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## Disparities in the Receipt of Cardiac Revascularization Procedures between Blacks and Whites: an Analysis of Secular Trends

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### Abstract

**Introduction**—Mortality rates for coronary heart disease (CHD) have declined markedly since the early 1970s. However, CHD remains the number one cause of death in the United States. The decline in mortality has been attributed to declines in CHD risk factors (tobacco use, hypertension) and the increase in protective behaviors (exercise, weight control). Medical interventions may have also contributed to the decline in mortality. Despite these declines in mortality, racial disparities persist between Blacks and Whites. The purpose of this study was to examine the differences in receipt of cardiac catheterization, percutaneous transluminal coronary angioplasty, and coronary artery bypass graft.

**Methods**—Data from the National Hospital Discharge Survey were used for the analysis. Patients who were Black or White and  $\geq 40$  years of age were included. Independent variables included age at discharge, sex, race, and insurance coverage. Multivariate logistic regression was used to derive odds ratios for the receipt of the three procedures by age group, sex, insurance type, and race.

**Results**—Significant differences ( $P < .05$ ) in the odds of receipt of all of cardiac catheterization, percutaneous transluminal coronary angioplasty, and coronary artery bypass graft were found by age group, insurance type, sex, and race. While the disparities persisted from 1979 to 2004, the magnitude of the differences decreased during this time period.

**Conclusion**—Disparities by race, sex, and insurance type existed in the receipt of three cardiac procedures. Although differences are narrowing over time, further in-depth studies are needed to elucidate the patient, physician, and healthcare system factors associated with the disparity in receipt of these beneficial procedures.

### Keywords

Coronary Heart Disease; Cardiac Catheterization; Percutaneous Transluminal Coronary Angioplasty; Coronary Artery Bypass Graft; Health Disparity

## Introduction

Coronary heart disease (CHD) is a major public health concern in the United States, and Blacks are disproportionately affected by the disease.<sup>1,2</sup> An estimated 15.8 million American adults (8.5 million men, 7.2 million women) have CHD, and the average number of years of life lost to CHD is 15.<sup>3</sup> Blacks and Whites develop CHD in similar proportions; however, Blacks die from CHD at much higher rates. According to the American Heart Association, 9.4% of White men, 7.1% of Black men, 6% of White women, and 7.8% of Black women have CHD.<sup>4</sup> CHD mortality rates for White men, Black men, White women, and Black women are 194.4/100,000, 222.2/100,000, 115.4/100,000, and 148.6/100,000, respectively.<sup>3</sup>

Health disparities research for CHD can span the spectrum of care from prevention to treatment to concerns surrounding survivorship and end-of-life care.<sup>1,2,5</sup> Many investigators conducting CHD treatment disparities research have focused on factors related to the receipt of three standard rehabilitative procedures: cardiac catheterization, percutaneous transluminal coronary angioplasty (PTCA), and coronary artery bypass graft (CABG).<sup>6–13</sup> Systematic reviews of this body of literature reveal that patients who undergo PTCA and CABG tend to have better health and quality-of-life outcomes than those who undergo catheterization or no treatment at all. In addition, Black men and Black women in the United States have historically undergone PTCA and CABG less frequently than their White counterparts.<sup>14–17</sup>

Although several studies have shown that White-Black differences in rates of PTCA and CABG have narrowed in some regions of the country and nationally with subsets of CHD populations throughout the late 1990s,<sup>9,13,18,19</sup> contemporary national-level trends for the general population are unknown. The present study examined the relationship of age, sex, insurance status, race, and trends over time in the receipt of catheterization, PTCA, and CABG in a nationally representative sample of hospital discharges.

