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Racial and ethnic differences in hospital utilization for cardiovascular surgeries have been studied for many years, but most of this research is limited to the Medicare or veteran population. The present study extends to the wider Texas population including all insurance types, and includes non-Hispanic whites, non-Hispanic blacks, Hispanics, and others. This retrospective cross-sectional study examines racial/ethnic differences in the utilization of cardiac procedures. Descriptive analyses and multiple logistic regression models adjusted for demographic, clinical, and hospital level factors are used to test the racial/ethnic differences in the use of cardiovascular procedures. Results suggest that racial and ethnic differences in the utilization of cardiac procedures exist in Texas and are observed across all types of insurance.

VARIATION IN HOSPITAL UTILIZATION FOR CARDIOVASCULAR SURGICAL
PROCEDURES IN TEXAS


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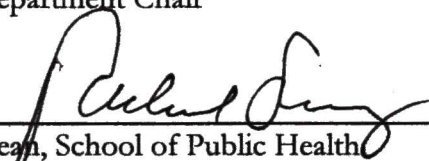
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CHAPTER I

INTRODUCTION

Cardiac catheterization, coronary artery bypass graft (CABG), and percutaneous transluminal coronary angioplasty (PTCA) are proven and tested surgical procedures commonly used to treat critical heart disorders (Schneider, Leape, Weissman, et al., 2001). According to the American Heart Association (AHA) from 1979 to 2004 there has been 432 percent increase in the total number of inpatient cardiovascular operations and procedures (AHA, 2007). Further, the AHA estimates that 1,297,000 inpatient cardiac catheterizations and 664,000 PTCA procedures were performed in 2004. Despite superlative surgical and therapeutic advances, cardiovascular disease remains one of the leading causes of death in the United States. Currently, in United States, there are about 15,800,00 prevalent cases of coronary heart disease, 7,900,000 prevalent cases of myocardial infarction and 8,900,000 prevalent cases of chest pain (AHA, 2007). Although being well-established surgical procedures for several years, substantial variation in hospital utilization for these three procedures still exists.

Wennberg and Gittlesohn (1973) first examined variation in hospital utilization and the consequent impact of legislation and regulation on how health care is distributed. According to Wennberg and Gittlesohn, wide utilization variations and the differences in rates was a result of choice of medical practices, not illness distribution. Further, they concluded that rates of utilization did not vary consistently with expected rates of illness. Following this revolutionary work on variations in hospital utilization, a growing number of

studies have repeatedly observed these differences in hospital utilization among different groups of interest including race and ethnicity, gender and socioeconomic status across US populations.

Mukamel, Weimer, Buchmueller, Ladd, and Mushlin (2007) suggest that the long existing racial/ethnic disparities between non-Hispanic black and non-Hispanic white Medicare populations in 1990's may have diminished for CABG surgery in recent years. Further, they demonstrate that even if the gap in these disparities has reduced to a certain extent, non-Hispanic black patients still had surgery at less than half the rate compared with white patients. According to Mukamel et al., (2007), one of the potential explanations might be substitution of CABG by PTCA. Such trends raise some important questions such as: are the racial/ethnic disparities for older surgical procedures like CABG declining whereas they still exist for newer surgical advances like PTCA? The increased use of CABG by non-Hispanic black patients may suggest that they do not enjoy the same access to PTCA as non-Hispanic white patients (Mukamel et al., 2007). Therefore, the important question being raised here was: are non-Hispanic blacks deprived of access to newer advances in cardiac surgical procedures?

Medicare is a health insurance program designed to assist the elderly US population 65 years of age or above to meet hospital, medical, and other health costs. The program includes two related health insurance programs: hospital insurance (Part A) and supplementary medical insurance (Part B) (CMS, 2006). Although many studies have demonstrated racial/ethnic disparities in the use of cardiac procedures most have been restricted to Medicare data or a specific health care delivery system like the Veterans administration system. Secondly, most of these studies have been limited to racial disparities

between non-Hispanic whites and non-Hispanic blacks. Very few studies have investigated these disparities across other health insurance categories including the uninsured and other races and ethnicities. Carlisle, Leake, and Shapiro (1997) studied the association between racial/ethnic disparities in use of cardiovascular surgeries and the type of health care insurance. They concluded that statistically significant differences remained within several health insurance categories even after adjustment for potential confounders. Philbin, McCullough, and DiSalvo (2001) found out that Medicaid insurance is a significant independent negative predictor of cardiac catheterization, PTCA, and any revascularization procedure after controlling for demographic factors, clinical factors and hospital characteristics

The State of Texas has a diverse population with a fair representation of the largest racial and ethnic groups in the US. Along with non-Hispanic whites and non-Hispanic blacks it also has a large Hispanic community. Further, the state was ranked number one among all other states in the percentage of the uninsured population, with 25.1 percent of Texas population uninsured (U.S. Census Bureau, 2005). Thus State of Texas provides an ideal population to investigate racial and ethnic variation in use of cardiovascular surgical procedures. This study aims to study racial/ethnic variation in utilization of cardiac procedures across different insurance categories using the 2004 and 2005 hospital discharge data for the State of Texas.

Rationale

In order to reduce racial and ethnic variation in hospital utilization for cardiac procedures in Texas it is important to identify factors responsible for these variations. This study examined racial and ethnic variations in hospital utilization for cardiac procedures

across different health insurance categories including the uninsured in Texas. This would provide hospital administrators, health practitioners, public health professionals, and policy makers in Texas valuable information on factors responsible for these variations. Ultimately, the findings of this study may contribute to reduce racial and ethnic disparities in cardiovascular surgical procedures in Texas.

Statement of Purpose

The purpose of this retrospective cross-sectional study was to examine the association between race/ethnicity and variation in hospital utilization for cardiac procedures across different insurance categories in Texas. Variation in hospital utilization for cardiovascular surgical procedures have been studied extensively, but most of this research has been done at national level primarily on Medicare data and much remains to be explored at the State level across other insurance categories including the uninsured population.

Research Question

Does the race/ethnicity related variation in hospital utilization for cardiac catheterization, PTCA, and CABG vary across different insurance categories?

Hypothesis

Patterns of racial/ethnic variations in utilization of cardiac procedures namely cardiac catheterization, PTCA, and CABG should differ across different insurance categories after controlling for other confounding factors. Particularly, there should not be any racial/ethnic differences within patients with private insurance.

Delimitations

The study was delimited by excluding patients admitted with conditions related to pregnancy, childbirth, puerperium, and patients with HIV or drug/alcohol use. Secondly,

this study was restricted to patients age 30 and above. Further, patients discharged from or admitted to other acute care hospitals were excluded from the study to minimize the possibility of patient redundancy (Carlisle et al., 1997). Additional exclusions included patients admitted due to court and law enforcement, patients discharged to federal health care facility, and patients discharged to other institutions like psychiatric hospital. Further patients with unknown, invalid, or missing data for all variables included in this study were excluded.

Data Limitations

The data in the 2004 and 2005 Texas Health Care Information Council (THCIC) public use data file (PUDF) were subject to many limitations. One data limitation was that the participating hospitals are required to submit discharge data to the Department of State Health Services no later than 60 days after the close of a calendar quarter (THCIC Manual, 2005). Depending on the hospital's collection and billing cycles, not all discharge data may have been reported during each quarter. As a result of these inconsistencies, the accuracy of variables like source of payment, specifically, self-pay, and charity was questionable and may later affect quality of the insurance variable (THCIC Manual, 2005). Further, hospitals located in a county with a population less than 35,000 or those located in a county with a population more than 35,000 and with fewer than 100 licensed hospital beds and not located in an area delineated as an urbanized area by the United States Bureau of the Census are exempt from the reporting requirement to THCIC. Exempt hospitals also include hospitals that do not seek insurance payment or government reimbursement (THCIC Manual, 2005).

Study Design Limitations

One of the primary variables of interest in this study was patient race/ethnicity. This variable was not specifically included in the dataset and has been created by combining the race variable and the ethnicity variable. Furthermore, these two variables are not generally collected by the hospital and may be subjectively captured, which means that conclusions based on race/ethnicity must be interpreted cautiously. Secondly, no adjustment has been made for the socioeconomic status of patients directly as THCIC data does not contain information on socioeconomic status. Another important limitation was one imposed by the data itself. The THCIC public use data are administrative data and not collected for research or clinical purposes. Rather, the data represented the best efforts of each facility to meet the state requirements for reporting.

Definition of Terms

Cardiac catheterization. - This is a procedure done on the heart. A thin plastic tube called catheter is inserted into an artery or vein in the arm or leg. The catheter can be further advanced into the chambers of the heart or into the coronary arteries. Catheters are also used to inject dye into the coronary arteries. This test is used to get information about the pumping ability of the heart muscle, to check for any plaques or clogs in arteries (AHA, n.d.).

