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Racial Disparities in Knee and Hip Total Joint Arthroplasty: An 18-year Analysis of National Medicare Data

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Abstract

Objective—Examine whether racial disparities in utilization and outcomes of total knee and total hip arthroplasty (TKA and THA) have declined over time.

Methods—We used 1991-2008 Medicare Part A (MedPAR) data to identify four separate cohorts of patients (primary TKA, revision TKA, primary THA, revision THA). For each cohort, we calculated standardized arthroplasty utilization rates for White and Black Medicare beneficiaries for each calendar year and examined changes in disparities over time. We examined unadjusted and adjusted arthroplasty outcomes (30-day readmission rate, discharge disposition etc.) for Whites and Blacks and whether disparities decreased over time.

Results—In 1991 utilization of primary TKA was 36% lower for Blacks compared to Whites (20.6 per 10,000 for Blacks; 32.1 per 10,000 for Whites; $p<0.0001$); in 2008 utilization of primary TKA for Blacks was 40% lower for Blacks (41.5 per 10,000 for Blacks; 68.8 per 10,000 for Whites; $p<0.0001$) with similar findings for the other cohorts. Black-White disparities in 30-day hospital readmission increased significantly from 1991-2008 among three patient cohorts. For example in 1991 30-day readmission rates for Blacks receiving primary TKA were 6% higher than for Whites; by 2008 readmission rates for Blacks were 24% higher ($p<0.05$ for change in disparity). Similarly, Black-White disparities in the proportion of patients discharged-to-home after surgery increased across the study period for all cohorts ($p<0.05$).

Conflict of Interest: JAS has received investigator-initiated research grants from Takeda and Savient; consultant fees from URL pharmaceuticals, Takeda, Ardea, Savient, Allergan and Novartis; and is a member of the executive of OMERACT, an organization that develops outcome measures in rheumatology and receives arms-length funding from 36 companies. Dr. Singh is also a member of the American College of Rheumatology's Guidelines Subcommittee of the Quality of Care Committee and Veterans Affairs Rheumatology Field Advisory Committee. Dr. Cram, Dr. Ibrahim and Xin Lu have no conflicts to disclose.

Conclusions—In an 18-year analysis of Medicare data we found little evidence of declines in racial disparities for joint arthroplasty utilization or outcomes.

Introduction

Total knee arthroplasty (TKA) and total hip arthroplasty (THA) are two of the most common major surgical procedures performed in the United States (U.S.) with an estimated 670,000 TKA and 427,000 THA procedures performed in 2009 annually according to the Healthcare Cost and Utilization Project.[1] Moreover, the utilization of these procedures has increased by 10%-20% per-year over the past decade garnering attention from both researchers and policy makers. [2-6]

Prior analyses have demonstrated racial disparities for both TKA and THA with Blacks having reduced utilization and higher complication rates as compared to Whites.[7-9] However, many of these studies were conducted within discrete healthcare systems at a single point-intime [7,8] and few have examined whether disparities in utilization and outcomes have declined over time. In a landmark study published in *NEJM* in 2005 Jha et al. found that racial disparities in joint arthroplasty utilization had increased between 1992 and 2001.[10] However, updated analyses using more contemporary data have not been conducted and their analysis did not examine disparities in arthroplasty outcomes.

The lack of contemporary data evaluating trends in racial disparities for joint arthroplasty is particularly important given the myriad of publications, reports, and directives that have been issued over the past decade in an effort to both draw attention to and reduce racial disparities.[9,11,12] For example, the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)[13] and the American Academy of Orthopaedic Surgeons[14] have made arthroplasty disparities a major priority for investigation and action.

The overarching objective of our study was to examine longitudinal trends in racial disparities in primary and revision TKA and THA. Specifically, we set out to examine whether the disparities in TKA and THA utilization and outcomes that have been documented previously have decreased over the past 18-years. We hypothesized that racial disparities in joint arthroplasty utilization rates and outcomes have narrowed over time.