## Methods

This analysis used the National Hospital Discharge Survey (NHDS) dataset from the National Center for Health Statistics (CD-ROM series 13, number 38A). The nationally representative sample was drawn from 1979 through 1987 and was based on a two-stage sampling plan. A new sample was drawn in 1988, when a three-stage sampling plan was implemented, and several data collection and estimation procedures were revised. A report detailing pre- and post-redesign differences has been published elsewhere.<sup>20</sup>

Data were abstracted from a sample of inpatients at nonfederal, short-stay hospitals in the United States. Discharges from 1979 through 2004 were examined. Patients discharged with a primary diagnosis of ischemic heart disease (International Classification of Diseases, Ninth Revision, Clinical Modification codes 410.0–414.9) were selected. The independent variables included: age at discharge, sex, race, and insurance coverage. The dependent variables were receipt of cardiac catheterization (procedure code 3720–3723), PTCA (procedure codes 3601, 3602, and 3605), and CABG (procedure codes 3610–3620). Diabetes and hypertension were considered to be potential confounders.

Patient age was grouped into 40–49, 50–64, and  $\geq 65$  years. Because of the small proportion of other racial/ethnic groups represented in the sample, only Blacks and Whites were selected for analysis. The method of payment was grouped into private and government. Private payers included commercial insurance carriers such as private health maintenance organizations. Government payers included Medicare and Medicaid. Year of discharge was

combined into five-year groups (1979–1984, 1985–1989, 1990–1994, 1995–1999, and 2000–2004).

Sample weights were used to provide nationally representative estimates. Preliminary analysis consisted of weighted frequency distributions for the independent variables. Unweighted adjusted odds ratios were calculated for receipt of each of the cardiac procedures, controlling for age group, insurance status, and sex across the five-year intervals. The referent groups for the analysis were men, the 40- to 49-year age group, patients with government insurance, and White race. The presence of hypertension and/or diabetes was added to the model to address the potential confounding effect of co-morbidity.

## Results

A total of 277,035 patients fit the inclusion criteria for this study ( $\geq 40$  years of age, Black or White, and a primary diagnosis of ischemic heart disease). The proportion of male and female discharges remained constant. Similarly, the proportion of patients with private and government (Medicaid and Medicare) health insurance was unchanged during the interval. The age distribution of discharged patients also was fairly constant over the interval. The one characteristic of the study sample that changed was the proportion of Black patients represented in the discharge data. From 1979 to 2004, the proportion of Black patients discharged with ischemic heart disease increased by 69%, from 5.8% to 9.9% (Table 1).

Differences in the receipt of cardiac catheterization existed by age group, sex, insurance payer, and race (Table 2). Patients in the 50- to 64-year age range had significantly lower odds of receiving cardiac catheterization in 1979–1984 compared to the referent age group. No significant differences in odds were seen from 1985 through 2004. Patients over the age of 65 had significantly lower odds of receiving cardiac catheterization throughout the period of analysis. Patients with private insurance had significantly higher odds of receiving cardiac catheterization, although the magnitude of the difference declined from 1979 through 2004. At the beginning of the observation period, the odds of women receiving cardiac catheterization were 42% lower than those of men. By 2004, the odds were 24% lower. Black patients in 1979–1984 had odds of receiving cardiac catheterization that were 27% lower than those of White patients. At the end of the observation period, the difference had declined to 11%.

Data on PTCA were not available for 1979–1984; in all other years of the analysis, the odds of receiving PTCA for 50–54 years olds were the same as those of the referent age group. However, the odds ratios for receiving PTCA for those over the age of 65 were significantly lower than those of the referent age group. With regard to insurance status, the odds of receiving PTCA were significantly higher for patients with private insurance across all time periods. Women had consistently lower odds of receipt than did men. In 1985–1989, the odds of Black patients receiving PTCA were 50% less than the odds in White patients. In the most recent time interval (2000–2004), the deficit in odds for Black patients had declined to 32% (Table 3).

The odds of receiving CABG were compared across time intervals and demographic groups (Table 4). The odds of receiving CABG showed similar patterns as for catheterization and PTCA. The 50- to 64-year age group and the  $\geq 65$ -year age group had significantly greater odds of receiving CABG than did the referent age group. Patients with private health insurance had higher odds of receiving CABG than did those with government insurance. Women had consistently and significantly lower odds for receipt. The odds of a Black patient receiving CABG were 63% lower than for Whites between 1979 and 1984. By 2000–2004 the disparity in odds was 38%.