Percutaneous transluminal coronary angioplasty (PTCA). - It is a surgery commonly used to treat patients with clogged arteries of the heart. Typically, PTCA is performed by threading a slender balloon-tipped tube called catheter from an artery in the groin to the clogged artery of the heart. The balloon is then inflated, compressing the plaque and dilating the narrowed

coronary artery so that blood can flow more easily. This is often accompanied by inserting an expandable metal stent (AHA, n.d.).

Coronary artery bypass graft (CABG). - The coronary arteries that supply blood to the heart muscle can become clogged by plaque (a buildup of fat, cholesterol and other substances). This results in reduced blood flow and oxygen supply to the heart, leading to chest pain or a heart attack. CABG is a type of heart surgery which bypasses around the clogged arteries to improve blood flow and oxygen supply to the heart. Surgeons take a segment of healthy blood vessel from another part of the body and make a detour around the blocked part of coronary artery (AHA, n.d.).

Importance of Study

Hospital services and utilization for cardiovascular surgical procedures vary widely across the nation. Such variation is of particular interest in examining cardiac health care across the State of Texas, including differences in racial and ethnic disparities across different insurance categories. A greater understanding of population health and utilization of services is critical for effective decision making and planning by state and local public health agencies. This study examined these variations and may help the state and local public health agencies to identify populations with deprived access to advanced cardiac care. Recognizing racial and ethnic disparities in cardiovascular surgical procedures as a quality issue, can improve the ability to monitor and decrease health disparities in cardiovascular care, and help to achieve equality in medical treatment.

CHAPTER II

THE LITERATURE

The literature on variation in hospital utilization for cardiac catheterization, CABG and PTCA is abundant. Schneider, Leape, Weissman, et al. (2001) studied a random sample of Medicare beneficiaries during 1991 and 1992 in one of the five U.S. states (Alabama, California, Georgia, New Jersey and Pennsylvania) that had a coronary angiography. They reported that non-Hispanic white patients were 1.7 times more likely than non-Hispanic black patients to receive CABG surgery and 1.2 times more likely to receive PTCA. Further, they suggest that underuse among non-Hispanic black patients for whom the procedure is necessary, rather than overuse among non-Hispanic white patients, is a more plausible explanation for racial disparities in rates of procedure use (Schneider, et al. 2001).

Lucas, DeLorenzo, Siewers, and Wennberg (2006) provided temporal trends in utilization of cardiac testing and revascularization using Medicare claims data from 1993 to 2001. They reported a substantial increase in the utilization of procedures for the diagnosis and treatment of coronary artery disease from 1993 to 2001, and this increase was unlikely to be related to underlying disease prevalence because the rate for acute myocardial infarction in the same population did not increase. Further, Lucas et al. (2006) reported catheterization rates were two times higher in non-Hispanic black women and increased by 60% to 80% in the remaining subgroups as compared to non-Hispanic white women and percutaneous coronary intervention rates increased by two times in other subgroups and three times in non-Hispanic blacks as compared to non-Hispanic whites regardless of gender.

Jha, Staiger, Lucas, and Chandra (2007) examined hospitalized patients in Veteran's Administration (VA) Hospitals from 1993 to 2001. Jha et al. (2007) concluded that racial differences in cardiovascular procedure rates existed throughout the VA health care system and the magnitude of these differences varied according to the inpatient racial composition of VA hospitals.

Epstein, Weissman, Schneider, et al. (2003) examined Medicare data to study quality of care, they utilized failure to use or underuse either PTCA or CABG as a measure of quality of care. They concluded that racial differences in procedure use reflect higher rates of clinical appropriateness among whites, greater underuse among non-Hispanic blacks, and more frequent revascularization when it was not clinically indicated among whites (Epstein, et al., 2003). A large population-based cohort study of Medicare beneficiaries hospitalized for AMI who underwent cardiac catheterization demonstrated that women are less likely to undergo coronary revascularization after AMI than men (Rathore, Foody, Radford, & Krumholz, 2003).

A recent study done by Maynard, Sun, Lowy, Sales, and Fihn (2006) examined non-Hispanic black and non-Hispanic white veterans who were admitted to Veterans Health Administration (VHA) medical centers between July 2003 and August 2004. Maynard, et al., concluded that in this era of more aggressive treatment for AMI, non-Hispanic black versus non-Hispanic white differences in the use of percutaneous coronary intervention persist in VHA where access to procedures is not based on ability to pay (2006). Barnhart, Fang and Alderman (2003) findings were consistent with previous research and they lead to a similar conclusion that non-Hispanic blacks are less likely to have an angiography or be

revascularized than non-Hispanic whites. They further suggested that both clinical and non-clinical factors are responsible for these differences.

Kuykendall, Johnson, and Geraci (1995) studied patients treated for coronary atherosclerosis from California acute care hospitals in California during 1989. They concluded that the odds of a PTCA for privately insured patient were much higher than odds for those covered by Medicaid and the uninsured. Kuykendall et al. (1995) further suggested a trend toward greater chances of revascularization existed for the Medicaid insured compared with the uninsured however this was not statistically significant.

Philbin, McCullough, DiSalvo, et al. (2001) examined the influence of insurance payor status and other demographic and clinical factors and hospital characteristics on the use of invasive procedures among patients treated for acute myocardial infarction. Philbin, et al. reported that crude rates of PTCA are lower among Medicaid patients. Further, they controlled for demographic and clinical factors and hospital characteristics to demonstrate that Medicaid insurance is a significant independent negative predictor of cardiac catheterization, PTCA, and any revascularization procedure.

Brown (2004) raised the question of whether economic considerations may have partially contributed to the degree of differences observed among payor groups. Brown concluded that patients with Health Maintenance Organization (HMO) insurance have a lower likelihood of having a cardiac catheterization than patients with fee-for-service insurance. Further, Brown and O'Connell (2004) hypothesized that races will present different profiles of insurance coverage with non-Hispanic blacks more likely to depend on Medicaid, self pay, and HMO's compared to non-Hispanic whites who are more likely to

depend on Medicare and fee-for-service plans, and they concluded that marked differences in access, to cardiac care exist, among races, even among those with the best insurance.

Carlisle, Leake, and Shapiro (1995), in their study on racial and ethnic disparities in invasive cardiac procedures, adjusted for hospital procedure volume. They found out that procedure volume adjustment diminished disparities in angiography and bypass graft surgery and eliminated disparities in angioplasty for Hispanics. At the same time it had little effect on disparities in bypass graft surgery and angioplasty for non-Hispanic blacks, while it eliminated disparities in angiography for the same group. Further, another study evaluated ethnicity-related disparities in cardiac procedures across a wide range of insurance categories and concluded that people with private insurance were not likely to show ethnicity related disparities in the odds of receiving any cardiac procedure (Carlisle, Leake, & Shapiro, 1997).

Conigliaro, Whittle, Good, et al. (2000) did a retrospective study on patients admitted to Veteran Affairs Hospitals from October 1, 1989 to September 30, 1995 with acute myocardial infarction. These authors compared non-Hispanic black and non-Hispanic white male patients matched on age, race, admitting diagnosis, and medical center and they found that non-Hispanic black patients underwent CABG or PTCA less often than non-Hispanic whites.

Trivedi, Sequist, and Ayanian (2006) explored the racial/ethnic disparities in the use of high volume and low volume hospitals and concluded that minority patients are more likely to undergo surgery in hospitals that have less experience with complex cardiovascular procedures. The research work done by Barnato, Lucas, Staiger, Wennberg, and Chandra (2005) brings forward an interesting aspect about racial disparities at hospital level. In this study Barnato et al., show that utilization of different hospitals by non-Hispanic blacks and

non-Hispanic whites contributed substantially to observed treatment disparities and conclude that, on average, non-Hispanic blacks went to hospital that had lower rates of evidence-based medical treatments and higher rates of cardiac procedures after acute myocardial infarction.

Using a nationally representative sample, Sonel, Good, Mulgund, et al. (2005) concluded that non-Hispanic blacks with acute coronary symptoms have a 20% to 40% lower likelihood of cardiac catheterization and revascularization even after adjustment for various baseline patient and hospital level variables. Non-Hispanic blacks and non-Hispanic whites are generally assumed to have different levels of co-morbid conditions and important differences in socioeconomic factors. According to Jha et al. (2007), these differences whether or not clinically appropriate have only modest effect on the true relationship between race and treatment outcomes in cardiac care.

Laouri, Kravitz, French, et al., (1997) found that the provision of necessary revascularization procedures were driven by clinical factors. They reported that clinical illness severity was the most important predictor of whether revascularization is performed. They provided sufficient evidence to conclude that non-clinical factors were also significantly associated with underuse of CABG and PTCA. They found that patients in public hospitals were less likely to undergo PTCA than those in private hospitals and non-Hispanic blacks were less likely to undergo both CABG and PTCA even after controlling for important clinical factors (Laouri, et al., 1997).