Methods

Data

We used Medicare Provider Analysis and Review (MedPAR) Part A data files to identify fee-for-service beneficiaries who underwent primary or revision TKA or THA between 1991 and 2008. Patients were identified using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD9-CM) procedure codes: 81.54 for primary TKA; 80.06, 81.55, 00.80, 00.81, 00.82, 00.83, 00.84 for revision TKA; 81.51 for primary THA; and 80.05, 81.53, 00.70, 00.71, 00.72, 00.73 for revision THA.[15-18] The Part A files contain data collected from discharge abstracts for all hospitalized fee-for-service Medicare enrollees including: patient demographics (age, sex, race/ethnicity); ICD9-CM codes for primary and secondary diagnoses and procedures (for index admission and subsequent

admissions); admission source (e.g., emergency department or transfer from outside hospital); admission and discharge dates; discharge disposition (e.g., home, nursing home, transfer to another acute-care hospital, dead); death occurring up to three years after discharge; each patient's unique Medicare beneficiary number allowing for identification of patient readmissions; and each hospital's unique six digit identification number.

We limited our cohort to patients whose race was categorized as either Non-Hispanic White or Black; patients whose race was listed as unknown or missing were excluded. Likewise, we excluded patients with other racial categories (e.g., Native American, Asian/Pacific Islander, and Hispanic). We focused our analysis on blacks and whites for several reasons: First, prior studies have shown that Black/White racial designation to be more reliable than other ethnic or racial designations. Second, most recent studies that examined this disparity have focused on black and white patients. Lastly, the representation of other racial/ethnic groups in our sample was less robust, particularly in the early 1990s.[19]

Consistent with prior studies in this area, we applied separate exclusion criteria to the primary and revision populations.[20-22] Primary TKA and THA are most often elective procedures while revision TKA and THA can be either elective or non-elective. To insure a cohort of primary elective TKA and THA procedures, we excluded patients with codes indicating infection at the time of surgery (N=4517 for TKA, 6250 for THA), bone or metastatic cancer (N=3101 for TKA, 13794 for THA), or fracture (N=4603 for TKA, 127102 for THA), patients admitted through the emergency department (N=14343 for TKA, 14851 for THA), and patients admitted after transfer from another acute-care hospital (N=2590 for TKA, 2248 for THA)(Appendix 1). These exclusions were not applied to the revision TKA and THA populations because revision procedures are commonly non-elective and exclusion of emergent procedures would not make sense from a clinical standpoint.

For each hospital admission (primary or revision TKA or THA), we identified comorbid conditions using algorithms described by Elixhauser et al.[23,24] We also calculated the mean number of comorbid conditions for each patient as an aggregate measure of comorbidity. We assessed key outcomes for each admission including: hospital length-of-stay (LOS); mortality within 30-days of discharge; readmission within 30-days of discharge; discharge disposition (categorized as home versus other); and the occurrence of a composite outcome representing readmission for one-or-more of six key complications within 30-days of discharge (infection, hemorrhage, myocardial infarction, sepsis, deep vein thrombosis, or pulmonary embolism). For this analysis, we used algorithms that we and others have published previously.[20-22]

Statistical Analysis

We compared demographic and clinical characteristics of White and Black patients who underwent primary or revision TKA or THA between 1991 and 2008. We used analysis of variance (ANOVA) for comparisons of continuous variables and the chi-squared test for categorical variables. All analyses were performed separately for primary TKA, revision TKA, primary THA and revision THA. We then calculated age- and sex-standardized utilization rates for Whites and Blacks for each of the four cohorts for each calendar year. Utilization rates were calculated as the number of each procedure performed for Whites and

Blacks divided by the number of fee-for-service White (or Black) Medicare enrollees. We used graphical methods to plot the trends in utilization over time for White and Black Medicare enrollees and compared Black-White differences in utilization using logistic regression. Changes in the magnitude of disparities in utilization over time were assessed in each cohort using an interaction term between race and calendar year and P-values of <0.05 were construed as evidence of a significant interaction.