## Discussion

The present study was a retrospective analysis that compared the procedural experience of >277,000 Black and White patients discharged from US hospitals from 1979 through 2004. The results demonstrated disparities in the receipt of cardiac catheterization, PTCA, and CABG by age, sex, insurance status, and race. The magnitude of the disparity in receipt of catheterization diminished over the 25-year period for all comparisons. Blacks were initially 27% less likely to receive catheterization in 1979 and 11% less likely in 2004.

These results are similar to those from previous work with the Florida inpatient population discharge database.<sup>21</sup> In that study, Blacks were less likely than non-Hispanic Whites to receive any of the invasive cardiac revascularization procedures. The current work has results similar to those of other studies conducted. Herholz et al<sup>22</sup> found that both Blacks and Hispanics were less likely to receive cardiovascular drugs than were non-Hispanic White patients. Several investigators have found that these groups are less likely to undergo coronary bypass surgery.<sup>11,14,16,23</sup> They associated these disparities in the receipt of invasive cardiac revascularization with higher cardiovascular death rates among Blacks.

The differential receipt of clinically effective therapies is an area that the Institute of Medicine (IOM) considers a component of the overall picture of health disparities.<sup>1</sup> The sources of this difference in health care have been reported by the IOM. These may be categorized as patient-level, provider-level, and care process-level variables (bias, stereotyping, and clinical uncertainty). Patient-level variables include factors such as refusal to accept suggested treatment regimens and biologic polymorphisms that affect the host response to therapies. Provider-level factors include geographic availability and access to services after enrolling in a government-funded health maintenance organization. In a five-state review of Medicare patients, Epstein et al<sup>6</sup> found that Blacks were less likely to be rated as eligible for revascularization procedures. When patients were clinically eligible for revascularization, Blacks were less likely to receive the procedures. In patients rated inappropriate for the procedures, the utilization of revascularization procedures was nonetheless greater in non-Hispanic Whites than in Blacks.

Another explanation for the disparity in receipt of cardiac revascularization procedures may be the lack of access of minority patients to specialty services (cardiology). LaVeist et al<sup>24</sup> studied 2623 cardiac patients seen at three Baltimore areas hospitals. Overall, a cardiac consultation was associated with an increased likelihood of referral for PTCA. However, Black patients were 2.2 times as likely not to be seen by a cardiologist and 1.9 times more likely not to receive the procedure. Among patients referred for consultation, the odds of a Black patient not receiving PTCA were reduced to 1.4.

There are a number of limitations and other considerations to the present analysis and study. We dichotomized two independent variables, race and insurance status. Our racial categories were Black and White. The use of dichotomized racial variables is problematic. According to Agyemang,<sup>25</sup> there are many terms used to describe peoples of African origin, and each has strengths and weaknesses. The use of Black to describe one of our racial groups has the advantage that it is a standard term used by the US Census Bureau and other federal agencies. The weakness of this term is that it summarizes a heterogeneous group without accounting for ethnic differences within the group. Our use of Black conforms to the classifications utilized in the NHDS. Racial disparities in health have been well documented. Ethnic disparities have been less well documented in part due to the lack of ethnic data on health (both numerator and denominator). The National Research Council of the National Academies<sup>26</sup> made a number of recommendations regarding the collection of racial and

ethnic data at the federal level. One of the recommendations was for measures of race and ethnicity to be obtained in all healthcare data systems.

Another consideration related to the classification of patients according to race is the classification of Latinos in the data and how it may have affected the analysis. The recent evolution of federal race and ethnicity data categories began with four races in 1977: White, Black, Asian and Pacific Islander, and Native American.<sup>27</sup> Adjustments were made in 1997 that added the race of Native Hawaiian or other Pacific Islander as separate from Asian; allowed for multi-racial self-identification; and added Hispanic or Latino origin as a category distinct from race.<sup>27</sup> The effect of the Hispanic or Latino ethnicity variable on racial data collection has been examined.<sup>28–31</sup> Regarding ethnicity data quality of the National Hospital Discharge Survey (NHDS), which is voluntarily collected by hospitals, there are several problems. Ethnicity in general was not well reported, with only 24.6% of all NHDS discharges identified as Hispanic or non-Hispanic. As a result, ethnicity data were deemed not reliable and were not released from the NHDS.<sup>32</sup> Moreover, even when absent from the general reporting of NHDS data, the underreporting of Hispanic patients could affect racial reporting by appearing as other or race not stated categories. A 1992 decision to place the mislabeled Hispanics into the White race category affected NHDS estimates of White discharges disproportionately and was reported to have resulted in negligible underreporting of Blacks.<sup>32,33</sup> Progress in NHDS Hispanic ethnicity data collection continues to be slow, as Hispanic origin was not reported for 75% of the NHDS records in 1992.<sup>33</sup> Subsequently, data collection relative to Hispanic ethnicity was still suppressed because of high nonresponse to the Hispanic origin item.<sup>32</sup>