Hannan, Racz, Jollis, and Peterson (1997) questioned the use of Medicare data for studying hospital quality, since Medicare does not represent all patients and the authors recommend the using administrative databases with some clinical data elements for studying

disparities in hospital utilization for cardiac procedures to have better representation of all patients.

“Significant progress in eliminating racial/ethnic health and health care disparities, including disparities in cardiac care, cannot be made unless there is broad recognition that disparities exist and that they are unacceptable.” (Lillie-Blanton, Maddox, Rushing, & Mensah, 2004, p. 507).

CHAPTER III

METHODOLOGY

Data Sources

The data used for this retrospective cross-sectional study were the 2004 and 2005 Texas Hospital Inpatient Discharge Public Use Data Files. These data were comprised of two parts; a base data file and a charges data file. For the purpose of this study only 2004 and 2005 base data files were used. Beginning September 1, 2004 Texas Health Care Information Council (THCIC) became a part of the Texas Department of State Health Services (DSHS). DSHS has now become responsible for the collection and release of hospital discharge data. The hospitals are required to submit discharged inpatient claims data in the uniform bill (UB-92) format. Data validation is done through a process of automated auditing and verification. The individual records are subjected to series of audits to check for consistency and conformity with definitions stated in the data specification manual. Further, THCIC check and adjust for missing and invalid codes and generate the Public Use Data File (THCIC, 2005).

Population and Sample

All patients age 30 and above with principal diagnosis of acute myocardial infarction (*International Classification of Diseases, 9th Revision, Clinical Modification* [ICD-9-CM] codes 410, 410.0 through 410.9), coronary atherosclerosis or other heart disease (ICD-9-CM codes 411.0, 411.1, 411.8, 411.81, 411.89, 412, 413.0, 413.1, 413.9, 414.0, 414.00, 414.01, 414.03, 414.06, 414.8, 414.9, V4581, and V4582), and chest pain (ICD-9-CM codes 786.50, 786.51,

786.59) were identified for this study. There were 273,389 patients identified with these three diagnoses from the 2004 and 2005 THCIC base files. In all, 88,076 patients were excluded from the analysis due to missing data for the variables included in this study. This resulted in a final sample size of 185,313 patients, of which 47,499 were diagnosed with acute myocardial infarction, 114,237 were diagnosed with coronary atherosclerosis or other heart disease, and 23,577 were diagnosed with chest pain.

Protection of Human Participants

This study complied with the University of North Texas Health Science Center Institutional Review Board (IRB) requirements for use of secondary healthcare data. A waiver of informed consent was requested and approved by the Institutional Review Board (IRB) at the University of North Texas Health Science Center prior to the start of this study. Furthermore, THCIC employs appropriate safeguards to protect physician and patient confidentiality while creating the public use data file through the use of a uniform identification number for the patients and physicians in practice (THCIC Manual, 2005). This study accessed pre-existing hospital discharge data for public use purposes contained in a database with no identifiers.

Study Variables

Outcome variable

For this study, the principal surgical procedure ICD-9-CM code variable and the first 8 surgical procedure code variables were used to identify patients who underwent cardiac catheterization (ICD-9-CM codes 37.21 to 37.23, 88.52 to 88.57), PTCA (ICD-9-CM codes 0066, 36.01, 36.02, 36.05), and CABG (ICD-9-CM codes 36.10 to 36.17, 36.19, 36.2, 36.3,

36.32 to 36.34, 36.39). Binary outcome variables were created for all three procedures and are used as dependant variables for this study.

Age

Patient age was classified into 5 age categories of 30-39 years, 40-49 years, 50-64 years, 65-74 years and 75+ years respectively. It is a well-established fact that age is an important confounder in public health research. Hence, age was included as one of the covariates in this analysis.

Gender

Gender differences in utilization of hospitals for cardiac surgical procedures have been repeatedly demonstrated in numerous studies. In general male patients have higher odds of utilizing surgical cardiac procedures as compared to females. Previous research by Watson, Stein, Dwamena, et al. (2001) and Rathore et al. (2003) demonstrated the presence significant gender disparities in the use of cardiac procedures. All patients with missing or unknown data for gender were excluded from this study. Patients were categorized as *male* or *female*.

Race/ethnicity

Racial and ethnic disparities in use of cardiovascular surgical procedures are well-documented for almost two decades. *Race/ethnicity* is the primary variable of interest for this study. Race and ethnicity are recorded as two different variables in the data. In this study, race was combined with ethnicity to create a race/ethnicity variable, which includes *non-*

Hispanic White, non-Hispanic Black, Hispanic, and other. Due to small numbers of American Indians and Asian/Pacific Islanders, these patients were classified as *other*.

Primary Diagnosis

The primary diagnosis variable was created using the ICD-9-CM diagnosis codes given under the principal diagnosis code variable in the THCIC data. The clinical classification software tool provided by the Healthcare Cost and Utilization Project (HCUP) was used to classify the principle diagnosis codes into the three broad categories as acute myocardial ischemia, coronary atherosclerosis or other heart diseases, and chest pain.

Insurance

This study used the primary payment source variable as an indicator to assess patient health insurance status (THCIC Manual, 2005). The primary payment source was recoded as *Insurance* and categorized based on THCIC codes into five categories as *Medicaid, Medicare, Private, None, and other*. Previous scholarship by Bacak, Callaghan, Dietz, and Crouse (2004) used the same methodology to group primary payment source variables.

Illness Severity

The illness severity variable in the THCIC data indicated the extent of physiologic decomposition and was included in this study to adjust for co-morbid conditions associated with the primary diagnosis. Assignment of a severity of illness score was done from All Patient Refined (APR) Diagnosis Related Group (DRG) using the 3M APR-DRG Grouper, version 20 (THCIC user manual, 2005). It was categorized into four categories as minor,

moderate, major, and extreme. For this study, the illness severity variable was narrowed down to two broad categories: *minor to moderate* and *major to extreme*.

Type of Admission

The type of admission variable was included as a potential confounder for possible racial/ethnic disparities. This variable was classified into four categories as *emergency*, *urgent*, *elective* and *other*.

Procedure Volume

Procedure volume was considered a potential confounder for cardiac surgical procedures as not all hospitals have facilities to provide these surgeries. To control for these volume differences an additional variable was created by computing the total number of surgeries per year performed in each hospital for the period 2004 to 2005. The procedure volumes were classified as *less than 100*, *100 through 200* and *more than 200* per year. In previous research, Carlisle, et al. (1997, 1995) utilized similar methods to classify the procedure volume.

Measures

A primary descriptive analysis was performed to study the distribution of the population within each race/ethnicity category across all independent variables. A secondary descriptive analysis was employed to study the distribution of patients for each of the three cardiac procedures across all independent variables. The distributions for all descriptive analyses were reported as proportions. Overall tests of association for the three cardiac procedures by race/ethnicity and all other independent variables were performed using the chi-square statistic. Multiple logistic regression models were used to examine the relationship

between hospital utilization for each procedure and race/ethnicity stratified by insurance categories. The unit of analysis used for these analyses was each hospital discharge record. Both unadjusted and adjusted models were used to compare odds ratios for each race/ethnicity categories. Non-Hispanic white patients were used as the reference group in all five insurance specific analyses performed for each of the three cardiac procedures. All analyses were done using *SAS software, Version 9.1 of the SAS system for Windows*.

CHAPTER IV

RESULTS

Results from Descriptive Analyses

The study population for this study consisted of 185,313 patients admitted with a diagnosis of acute myocardial infarction, coronary atherosclerosis or other heart disease, and chest pain from hospitals within Texas. In general, the sample had more males (59%) than females (41%). The proportion of non-Hispanic white males (61%) is much higher than non-Hispanic white females (38%). Conversely, non-Hispanic black females (55%) had much higher proportion than non-Hispanic black males (45%). More than 75% of the study population were 50 years of age or older. About 2% of non-Hispanic whites had Medicaid insurance whereas 7.4 % non-Hispanic black and 8% Hispanics had Medicaid insurance. Appendix Table 1 presents the results of descriptive analyses for distribution of the study population across the race/ethnicity categories for all potential confounding variables and the insurance categories used in this study.

Similarly, the number of uninsured in the study population was much higher for non-Hispanic blacks (12%) and Hispanics (11%) as compared to non-Hispanic whites (6%). Non-Hispanic blacks (62%) showed a substantially higher percentage of population admitted as emergency admissions as compared to non-Hispanic whites (45%) and Hispanics (45%). For elective admissions non-Hispanic blacks (21%) demonstrated a significantly less proportion of population as compared to Hispanics (34%) and non-Hispanic white (36%).