We used similar methods to examine trends in several distinct unadjusted arthroplasty outcomes among Whites and Blacks over the study period. These included hospital LOS; 30-day mortality; hospital readmission within 30-days of discharge; occurrence of the composite outcome; and discharge-to-home after hospitalization. We compared changes in the unadjusted Black-White differences for each of these outcomes between 1991 and 2008 using Cochran-Mantel-Haenszel statistics. Finally, we examined trends in risk-adjusted 30-day mortality using logistic regression models with generalized estimating equations (GEE) to account for clustering of patients within hospitals. These models adjusted for age, sex, hospital arthroplasty volume, and comorbidity; changes in disparities were again assessed using interaction terms for each model. Details of the models are available on request.

To insure the robustness of our findings, we conducted an array of sensitivity analyses. First, we added back excluded populations to our primary TKA and THA groups and repeated our analyses. Second, we conducted adjusted analyses for each of the principle outcomes described above. Third, we examined each of the outcomes included in our composite measure individually for each of our four cohorts. All analyses were performed using SAS Version 9.2 (Cary, NC). This study was approved by the University of Iowa Institutional Review Board.

Results

Baseline sample characteristics

Our analytic sample included, 2,684,575 primary TKAs and 267,644 revision TKAs and 1,328,902 primary THAs and 317,408 revision THAs performed between 1991 and 2008 (**Appendix 1**). Demographic and clinical characteristics of the primary and revision TKA and THA populations are shown in **Tables 1** and **2**. Compared to White patients, Black patients undergoing both primary and revision TKA were younger, more likely to be women and had significantly more comorbidities (**Table 1**). Similar differences were observed for primary and revision THA (**Table 2**).

Utilization Rates for Primary and Revision TKA and THA

Standardized utilization rates for both primary and revision TKA were significantly lower for Blacks when compared to Whites throughout the study period (**Figure 1**); results were similar for primary and revision THA (**Figure 2**). For example, in 1991 utilization of primary TKA was 35.8% lower for Blacks compared to Whites (20.6 per 10,000 for Blacks; 32.1 per 10,000 for Whites; p<0.0001); in 2008 utilization of primary TKA for Blacks was 39.7% lower for Blacks (41.5 per 10,000 for Blacks; 68.8 per 10,000 for Whites; p<0.0001). Over the18–year study period the magnitude of the Black-White disparity increased for

primary TKA utilization by 15.8% (p<0.001), was unchanged for primary THA (p=0.25) and revision THA (p=0.94) and decreased modestly (by 12.8%) for revision TKA (p<0.01).

TKA and THA Outcomes

In unadjusted analyses for primary and revision TKA Blacks experienced worse outcomes than Whites according to most measures throughout the study period (**Table 3**). In particular, Blacks had longer hospital LOS, higher all-cause hospital readmission rates, higher rates of the composite outcome, and were significantly less likely to be discharged to home (**Table 3**). Thirty-day mortality was higher in Blacks compared to Whites for primary TKA, but not revision TKA (**Table 3**).

In unadjusted analyses, there was substantial variability in the magnitude of change in Black-White disparities for primary and revision TKA over the study period depending upon the outcome under consideration (**Table 3)**). For example, in 1991 Blacks were 3.5% less likely than Whites to be discharged to home following revision TKA, but 20.7% less likely to be discharged home in 2008 (p<0.001 for change in disparity). Unadjusted analyses focusing on primary and revision THA yielded similar results (**Table 4**). Black-White disparities in 30-day hospital readmission increased significantly from 1991-2008 among three of the study cohorts, namely, primary TKA, 6% to 24%, revision TKA, -6% to 18% and revision THA, 5% to 15% (all three p-values <0.05), but not primary THA, 9% to 15% (p=0.09). Alternatively, looking at length of hospital stay, in 1991 hospital LOS for Blacks after primary TKA was 18.1% higher than for Whites, but was only 8% higher for Blacks in 2008 (p<0.001 for change in disparity).