The other dichotomized independent variable was insurance type. The NHDS data abstraction protocol collects data on principal expected source of payment. This type of data collection strategy does not capture information on the actual source of payment. Most facilities would enroll the uninsured in Medicaid. These individuals are represented in the “government insurance” category. The potential inclusion of uninsured patients in this category should not introduce any significant bias.

The use of sampling weight provides correct estimates that are adjusted for sampling methods and nonresponses and allows making generalizations to the entire population from which the sample was selected. This method was used to produce Table 1. The NHDS used a two-stage sampling design (selection of hospitals and then discharges). Admittedly, ignoring the multilevel nature of the data and failing to account for the sampling methods used may produce biased results. However, for confidentiality concerns, key identifying variables, including variables that identify residence of the patient and location or identification of hospitals, were not available to us. Consequently, our results in the multivariate analysis do not take to account the hierarchical structure of the data, and we recognize this as a limitation of this study.

The IOM identified individual and institutional (health systems-level) variables that could account for a portion of the observed health disparities.<sup>1</sup> Many of these individual factors are potentially covariates in any disparity analysis. Factors such as access to care, barriers to specialty care, and interpersonal interactions between patient and provider are also potential covariates. Unfortunately, these variables are not included in the limited public use data. The result of the analysis is the potential for residual confounding.

## Conclusion

The current study found consistent and significant disparities in the receipt of cardiac catheterization, PTCA, and CABG by age group, sex, insurance status, and race. These

disparities persisted across a 25-year period. While the disparities lessened over time, the odds of a Black patient receiving catheterization were still 11% less than the odds of a White patient. The odds of a Black patient were 32% lower than a White patient for receiving PTCA. Black patients' odds of receiving CABG were 38% lower than the odds of a White patient. The more invasive the procedure, the greater the Black-White disparity in receipt of revascularization, even though these procedures have been shown to reduce morbidity and mortality. If we are to achieve the Healthy People 2010 goal of eliminating CHD health disparities, further in-depth studies are needed to elucidate the patient, physician, and healthcare system factors associated with the receipt of these beneficial procedures.

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Weighted characteristics of Black and White ischemic heart disease patients aged  $\geq 40$  years, National Hospital Discharge Survey, 1979–2004\*

**Table 1**

Characteristic	1979–1984 n=10,130,910	1985–1989 n=8,932,201	1990–1994 n=8,088,544	1995–1999 n=8,305,604	2000–2004 n=7,368,105
<b>Sex</b>					
Male	57.9	58.5	57.8	58.3	57.5
Female	42.1	41.5	42.2	41.7	42.5
<b>Insurance Payer</b>					
Private	36.6	36.5	34.1	36.4	35.1
Government	63.4	63.5	65.9	63.6	64.9
<b>Age Group, years</b>					
40–49	9.8	9.8	10.4	10.1	9.9
50–64	36.1	34.4	31.1	30.8	31.2
$\geq 65$	54.1	55.9	58.5	59.1	58.9
<b>Race</b>					
White	94.2	93.2	92.0	91.3	90.1
Black	5.8	6.8	8.0	8.7	9.9
<b>Co-morbidity</b>					
Hypertension	15.8	23.6	35.6	44.3	53.6
Diabetes	15.4	18.2	19.9	23.1	24.7

\* All values are given as percentages.