Approximately 24 % of the non-Hispanic black population were diagnosed with chest pain as primary diagnosis, whereas in non-Hispanic white and Hispanic populations only around 11% and 13% patients were diagnosed with chest pain, respectively. Patients diagnosed with acute myocardial infarction as a primary diagnosis had a similar distribution across all race/ethnicity categories. Almost 64% non-Hispanic whites and 60% Hispanics were diagnosed with coronary atherosclerosis and other heart diseases whereas only about 49% non-Hispanic black had coronary atherosclerosis or other heart diseases. A higher percentage of non-Hispanic blacks (24%) and Hispanics (23%) as compared to non-Hispanic whites (20%) were likely to have their illness severity score between major to extreme.

About 79% of non-Hispanic black population utilized hospitals with a procedure volume more than 200 per year for cardiac catheterization, whereas higher percentage of non-Hispanic white (89%) and Hispanic (86%) utilized hospitals with similar procedure volume for cardiac catheterization. In the case of hospitals with a procedure volume of less than 100 per year, non-Hispanic blacks (16%) had higher utilization for cardiac catheterization as compared to non-Hispanic whites (7%) and Hispanics (9%). Almost 20% of non-Hispanic blacks utilized hospitals with less than 100 PTCA procedures per year as compared to 10% of non-Hispanic whites and 14% Hispanics. Higher percentages of non-Hispanic whites (82%) and Hispanics (75%) underwent PTCA at hospitals with procedure volumes more than 200 procedures per year as compared to non-Hispanic blacks. Forty-four percent of non-Hispanic blacks were admitted at a hospital with a volume of less than 100 CABG procedures per year. Only 32% non-Hispanic whites and 29% Hispanics had a CABG surgery at hospitals with a procedure volume of less than 100 per year.

During the study period 2004-2005, a total of 144,172 cardiac catheterizations, 80,576 percutaneous transluminal coronary angioplasties, and 31,302 coronary artery bypass grafts were performed in State of Texas. Due to the large sample size, chi-square tests for all associations between outcome variables, and the independent variables were significant at the 0.05 level of significance and were not reported. Appendix Table 2 describes the distribution of study population by the three outcome variables.

More than 65% of utilizations for the three cardiac procedures were by non-Hispanic whites. Males utilized the three cardiac procedures to a much greater extent as compared to females; 71% of males used the CABG procedure, whereas only 29% female used the same. Similarly for PTCA surgery, males (64%) had much higher utilization, as compared to females (36%). Patients with Medicare and private insurance used these cardiac procedures to a much greater extent, as compared to those with Medicaid and those who were uninsured. More than 70% of the cardiac catheterization and 60 % PTCA procedures were likely to be used by emergency and urgent admissions. Patients diagnosed with coronary atherosclerosis or other heart diseases were most likely to use these three cardiac procedures as compared to acute myocardial infarction.

Patients with illness severity rated as minor to moderate were most likely to utilize these three cardiac procedures; 82% used cardiac catheterizations, 87% used PTCA and 63% used CABG. Hospitals showing procedure volumes of more than 200 per year performed the highest percentages of these procedures, 89%, 92%, and 94% respectively, for cardiac catheterization, PTCA, and CABG.

Results from Multiple Logistic Regression Models

Cardiac catheterization as a binary outcome variable (Yes/No)

Unadjusted models were used to study the relationship between race/ethnicity and the binary outcome variable for cardiac catheterization. Non-Hispanic blacks with Medicaid insurance had 0.82 times less odds of receiving a cardiac catheterization as compared to non-Hispanic whites (95% CI (0.70, 0.95), $p = 0.0072$). Hispanics and non-Hispanic blacks with Medicare, Private, and those who were uninsured showed significant differences in hospital utilizations for cardiac catheterization with $p < 0.05$. Appendix Table 3 presents the results of multiple logistic regression models for cardiac catheterization as an outcome variable.

Adjusted models controlling for potential confounders like age, gender, type of admission, primary diagnosis, illness severity, and procedure volume were then used to identify deviations from results obtained in the unadjusted model. After adjusting for potential confounders, it was found that all Medicaid and other insurance patients had no significant differences across race/ethnicity categories with $p > 0.05$. Differences in hospital utilization for non-Hispanic blacks with private insurance reduced considerably but were still significant (OR 0.85, 95% CI (0.79, 0.91), $p < 0.0001$). The odds ratios for non-Hispanic blacks, Hispanics and others with Medicare were significant in negative direction.

Hispanic patients with private insurance did not differ from non-Hispanic whites (OR 0.94, 95% CI (0.89, 1.0), $p > 0.05$). Uninsured non-Hispanic blacks and Hispanics had significant differences in hospital utilizations for cardiac catheterization with OR 0.59, 95% CI (0.52, 0.67) and OR 0.72, 95% CI (0.64, 0.80), respectively, $p < 0.0001$. Patients categorized as other, that is, American Indians and Asian/Pacific Islanders, with private

insurance had 1.1 times higher odds of getting a cardiac catheterization done as compared to non-Hispanic whites (95% CI (1.0, 1.2), $p = 0.0387$).

PTCA as binary outcome variable (Yes/No)

Unadjusted models were used to study the relationship between race/ethnicity and the binary outcome variable for PTCA. Significant differences in hospital utilization for the PTCA procedure were observed for non-Hispanic blacks and Hispanics as compared to non-Hispanic whites across all insurance categories with $p < 0.05$ except Hispanics having Medicaid insurance (OR 0.94, 95% CI (0.83, 1.06), $p > 0.05$). Results obtained from adjusted models controlling for potential confounders did not vary substantially from the unadjusted model. But Hispanics having Medicaid insurance significantly differed in hospital utilization for PTCA as compared to non-Hispanic whites (OR 0.80 95% CI (0.69, 0.92), $p = 0.0023$). Patients from other race/ethnicity showed no significant difference across any of the insurance categories. Appendix Table 4 displays the results of multiple logistic regression models used for the PTCA outcome variable.

CABG as binary outcome variable (Yes/No)

Unadjusted models were used to study the relationship between race/ethnicity and the binary outcome variable for CABG across insurance categories. Non-Hispanic black patients had significant differences in hospital utilizations for CABG procedure across all insurance categories ($p < 0.0001$). Hispanics having Medicare insurance significantly differed from non-Hispanic whites (OR 0.91, 95% CI (0.87, 0.96), $p = 0.0001$). A similar trend was observed after controlling for the potential confounders in the adjusted model. The odds ratios for non-Hispanic black patients with Medicare, Private insurance, and the uninsured

were significant in the negative direction. Hispanics having Medicare insurance continued to differ significantly from non-Hispanic whites (OR 0.86, 95% CI (0.81, 0.90), $p < 0.0001$). Patients from the other race/ethnicity category with Medicare insurance had significantly higher odds (1.14, 95% CI (1.04, 1.25), $p = 0.0055$) of getting a CABG surgery as compared to non-Hispanic whites. Similarly, in the uninsured population the other race/ethnicity had 1.4 times higher odds of getting a CABG surgery as compared to non-Hispanic whites (95% CI (1.14, 1.72), $p = 0.0012$). The adjusted models for Medicaid and other insurance categories were not presented because of small sample size and a questionable validity. Appendix Table 5 indicates the results of multiple logistic models used for the CABG outcome variable.

CHAPTER V

DISCUSSION

The main objective of this study was to examine racial and ethnic differences in hospital utilizations for cardiovascular surgical procedures in Texas across major insurance categories. The primary hypothesis of this study was that patients having private insurance would not show race/ethnicity related differences in hospital utilization for cardiac procedures. These findings clearly demonstrated that statistically significant differences existed even among patients having private insurance, and therefore the hypothesis was rejected. The principal finding of this study is that significant racial and ethnic differences in hospital utilization for cardiovascular surgical procedures exist after adjusting for age, gender, admission type, primary diagnosis, illness severity, and hospital procedure volume.

The results of this study are consistent with previous studies. Racial and ethnic differences in hospital utilization for the cardiovascular procedures are evident among non-Hispanic whites and non-Hispanic blacks. This study contributes valuable information about race and ethnicity minority groups like Hispanics and people of the other group, which includes American Indians and Asian/Pacific Islanders. This study demonstrates that privately insured non-Hispanic blacks in Texas are less likely to receive cardiac catheterization, CABG, and PTCA procedures as compared to non-Hispanic whites. Another interesting finding of this study is that privately insured Hispanic patients do not differ from non-Hispanic whites in terms of hospital utilizations for cardiac catheterization and CABG. The racial and ethnic differences were more prominent in hospital utilization for

PTCA versus CABG procedures in both Hispanics and non-Hispanic blacks as compared to non-Hispanic whites.

One of the strengths of this study is racial and ethnic differences in the utilization of cardiovascular surgical procedures across all major insurance categories including Medicaid, Medicare, and private insurance as well as the uninsured were examined. Most previous research has primarily used Medicare data, which fails to provide complete representation of population utilizing cardiovascular procedures. The finding that racial and ethnic differences in cardiovascular surgical procedures are clearly evident in patients having private insurance is of particular concern as it suggests that provider-level racial and ethnic differences in these procedures may exist. Another important highlight of this study involves the results being adjusted for illness severity, an important confounder in these types of studies.