In adjusted analyses, we found that the Black-White disparity for 30-day mortality for primary and revision TKA remained largely unchanged (**Figure 3**). For example, in 1991 for primary TKA the adjusted 30-day mortality for Whites was 0.2% and for Blacks was 0.3% while in 2008 the rates were 0.1% and 0.2% for Whites and Blacks respectively; thus, the magnitude of the Black-White disparity was statistically unchanged between 1991 and 2008 (p-value for interaction term=0.81). In adjusted analyses focusing on mortality following primary and revision THA, we again found no consistent evidence for reductions in Black-White disparities. For example, we found that for primary THA the Black-White disparity for 30-day mortality decreased by 0.3% between 1991 and 2008 (p<0.01) while the disparity in 30-day mortality for revision THA increased by a statistically insignificant 0.1% (p=0.76). Results of the sensitivity analyses for each of our outcomes for each of the study cohorts failed to demonstrate evidence of declines in disparities over the study period. These results are available by request.

Discussion

In a longitudinal analysis of Medicare administrative data from 1991 to 2008 we found persistent disparities in joint arthroplasty utilization and outcomes. We found that Blacks had significantly lower utilization rates for primary and revision knee and hip arthroplasty compared to Whites and that these disparities persisted over our 18-year study period. We also found that Blacks had significantly worse outcomes by most measures (e.g., readmission rates, ability to be discharged to home) when compared with Whites and that

disparities in outcomes did not decline substantially over time. In aggregate, these results suggest little progress in reducing Black-White disparities for joint arthroplasty over the past 18-years.

A number of prior studies have demonstrated racial disparities in joint arthroplasty utilization with Blacks being less likely to receive surgery as compared to Whites, but none of these studies examined whether disparities in utilization declined over time.[9,25-27] The notable exception was a 2005 landmark paper by Jha et. al.,[10] that found little evidence of reductions in Black-White disparities in the utilization of nine surgical procedures between 1992 and 2001 including TKA and THA. Our analysis builds on the prior analysis in a number of important ways.[28] First, our analysis extends the prior study by demonstrating persistence of disparities in arthroplasty utilization over an 18-year period. Second, our analysis documents not only persistent disparities in arthroplasty utilization but also persistent disparities in arthroplasty outcomes.

As with prior studies, we observed that Blacks experienced inferior arthroplasty outcomes when compared to whites.[8,29-31] Specifically, we found that Whites tended to have a shorter hospital LOS, were more likely to be discharged home after hospitalization, and had lower rates of hospital readmission. As with the disparities in joint arthroplasty utilization, we found little evidence that disparities in arthroplasty outcomes have declined over time. While we did observe a significant decline in certain disparities (most notably hospital LOS), we saw no decline in other disparities (e.g., mortality) and increases in others (hospital readmission, discharge to home).

The combination of longer hospital LOS for Blacks accompanied by a reduced probability of being discharged to home is thought provoking. It is possible that Blacks experience more in-hospital complications and thus have both longer hospital LOS and are more likely to require admission to rehabilitation facilities after hospital discharge. Alternatively, it is possible that the longer LOS reflects patient preference while lower probability of being discharged home reflects reduced social support for Blacks when compared to Whites[32,3334] or lower rates of functional improvement during and after hospitalization in Blacks compared to Whites.[35] Further research is needed to address these issues.

The lack of a reduction in disparities in either utilization or outcomes over an 18-year period is sobering. It is possible that the lack of reduction we observed is unique to joint arthroplasty and that disparities in utilization and outcomes have declined more substantially in other areas of healthcare.[36,37] Alternatively, we believe it to be more likely that the lack of a reduction in disparities that we observed extends to other areas of healthcare.[38,39] It is increasingly apparent that while broad-based policy briefs and consensus statements disavowing disparities are symbolically important [11,13,14,40] they are insufficient to meaningfully reduce disparities on their own.[41] Conversely, there is growing evidence that disparities can be reduced at the local level[42] when carefully targeted at a single disease and when interventions are tailored to address the particular barriers in a community.[43-45] It is also important to recognize that our finding of a lack of meaningful reductions in arthroplasty disparities over the past 18-years at a national level should not be interpreted as evidence of a lack of reductions in disparities in all communities. In fact, it is nearly certain

that disparities declined in certain communities, but increased in others. This too is an important area for further research.