Table 2

Adjusted odds ratios (95% confidence intervals) of receiving cardiac catheterization among Black and White ischemic heart disease patients aged  $\geq 40$  years, National Hospital Discharge Survey, 1979–2004

Independent Variable	1979–1984	1985–1989	1990–1994	1995–1999	2000–2004
<b>Age, years</b>					
40–49	1.00	1.00	1.00	1.00	1.00
50–64	.91 (.84–.98)	.99 (.93–1.06)	1.07 (1.00–1.14)	.94 (.89–1.00)	1.01 (.95–1.07)
$\geq 65$	.47 (.42–.52)	.75 (.69–.82)	.75 (.70–.81)	.68 (.63–.72)	.71 (.67–.76)
<b>Insurance</b>					
Government	1.00	1.00	1.00	1.00	1.00
Private	1.78 (1.64–1.93)	1.74 (1.63–1.85)	1.26 (1.20–1.32)	1.17 (1.12–1.23)	1.22 (1.17–1.28)
<b>Sex</b>					
Male	1.00	1.00	1.00	1.00	1.00
Female	.58 (.54–.61)	.65 (.62–.68)	.72 (.69–.75)	.80 (.77–.83)	.76 (.74–.79)
<b>Race</b>					
White	1.00	1.00	1.00	1.00	1.00
Black	.73 (.64–.83)	.81 (.75–.89)	.87 (.82–.93)	.85 (.80–.90)	.89 (.84–.93)

**Table 3**

Adjusted odds ratios (95% confidence intervals) of receiving percutaneous transluminal coronary angioplasty among Black and White ischemic heart disease patients aged  $\geq 40$  years, National Hospital Discharge Survey, 1985–2004

Independent Variable	1985–1989	1990–1994	1995–1999	2000–2004
<b>Age, years</b>				
40–49	1.00	1.00	1.00	1.00
50–64	.89 (.79–1.00)	.95 (.88–1.02)	.98 (.92–1.05)	1.03 (.97–1.10)
$\geq 65$	.72 (.62–.84)	.65 (.59–.71)	.70 (.65–.76)	.78 (.73–.84)
<b>Insurance</b>				
Government	1.00	1.00	1.00	1.00
Private	1.80 (1.59–2.02)	1.29 (1.20–1.38)	1.28 (1.21–1.35)	1.28 (1.22–1.35)
<b>Sex</b>				
Male	1.00	1.00	1.00	1.00
Female	.72 (.66–.78)	.72 (.69–.76)	.79 (.74–.80)	.71 (.68–.74)
<b>Race</b>				
White	1.00	1.00	1.00	1.00
Black	.49 (.34–.60)	.71 (.65–.78)	.61 (.57–.66)	.68 (.64–.72)

Table 4

Adjusted odds ratios (95% confidence intervals) of receiving coronary artery bypass graft among Black and White ischemic heart disease patients aged  $\geq 40$  years, National Hospital Discharge Survey, 1979–2004

Independent Variable	1979–1984	1985–1989	1990–1994	1995–1999	2000–2004
<b>Age, years</b>					
40–49	1.00	1.00	1.00	1.00	1.00
50–64	1.28 (1.15–1.41)	1.35 (1.22–1.50)	1.49 (1.35–1.64)	1.57 (1.44–1.72)	1.66 (1.50–1.84)
$\geq 65$	.76 (.66–.87)	1.26 (1.11–1.43)	1.38 (1.24–1.53)	1.62 (1.47–1.78)	1.50 (1.35–1.66)
<b>Insurance</b>					
Government	1.00	1.00	1.00	1.00	1.00
Private	1.77 (1.50–1.96)	1.38 (1.27–1.51)	1.19 (1.10–1.28)	1.23 (1.16–1.31)	1.17 (1.10–1.25)
<b>Sex</b>					
Male	1.00	1.00	1.00	1.00	1.00
Female	.46 (.43–.50)	.50 (.47–.53)	.51 (.48–.54)	.56 (.54–.59)	.56 (.53–.59)
<b>Race</b>					
White	1.00	1.00	1.00	1.00	1.00
Black	.37 (.29–.46)	.45 (.39–.53)	.51 (.46–.57)	.53 (.49–.58)	.62 (.59–.68)