Further, this study has been focused on Texas population, and to date, little research has been done at the State level. This study may be used to assist in the development of State health policies and strategies to reduce these disparities. The finding that non-Hispanic blacks in Texas are most likely to be deprived of access to all three cardiac procedures is disturbing and needs to be further investigated. Furthermore, American Indians and Asian/Pacific Islanders classified as other with private insurance are more likely to get a cardiac catheterization procedure as compared to non-Hispanic whites and the same group with Medicare insurance is more likely to get a CABG surgery as compared to non-Hispanic whites. These findings bear further investigation.

This study has several limitations. First, this is a cross-sectional study using the Texas population and only includes the years 2004-2005. The findings of this study cannot be generalized to other populations in the past or future. Secondly, due to cross-sectional nature

of the study, a cause and effect relationship cannot be inferred. Further, the study may have been affected by selection bias as hospitals located in a county with a population less than 35,000 or with fewer than 100 licensed hospital beds or located in rural area were exempted from reporting the data to THCIC. The study statistics have not been adjusted for socioeconomic status variable directly, but the fact that racial and ethnic differences were examined across different insurance types might have indirectly adjusted for effects of socioeconomic status in this study. Previous research (Horne, Muhlestein, Lappe, 2004; Nordstrom, Diez Roux, Jackson, Gardin, & Cardiovascular Health Study, 2004) has demonstrated an association between socioeconomic status and the type of insurance. It is most likely that employed people have private insurance, poor people are likely to have Medicaid, and people not otherwise eligible for Medicaid or Medicare are most likely uninsured.

The differences in utilization of CABG and PTCA procedures between non-Hispanic whites and non-Hispanic blacks observed in this study are similar to earlier research work done by Fang and Alderman (2004) who concluded that blacks are less likely to utilize cardiac procedures regardless of their insurance status. Similarly, Cromwell, McCall, Burton, and Urato (2005) concluded that elderly patients having similar Medicare health insurance are significantly different in utilizations not only between whites and other minorities but also within minority groups themselves.

The use of cardiovascular surgical procedures should be strictly dependent on a patient's clinical diagnosis and his or her preference for such a surgery. However, the findings of this study demonstrate a strong relationship between a patient's race and ethnicity and the use of these procedures even after controlling for patient's illness severity.

The fact that these racial and ethnic differences exist and are evident across all insurance types including the uninsured population in the State of Texas is a major concern and should be investigated to detail. Further research at several levels including hospital level and regional level is recommended. If possible, a multilevel analysis should be employed to adjust for patient level, hospital level, and regional level variables associated with racial and ethnic disparities in cardiovascular surgeries. This will help us to identify important information on possible causes of these racial and ethnic disparities.

In summary, the findings of this study help to expose the racial and ethnic disparities in use of cardiovascular surgical procedures in State of Texas. These findings are of much interest since disparities in utilization of cardiovascular surgeries exist in all types of insurance after controlling for demographic, clinical, and hospital level confounders. An important foundation for further investigation has been established.

APPENDIX A

TABLES

TABLE 1

Characteristics of Patients Diagnosed with Acute Myocardial Infarction, Coronary Atherosclerosis or Other Heart Disease, and Chest Pain by Race/Ethnicity: Inpatient Hospital Discharges, Texas, 2004-2005

	Total (N = 185313) %	Non-Hispanic White (n = 120366) %	Non-Hispanic Black (n = 18040) %	Hispanic (n = 34611) %	Other (n = 12296) %
Gender					
Male	58.9	61.5	45.0	56.0	62.5
Female	41.1	38.5	55.0	44.0	37.4
Age					
30-39 years	2.3	1.8	4.8	2.8	2.1
40-49	11.8	10.5	18.4	12.9	12.3
50-64	37.2	36.1	41.1	38.8	38.3
65-74	26.4	27.2	21.2	26.2	27.5
75+	22.1	24.4	14.5	19.3	19.8
Insurance					
Medicaid	3.9	2.13	7.4	7.9	4.2
Medicare	51.5	52.7	47.5	50.8	47.6
Private	35.1	37.6	30.8	27.9	36.6
None	8.1	6.4	12.2	11.4	10.3
Other	1.4	1.2	2.1	1.9	1.2
Type of admission					
Emergency	46.9	45.2	61.6	45.0	46.6
Urgent	19.0	18.7	16.9	20.4	21.5
Elective	34.0	36.1	21.5	34.2	31.8
Other	0.05	0.04	0.04	0.08	0.06
Primary Diagnosis					
AMI	25.6	24.8	26.6	27.3	27.1
CA or other heart disease	61.6	63.8	49.3	59.8	63.8
Chest pain	12.7	11.3	24.1	12.9	9.1
Illness severity					
Minor to moderate	79.1	80.4	75.6	76.5	78.8
Major to Extreme	20.9	19.6	24.4	23.5	21.2
CC volume/year					
Less than 100	8.5	7.2	15.8	8.9	9.9
100 to 200	4.4	4.1	4.8	5.1	5.3
More than 200	87.0	88.7	79.4	86.0	84.7
PTCA volume/year					
Less than 100	11.8	10.2	19.6	13.6	12.0
100 to 200	9.0	7.7	11.8	11.0	12.4
More than 200	79.1	82.1	68.5	75.4	75.6
CABG volume/year					
Less than 100	34.0	32.5	44.5	29.5	46.0
100 to 200	33.0	34.2	27.6	36.4	19.9
More than 200	33.0	33.3	27.9	34.1	34.1

Note. CC = Cardiac catheterization, PTCA = Percutaneous transluminal coronary angioplasty, CABG = Coronary artery bypass graft, AMI = Acute myocardial infarction, CA = Coronary atherosclerosis.

TABLE 2

Patient Characteristics by Three Cardiac Procedures: Inpatient Hospital Discharges, Texas, 2004-2005

	CC (n = 144172) %	PTCA (n = 80576) %	CABG (n = 31302) %
Race/Ethnicity			
Non-Hispanic white	66.0	69.3	66.3
Non-Hispanic black	9.03	7.2	5.8
Hispanic	18.2	16.3	21.0
Other	6.7	7.1	6.9
Gender			
Male	59.6	64.0	71.0
Female	40.4	36.0	29.0
Age			
30-39 years	2.3	1.5	0.82
40-49	12.4	10.7	7.4
50-64	38.5	38.7	38.1
65-74	26.3	27.6	32.9
75+	20.6	21.4	20.7
Insurance			
Medicaid	3.7	2.7	3.3
Medicare	49.4	50.5	53.4
Private	37.1	38.2	35.5
None	8.4	7.3	6.6
Other	1.4	1.2	1.3
Type of admission			
Emergency	48.0	38.7	26.4
Urgent	19.4	19.4	18.7
Elective	32.5	41.9	54.8
Other	0.04	0.05	0.0
Primary Diagnosis			
AMI	26.8	30.2	18.8
CA or other heart disease	63.1	69.7	81.2
Chest pain	10.2	0.2	0.0
Illness severity			
Minor to moderate	82.3	87.4	63.6
Major to Extreme	17.7	12.6	36.4
CC volume/year			
Less than 100	7.0	-	-
100 to 200	4.1	-	-
More than 200	88.8	-	-
PTCA volume/year			
Less than 100	-	4.2	-
100 to 200	-	3.7	-
More than 200	-	92.1	-
CABG volume/year			
Less than 100	-	-	0.4
100 to 200	-	-	5.7
More than 200	-	-	93.9

Note. CC = Cardiac catheterization, PTCA= Percutaneous transluminal coronary angioplasty, CABG= Coronary artery bypass graft, AMI= Acute myocardial infarction, CA= Coronary atherosclerosis.

TABLE 3

Odds Ratios and 95% Confidence Intervals of Cardiac Catheterization for Race/Ethnicity Stratified by Insurance Category: Inpatient Hospital Discharges, Texas, 2004-2005

	<u>Non-Hispanic Black</u>			<u>Hispanic</u>			<u>Other</u>		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Unadjusted									
Medicaid	0.82	(0.70, 0.95)	0.0072	1.14	(1.01, 1.29)	0.0371	1.01	(0.81, 1.25)	0.9484
Medicare	0.63	(0.60, 0.66)	<0.0001	0.81	(0.78, 0.84)	<0.0001	0.95	(0.89, 1.01)	0.0939
Private	0.81	(0.76, 0.87)	<0.0001	0.92	(0.87, 0.97)	0.0047	1.4	(1.04, 1.24)	0.0031
None	0.50	(0.45, 0.57)	<0.0001	0.72	(0.65, 0.79)	<0.0001	0.65	(0.56, 0.76)	<0.0001
Other	0.79	(0.61, 1.03)	0.0778	1.05	(0.84,1.32)	0.6442	1.14	(0.74, 1.74)	0.5558
Adjusted*									
Medicaid	0.93	(0.79, 1.08)	0.3392	1.13	(0.99, 1.2)	0.0713	0.95	(0.76, 1.19)	0.6743
Medicare	0.75	(0.71,0.79)	<0.0001	0.86	(0.82, 0.89)	<0.0001	0.93	(0.88, 0.99)	0.0445
Private	0.85	(0.79, 0.91)	<0.0001	0.94	(0.89, 1.00)	0.0547	1.1	(1.0, 1.2)	0.0387
None	0.59	(0.52, 0.67)	<0.0001	0.72	(0.64, 0.80)	<0.0001	0.62	(0.52, 0.72)	<0.0001
Other	1.03	(0.78, 1.37)	0.8254	1.01	(0.72, 1.28)	0.9377	1.13	(0.72, 1.78)	0.6036

Note. *Adjusted for age, gender, type of admission, primary diagnosis, illness severity and procedure volume. Non-Hispanic white patients were used as reference group.