Our study has a number of limitations that warrant brief mention. First, our study was limited to White and Black fee-for-service Medicare beneficiaries; extrapolation to other populations should be done with caution. Second, our study relied upon administrative data and thus we were unable to evaluate key arthroplasty outcomes including quality-of-life and functional status. Third, in using administrative data, our results could be biased by unmeasured differences in patient complexity.

In aggregate we found little evidence of reductions in racial disparities for knee and hip arthroplasty between 1991 and 2008. Our results highlight the need for better understanding of disparities and call into question the success of policies designed to reduce disparities over the past two decades.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. HCUP. HCUP Facts and Figures 2009- Section 3: Inpatient Hospital Stays by Procedure. Exhibit 3.1 Most Frequent All-listed Procedures. http://hcupus.ahrq.gov/reports/factsandfigures/2009/pdfs/FF_2009_section3.pdf. In.
2. Cram P, Lu X, Kaboli PJ, et al. Clinical characteristics and outcomes of Medicare patients undergoing total hip arthroplasty, 1991-2008. JAMA. 2011; 305:1560–7. [PubMed: 21505134]
3. Kurtz S, Ong K, Lau E, Mowat F, Halpern M. Projections of primary and revision hip and knee arthroplasty in the United States from 2005 to 2030. J Bone Joint Surg Am. 2007; 89:780–5. [PubMed: 17403800]
4. Cram P, Lu X, Callaghan JJ, Vaughan-Sarrazin MS, Cai X, Li Y. Long-term trends in hip arthroplasty use and volume. J Arthroplasty. 2012; 27:278–85. e2. [PubMed: 21752578]
5. Freid VM, Bernstein AB. Health care utilization among adults aged 55-64 years: how has it changed over the past 10 years? NCHS Data Brief. 2010:1–8. [PubMed: 20356438]
6. Centers for Disease Control and Prevention. National Center for Health Statistics. Health Data Interactive. www.cdc.gov/nchs/hdi.htm., 2012. (Accessed 03/26/2012)
7. Ibrahim SA, Siminoff LA, Burant CJ, Kwoh CK. Understanding ethnic differences in the utilization of joint replacement for osteoarthritis: the role of patient-level factors. Med Care. 2002; 40:I44–51. [PubMed: 11789631]
8. Ibrahim SA, Stone RA, Han X, et al. Racial/ethnic differences in surgical outcomes in veterans following knee or hip arthroplasty. Arthritis Rheum. 2005; 52:3143–51. [PubMed: 16200594]

