African American populations. It also appears that other factors beyond sociodemographic characteristics influence the likelihood of receiving cardiac procedures.

Overall, this study illustrates that disparities in access to cardiac care based on sociodemographic characteristics existed among patients with AMI in Baltimore City to a lesser extent than statewide, providing more generalizable findings about Maryland's population.

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