TABLE 4

*Odds Ratios and 95% Confidence Intervals of Percutaneous Transluminal Coronary Angioplasty (PTCA)
for Race/Ethnicity Stratified by Insurance Category: Inpatient Hospital Discharges, Texas, 2004-2005*

	<u>Non-Hispanic Black</u>			<u>Hispanic</u>			<u>Other</u>		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Unadjusted									
Medicaid	0.55	(0.47, 0.64)	<0.0001	0.94	(0.83, 1.06)	0.2992	1.12	(0.91, 1.38)	0.2968
Medicare	0.44	(0.42, 0.47)	<0.0001	0.71	(0.68, 0.74)	<0.0001	1.03	(0.97, 1.09)	0.3651
Private	0.46	(0.43, 0.49)	<0.0001	0.71	(0.68, 0.75)	<0.0001	1.05	(0.98, 1.12)	0.2017
None	0.47	(0.42, 0.52)	<0.0001	0.79	(0.72, 0.86)	<0.0001	1.19	(1.05, 1.36)	0.0087
Other	0.45	(0.34, 0.58)	<0.0001	0.78	(0.64, 0.96)	0.0212	1.26	(0.86, 1.87)	0.2375
Adjusted*									
Medicaid	0.73	(0.61, 0.88)	0.0009	0.80	(0.69, 0.92)	0.0023	0.89	(0.70, 1.14)	0.3635
Medicare	0.66	(0.62, 0.70)	<0.0001	0.73	(0.70, 0.76)	<0.0001	1.07	(0.99, 1.14)	0.0678
Private	0.65	(0.60, 0.71)	<0.0001	0.71	(0.66, 0.75)	<0.0001	1.01	(0.93, 1.10)	0.7399
None	0.61	(0.54, 0.70)	<0.0001	0.76	(0.68, 0.84)	<0.0001	0.98	(0.83, 1.15)	0.8040
Other	0.67	(0.47, 0.94)	0.0215	0.75	(0.57, 0.97)	0.0286	0.77	(0.49, 1.20)	0.2490

Note. *Adjusted for age, gender, type of admission, primary diagnosis, illness severity and procedure volume. Non-Hispanic white patients were used as reference group.

TABLE 5

*Odds Ratios and 95% Confidence Intervals of Coronary Artery Bypass Graft (CABG) for Race/Ethnicity
Stratified by Insurance Category: Inpatient Hospital Discharges, Texas, 2004-2005*

	<u>Non-Hispanic Black</u>			<u>Hispanic</u>			<u>Other</u>		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
Unadjusted									
Medicaid	0.49	(0.38, 0.62)	<0.0001	1.73	(1.47, 2.03)	<0.0001	1.62	(1.23, 2.12)	0.0005
Medicare	0.37	(0.42, 0.47)	<0.0001	0.91	(0.87, 0.96)	0.0001	1.00	(0.93, 1.09)	0.9830
Private	0.40	(0.36, 0.44)	<0.0001	0.95	(0.90, 1.02)	0.1416	0.99	(0.91, 1.09)	0.8946
None	0.39	(0.32, 0.46)	<0.0001	1.11	(0.99, 1.24)	0.0723	1.62	(1.36, 1.92)	<0.0001
Other	0.40	(0.26, 0.60)	<0.0001	1.55	(1.20, 2.07)	0.0008	2.15	(1.35, 3.42)	0.0013
Adjusted*									
Medicaid	-	-	-	-	-	-	-	-	-
Medicare	0.53	(0.48, 0.58)	<0.0001	0.86	(0.81, 0.90)	<0.0001	1.14	(1.04, 1.25)	0.0055
Private	0.57	(0.51, 0.64)	<0.0001	0.95	(0.88, 1.03)	0.1844	1.02	(0.91, 1.14)	0.7319
None	0.50	(0.41, 0.61)	<0.0001	1.04	(0.91, 1.20)	0.5434	1.40	(1.14, 1.72)	0.0012
Other	-	-	-	-	-	-	-	-	-

Note. *Adjusted for age, gender, type of admission, primary diagnosis, illness severity and procedure volume. Non-Hispanic white patients were used as reference group. Models for 'Medicaid' and 'other' insurance categories did not converge due to small sample size and are not reported.

REFERENCES

- American Heart Association (n.d.) *Bypass surgery, coronary artery*. Retrieved October 5, 2007, from <http://www.americanheart.org/presenter.jhtml?identifier=4484>
- American Heart Association (n.d.) *Cardiac catheterization*. Retrieved October 5, 2007, from <http://www.americanheart.org/presenter.jhtml?identifier=4491>
- American Heart Association (n.d.) Heart Disease and Stroke Statistics-2007 update. Dallas, TX: *American Heart Association*. Retrieved October 5, 2007, from http://www.americanheart.org/downloadable/heart/1166712318459HS_StatsInsideText.pdf
- American Heart Association (n.d.) *Percutaneous coronary interventions (Previously called angioplasty, percutaneous transluminal coronary (PTCA) or balloon angioplasty)*. Retrieved October 5, 2007, from <http://www.americanheart.org/presenter.jhtml?identifier=4454>
- Bacak, S. J., Callaghan, W. M., Dietz, P. M., & Chadd Crouse. (2005). Pregnancy-associated hospitalizations in the United States, 1999-2000. *American Journal of Obstetrics and Gynecology*, 192, 592-597.
- Barnato, A. E., Lucas, F. L., Staiger, D., Wennberg, D. E., & Chandra, A. (2005). Hospital-level racial disparities in acute myocardial infarction treatment and outcomes. *Medical Care*, 43(4), 308-319. Retrieved September 5, 2007, from <http://gateway.tx.ovid.com.proxy.hsc.unt.edu/gw2/ovidweb.cgi?WebLinkFrameset=1&S=LPECFPAOPFDDCPIINCILPBCKIDPPAA00&returnUrl=http%3a%2f%2fgateway.tx.ovid.com%2fgw2%2fovidweb.cgi%3f%26Full%2bText%3dL%257cS.sh.25.26%257c0%257c00005650-200504000->

00002%26S%3dLPECFPAOPFDDCPIINCILPBCKIDPPAA00&directlink=http%
3a%2f%2fgraphics.tx.ovid.com%2fovftpdfs%2fFPDDNCKPBIIPF00%2ffs047%
2fovft%2flive%2fgv024%2f00005650%2f00005650-200504000-00002.pdf

Barnhart, J. M., Fang, J., & Alderman, M. H. (2003). Differential use of coronary revascularization and hospital mortality following acute myocardial infarction. *Archives of Internal Medicine*, 163(4), 461-466. Retrieved October 20, 2007, from <http://archinte.ama-assn.org.proxy.hsc.unt.edu/cgi/reprint/163/4/461>

Brown, S. L. (2004). The impact of fee-for-service and managed care insurance on access to cardiac care in maryland. *Journal of Health Care Finance*, 30(4), 68-78. Retrieved September 2, 2007, from <http://web.ebscohost.com.proxy.hsc.unt.edu/ehost/pdf?vid=3&hid=17&sid=070a9280-7159-494e-af57-6d865af78bcc%40SRCSM1>

Brown, S. L., & O'Connell, L. (2004). Restricted access to care: The role of race, managed care, and type of insurance. *Journal of Health Care Finance*, 31(2), 26-37. Retrieved September 2, 2007, from <http://web.ebscohost.com.proxy.hsc.unt.edu/ehost/pdf?vid=3&hid=2&sid=501e9eb5-2331-4583-867e-dbaa1f15a5dd%40sessionmgr2>

Carlisle, D. M., Leake, B. D., & Shapiro, M. F. (1995). Racial and ethnic differences in the use of invasive cardiac procedures among cardiac patients in los angeles county, 1986 through 1988. *American Journal of Public Health*, 85(3), 352-356. Retrieved August 29, 2007, from <http://web.ebscohost.com.proxy.hsc.unt.edu/ehost/pdf?vid=4&hid=9&sid=bfcfce9e-179d-41f1-8c43-8a3968298b71%40SRCSM1>

- Carlisle, D. M., Leake, B. D., & Shapiro, M. F. (1997). Racial and ethnic disparities in the use of cardiovascular procedures: Associations with type of health insurance. *American Journal of Public Health*, 87(2), 263-267. Retrieved August 29, 2007, from <http://web.ebscohost.com.proxy.hsc.unt.edu/ehost/pdf?vid=5&hid=21&sid=c3789262-404b-4f52-898f-aaf581ae1046%40sessionmgr2>
- Center for Health Statistics-THCIC (2004). THCIC, PUDF- user manual. Austin, TX: *Department of State Health Services*.
- Center for Health Statistics-THCIC (2005). THCIC, PUDF- user manual. Austin, TX: *Department of State Health Services*.
- Center for Medicare and Medicaid Services (2006). Medicare general information, eligibility and entitlement manual. Washington, DC: *U.S. Department of Health and Human Services*. Retrieved October 26, 2007 from <http://www.cms.hhs.gov/manuals/downloads/ge101c01.pdf>
- Conigliaro, J., Whittle, J., Good, C. B., Hanusa, B. H., Passman, L. J., Lofgren, R. P., et al. (2000). Understanding racial variation in the use of coronary revascularization procedures: The role of clinical factors. *Archives of Internal Medicine*, 160(9), 1329-1335. Retrieved October 15, 2007 from <http://archinte.ama-assn.org.proxy.hsc.unt.edu/cgi/reprint/160/9/1329>
- Cromwell, J., McCall, N. T., Burton, J., & Urato, C. (2005). Race/ethnic disparities in utilization of lifesaving technologies by medicare ischemic heart disease beneficiaries. *Medical Care*, 43(4), 330-337. Retrieved September 9, 2007 from <http://gateway.tx.ovid.com.proxy.hsc.unt.edu/gw1/ovidweb.cgi?WebLinkFrameset=1&S=FJOJFPGDOBDDBNODNCILAHMJDCPPAA00&returnUrl=http%3a%2f%2f>

2f%2fgateway.tx.ovid.com%2fgw1%2fovidweb.cgi%3f%26Full%2bText%3dL%257
cS.sh.15.16.18.40%257c0%257c00005650-200504000-
00004%26S%3dFJOJFPGDOBDDBNODNCILAHMJDCPPAA00&directlink=htt
p%3a%2f%2fgraphics.tx.ovid.com%2fovftpdfs%2fFPDDNCMJAHODOB00%2ffs
047%2fovft%2flive%2fgv024%2f00005650%2f00005650-200504000-00004.pdf

Elixhauser A., Steiner C., & Palmer L. (2007). Clinical classifications software (CCS). *U.S. Agency for Healthcare Research and Quality*. Retrieved September 15, 2007, from
<http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp>

Epstein, A. M., Weissman, J. S., Schneider, E. C., Gatsonis, C., Leape, L. L., & Piana, R. N. (2003). Race and gender disparities in rates of cardiac revascularization: Do they reflect appropriate use of procedures or problems in quality of care? *Medical Care*, 41(11), 1240-1255. Retrieved September 1, 2007, from
<http://gateway.tx.ovid.com.proxy.hsc.unt.edu/gw1/ovidweb.cgi?WebLinkFrameset=1&S=JKPFFPFDGODDBNLKMCILAHOKANPPAA00&returnUrl=http%3a%2f%2fgateway.tx.ovid.com%2fgw1%2fovidweb.cgi%3f%26Full%2bText%3dL%257cS.sh.15.16.40.44%257c0%257c00005650-200311000-00004%26S%3dJKPFFPFDGODDBNLKMCILAHOKANPPAA00&directlink=http%3a%2f%2fgraphics.tx.ovid.com%2fovftpdfs%2fFPDDMCOKAHLKGO00%2ffs043%2fovft%2flive%2fgv021%2f00005650%2f00005650-200311000-00004.pdf>

Fang, J., & Alderman, M. H. (2004). Does supplemental private insurance affect care of medicare recipients hospitalized for myocardial infarction? *American Journal of Public Health*, 94(5), 778-782. Retrieved August 26, 2007, from

<http://web.ebscohost.com.proxy.hsc.unt.edu/ehost/pdf?vid=5&hid=8&sid=3910c1d3-17dd-402a-850d-f830f90a06da%40SRCSM2>

Hannan, E. L., Racz, M. J., Jollis, J. G., & Peterson, E. D. (1997). Using medicare claims data to assess provider quality for CABG surgery: Does it work well enough? *Health Services Research*, 31(6), 659-678. Retrieved August 16, 2007, from

<http://ukpmc.ac.uk/picrender.cgi?artid=529062&blobtype=pdf>

Horne, B. D., Muhlestein, J. B., Lappe, D. L., Renlund, D. G., Bair, T. L., Bunch, T. J., et al.

(2004). Less affluent area of residence and lesser-insured status predict an increased risk of death or myocardial infarction after angiographic diagnosis of coronary disease. *Annals of Epidemiology*, 14(2), 143-150. Retrieved October 2, 2007, from

http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=MImg&_imagekey=B6T44-49HDVJR-6-

[9&_cdi=4964&_user=100452&_orig=browse&_coverDate=02%2F29%2F2004&_s](http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=MImg&_imagekey=B6T44-49HDVJR-6-9&_cdi=4964&_user=100452&_orig=browse&_coverDate=02%2F29%2F2004&_sk=999859997&view=c&wchp=dGLbVzW-)

[k=999859997&view=c&wchp=dGLbVzW-](http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=MImg&_imagekey=B6T44-49HDVJR-6-9&_cdi=4964&_user=100452&_orig=browse&_coverDate=02%2F29%2F2004&_sk=999859997&view=c&wchp=dGLbVzW-zSkWW&md5=62cf8166829c9bfd8d9a7f9e4b464210&ie=/sdarticle.pdf)

ICD-9-CM: International Classification of Diseases Ninth Revision; Clinical Modification.

(1997). *American Medical Association; Spiral edition*. Health and Human Services Dept., Centers for Disease Control and Prevention, Centers for Medicare and Medicaid Services.

Jha, A. K., Staiger, D. O., Lucas, F. L., & Chandra, A. (2007). Do race-specific models

explain disparities in treatments after acute myocardial infarction? *American Heart Journal*, 153(5), 785-791. Retrieved October 16, 2007, from

http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=MImg&_imagekey=

B6W9H-4NJ7TFG-H-

1&_cdi=6683&_user=100452&_orig=browse&_coverDate=05%2F31%2F2007&_s

k=998469994&view=c&wchp=dGLbVzb-

zSkzS&md5=3f9d75fc8dc92f05498dff99825721c7&ie=/sdarticle.pdf

Kuykendall, D. H., Johnson, M. L., & Geraci, J. M. (1995). Expected source of payment and use of hospital services for coronary atherosclerosis. *Medical Care*, 33(7), 715-728.

Retrieved September 19, 2007, from [http://www.jstor.org/cgi-](http://www.jstor.org/cgi-bin/jstor/printpage/00257079/ap060355/06a00070/0.pdf?backcontext=table-of-contents&dowhat=Acrobat&config=jstor&userID=81786778@unt.edu/01cce4405a125971158b985401&0.pdf)

[bin/jstor/printpage/00257079/ap060355/06a00070/0.pdf?backcontext=table-of-](http://www.jstor.org/cgi-bin/jstor/printpage/00257079/ap060355/06a00070/0.pdf?backcontext=table-of-contents&dowhat=Acrobat&config=jstor&userID=81786778@unt.edu/01cce4405a125971158b985401&0.pdf)

[contents&dowhat=Acrobat&config=jstor&userID=81786778@unt.edu/01cce4405a](http://www.jstor.org/cgi-bin/jstor/printpage/00257079/ap060355/06a00070/0.pdf?backcontext=table-of-contents&dowhat=Acrobat&config=jstor&userID=81786778@unt.edu/01cce4405a125971158b985401&0.pdf)

[125971158b985401&0.pdf](http://www.jstor.org/cgi-bin/jstor/printpage/00257079/ap060355/06a00070/0.pdf?backcontext=table-of-contents&dowhat=Acrobat&config=jstor&userID=81786778@unt.edu/01cce4405a125971158b985401&0.pdf)

Laouri, M., Kravitz, R. L., French, W. J., Yang, I., Milliken, J. C., Hilborne, L., et al. (1997).

Underuse of coronary revascularization procedures: Application of a clinical method.

Journal of the American College of Cardiology, 29(5), 891-897. Retrieved September 19,

2007, from

[http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=ArticleURL&_udi=B](http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=ArticleURL&_udi=B6T18-3S0MH47-1K&_user=100452&_coverDate=04%2F30%2F1997&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000007818&_version=1&_urlVersion=0&_userid=100452&md5=f3791e1c1e561afab5368dbddd5f0567)

[6T18-3S0MH47-](http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=ArticleURL&_udi=B6T18-3S0MH47-1K&_user=100452&_coverDate=04%2F30%2F1997&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000007818&_version=1&_urlVersion=0&_userid=100452&md5=f3791e1c1e561afab5368dbddd5f0567)

[1K&_user=100452&_coverDate=04%2F30%2F1997&_rdoc=1&_fmt=&_orig=sea](http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=ArticleURL&_udi=B6T18-3S0MH47-1K&_user=100452&_coverDate=04%2F30%2F1997&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000007818&_version=1&_urlVersion=0&_userid=100452&md5=f3791e1c1e561afab5368dbddd5f0567)

[rch&_sort=d&view=c&_acct=C000007818&_version=1&_urlVersion=0&_userid=](http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=ArticleURL&_udi=B6T18-3S0MH47-1K&_user=100452&_coverDate=04%2F30%2F1997&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000007818&_version=1&_urlVersion=0&_userid=100452&md5=f3791e1c1e561afab5368dbddd5f0567)

[100452&md5=f3791e1c1e561afab5368dbddd5f0567](http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=ArticleURL&_udi=B6T18-3S0MH47-1K&_user=100452&_coverDate=04%2F30%2F1997&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000007818&_version=1&_urlVersion=0&_userid=100452&md5=f3791e1c1e561afab5368dbddd5f0567)

Lillie-Blanton, M., Maddox, T. M., Rushing, O., & Mensah, G. A. (2004). Disparities in

cardiac care: Rising to the challenge of healthy people 2010. *Journal of the American*

College of Cardiology, 44(3), 503-508. Retrieved September 20, 2007, from

[http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=ArticleURL&_udi=B](http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=ArticleURL&_udi=B6T18-3S0MH47-1K&_user=100452&_coverDate=04%2F30%2F1997&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000007818&_version=1&_urlVersion=0&_userid=100452&md5=f3791e1c1e561afab5368dbddd5f0567)

6W9H-4MV73M7-

15&_user=100452&_coverDate=02%2F28%2F2007&_rdoc=1&_fmt=&_orig=search&_sort=d&view=c&_acct=C000007818&_version=1&_urlVersion=0&_userid=100452&md5=e2a33df3212ffa9df312d52a1c9dd17c

Lucas, F. L., DeLorenzo, M. A., Siewers, A. E., & Wennberg, D. E. (2006). Temporal trends in the utilization of diagnostic testing and treatments for cardiovascular disease in the united states, 1993-2001. *Circulation*, 113(3), 374-379. Retrieved October 5, 2007, from <http://circ.ahajournals.org.proxy.hsc.unt.edu/cgi/reprint/113/3/374>

Maynard, C., Sun, H., Lowy, E., Sales, A. E., & Fihn, S. D. (2006). The use of percutaneous coronary intervention in black and white veterans with acute myocardial infarction. *BMC Health Services Research*, 6, 107. Retrieved August 26, 2007, from <http://www.biomedcentral.com.proxy.hsc.unt.edu/content/pdf/1472-6963-6-107.pdf>

Mukamel, D. B., Weimer, D. L., Buchmueller, T. C., Ladd, H., & Mushlin, A. I. (2007). Changes in racial disparities in access to coronary artery bypass grafting surgery between the late 1990s and early 2000s. *Medical Care*, 45(7), 664-671. Retrieved September 7, 2007, from <http://gateway.tx.ovid.com.proxy.hsc.unt.edu/gw1/ovidweb.cgi?WebLinkFrameset=1&S=MLMKFPICHNDDBNFOMCILCFNKKMPPAA00&returnUrl=http%3a%2f%2fgateway.tx.ovid.com%2fgw1%2fovidweb.cgi%3f%26Full%2bText%3d%257cS.sh.15.16.18.40%257c0%257c00005650-200707000-00011%26S%3dMLMKFPICHNDDBNFOMCILCFNKKMPPAA00&directlink=h>

ttp%3a%2f%2fgraphics.tx.ovid.com%2fovftpdfs%2fFPDDMCNKCFHOHN00%2f
fs046%2fovft%2flive%2fgv023%2f00005650%2f00005650-200707000-00011.pdf

Nordstrom, C. K., Diez Roux, A. V., Jackson, S. A., Gardin, J. M., & Cardiovascular Health Study. (2004). The association of personal and neighborhood socioeconomic indicators with subclinical cardiovascular disease in an elderly cohort. the cardiovascular health study. *Social Science & Medicine* (1982), 59(10), 2139-2147.

Retrieved October 10, 2007, from

http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=PublicationURL&_tockey=%23TOC%235925%232004%23999409989%23514655%23FLA%23&_cdi=5925&_pubType=J&_auth=y&_acct=C000007818&_version=1&_urlVersion=0&_userid=100452&md5=3faf31fe1283100013b1a14de03f0255

Philbin, E. F., McCullough, P. A., DiSalvo, T. G., Dec, G. W., Jenkins, P. L., & Weaver, W.

D. (2001). Underuse of invasive procedures among medicaid patients with acute myocardial infarction. *American Journal of Public Health*, 91(7), 1082-1088. Retrieved August 23, 2007, from

<http://web.ebscohost.com.proxy.hsc.unt.edu/ehost/pdf?vid=4&hid=7&sid=c01104b2-f504-409b-a07b-4b5ebb6f0ce3%40sessionmgr9>

Rathore, S. S., Foody, J. M., Radford, M. J., & Krumholz, H. M. (2003). Sex differences in use of coronary revascularization in elderly patients after acute myocardial infarction:

A tale of two therapies. *Chest*, 124(6), 2079-2086. Retrieved August 27, 2007, from

<http://web.ebscohost.com.proxy.hsc.unt.edu/ehost/pdf?vid=4&hid=12&sid=61d7cc78-2517-483d-a29d-ddc7800a17a8%40sessionmgr2>

SAS software, Version 9.1 of the SAS system for Windows Copyright © [2003-2004] SAS Institute Inc., Cary, NC, USA.

Schneider, E. C., Leape, L. L., Weissman, J. S., Piana, R. N., Gatsonis, C., & Epstein, A. M.

(2001). Racial differences in cardiac revascularization rates: Does "overuse" explain higher rates among white patients? *Annals of Internal Medicine*, 135(5), 328-337.

Retrieved September 28, 2007, from

<http://web.ebscohost.com.proxy.hsc.unt.edu/ehost/pdf?vid=3&hid=13&sid=0506288a-869e-4e58-adc1-9a448384963a%40sessionmgr7>

Sonel, A. F., Good, C. B., Mulgund, J., Roe, M. T., Gibler, W. B., Smith, S. C., Jr, et al.

(2005). Racial variations in treatment and outcomes of black and white patients with high-risk non-ST-elevation acute coronary syndromes: Insights from CRUSADE (can rapid risk stratification of unstable angina patients suppress adverse outcomes with early implementation of the ACC/AHA guidelines?). *Circulation*, 111(10), 1225-1232. Retrieved September 10, 2007, from

<http://circ.ahajournals.org.proxy.hsc.unt.edu/cgi/reprint/111/10/1225>

Trivedi, A. N., Sequist, T. D., & Ayanian, J. Z. (2006). Impact of hospital volume on racial

disparities in cardiovascular procedure mortality. *Journal of the American College of Cardiology*, 47(2), 417-424. Retrieved September 14, 2007, from

http://www.sciencedirect.com.proxy.hsc.unt.edu/science?_ob=MImg&_imagekey=B6T18-4J0Y6PR-C-1&_cdi=4884&_user=100452&_orig=browse&_coverDate=01%2F17%2F2006&_sk=999529997&view=c&wchp=dGLzVlz-zSkWW&md5=6e247b5f4c230de2e87b6e6d2954989f8&ie=/sdarticle.pdf

U.S. Census Bureau. Small Area Health Insurance Estimates: Model-based Estimates for Counties and States. *Health Insurance Coverage for Texas Counties, 2000: Experimental Estimates*. Available at: <http://www.census.gov/cgi-bin/hhes/sahie/sahie.cgi>.

Watson, R. E., Stein, A. D., Dwamena, F. C., Kroll, J., Mitra, R., McIntosh, B. A., et al. (2001). Do race and gender influence the use of invasive procedures? *Journal of General Internal Medicine: Official Journal of the Society for Research and Education in Primary Care Internal Medicine*, 16(4), 227-234. Retrieved August 2, 2007, from <http://web.ebscohost.com.proxy.hsc.unt.edu/ehost/pdf?vid=3&hid=12&sid=a3bb2254-fda5-41e3-ab81-d736c73d7034%40sessionmgr3>

Wennberg, J., & Gittelsohn, A. (1973). Small area variations in health care delivery. *Science*, 182 (4117), 1102-1108.