9. Skinner J, Weinstein JN, Sporer SM, Wennberg JE. Racial, ethnic, and geographic disparities in rates of knee arthroplasty among Medicare patients. N Engl J Med. 2003; 349:1350–9. [PubMed: 14523144]
10. Jha AK, Fisher ES, Li Z, Orav EJ, Epstein AM. Racial trends in the use of major procedures among the elderly. N Engl J Med. 2005; 353:683–91. [PubMed: 16107621]
11. Institute of Medicine. Unequal Treatment: Confronting Racial and Ethnic Disparities in Health Care. National Academy Press, National Academy of Sciences; Washington, D.C.: 2002. http://www.iom.edu/Reports/2002/Unequal-Treatment-Confronting-Racial-and-Ethnic-Disparities-in-Health-Care.aspx.
12. Koh HK, Graham G, Glied SA. Reducing racial and ethnic disparities: the action plan from the department of health and human services. Health Aff (Millwood). 2011; 30:1822–9. [PubMed: 21976322]
13. NIAMS National Institute of Arthritis Musculoskeletal and Skin Diseases. Department of Health and Human Services. Strategic Pan for Reducing Racial Disparities. 2006. http://www.niams.nih.gov/About_Us/Mission_and_Purpose/strat_plan_hd.asp.(Accessed 3/26/2012)
14. American Academy of Orthopaedic Surgeons. February 2004 Bulletin. AAOS look at racial, ethnic and gender disparities in osthopaedics. 2004. http://www2.aaos.org/aaos/archives/bulletin/feb04/fline2.htm.(Accessed 03/26/2012)
15. Mitchell JB, Bubolz T, Paul JE, et al. Using Medicare claims for outcomes research. Medical Care. 1994; 32:JS38–51. [PubMed: 8028412]
16. Katz JN, Barrett J, Mahomed NN, Baron JA, Wright RJ, Losina E. Association between hospital and surgeon procedure volume and the outcomes of total knee replacement. Journal of Bone & Joint Surgery - American Volume. 2004; 86-A:1909–16.
17. Losina E, Barrett J, Mahomed NN, Baron JA, Katz JN. Early failures of total hip replacement: effect of surgeon volume. Arthritis & Rheumatism. 2004; 50:1338–43. [PubMed: 15077318]
18. Katz JN, Losina E, Barrett J, et al. Association between hospital and surgeon procedure volume and outcomes of total hip replacement in the United States medicare population.[see comment]. Journal of Bone & Joint Surgery - American Volume. 2001; 83-A:1622–9.
19. DR W. Accuracy and bias of race/ethnicity codes in the Medicare Enrollment Database. Health Care Financ Review. 2004-2005; 26:61–72.
20. Katz JN, Losina E, Barrett J, et al. Association between hospital and surgeon procedure volume and outcomes of total hip replacement in the United States medicare population. J Bone Joint Surg Am. 2001; 83-A:1622–9. [PubMed: 11701783]
21. Cram P, Vaughan-Sarrazin MS, Wolf B, Katz JN, Rosenthal GE. A comparison of total hip and knee replacement in specialty and general hospitals. J Bone Joint Surg Am. 2007; 89:1675–84. [PubMed: 17671004]
22. Hagen TP, Vaughan-Sarrazin MS, Cram P. Relation between hospital orthopaedic specialisation and outcomes in patients aged 65 and older: retrospective analysis of US Medicare data. BMJ. 2010; 340:c165. [PubMed: 20150193]
23. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. Medical Care. 1998; 36:8–27. [PubMed: 9431328]
24. Quan H, Sundararajan V, Halfon P, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Med Care. 2005; 43:1130–9. [PubMed: 16224307]
25. Dunlop DD, Manheim LM, Song J, et al. Age and racial/ethnic disparities in arthritis-related hip and knee surgeries. Med Care. 2008; 46:200–8. [PubMed: 18219249]
26. Jones A, Kwoh CK, Kelley ME, Ibrahim SA. Racial disparity in knee arthroplasty utilization in the veterans health administration. Arthritis Rheum. 2005; 53:979–81. [PubMed: 16342110]
27. Steel N, Clark A, Lang IA, Wallace RB, Melzer D. Racial disparities in receipt of hip and knee joint replacements are not explained by need: the Health and Retirement Study 1998-2004. J Gerontol A Biol Sci Med Sci. 2008; 63:629–34. [PubMed: 18559639]
28. Ackerman IN, Graves SE, Wicks IP, Bennell KL, Osborne RH. Severely compromised quality of life in women and those of lower socioeconomic status waiting for joint replacement surgery. Arthritis Rheum. 2005; 53:653–8. [PubMed: 16208653]

29. Bang H, Chiu YL, Memtsoudis SG, et al. Total hip and total knee arthroplasties: trends and disparities revisited. Am J Orthop (Belle Mead NJ). 2010; 39:E95–102. [PubMed: 21290031]
30. Lavernia CJ, Alcerro JC, Rossi MD. Fear in arthroplasty surgery: the role of race. Clin Orthop Relat Res. 2010; 468:547–54. [PubMed: 19763716]
31. Berges IM, Kuo YF, Ostir GV, Granger CV, Graham JE, Ottenbacher KJ. Gender and ethnic differences in rehabilitation outcomes after hip-replacement surgery. Am J Phys Med Rehabil. 2008; 87:567–72. [PubMed: 18574348]
32. Ottenbacher KJ, Smith PM, Illig SB, et al. Disparity in health services and outcomes for persons with hip fracture and lower extremity joint replacement. Med Care. 2003; 41:232–41. [PubMed: 12555051]
33. Peng TR, Navaie-Waliser M, Feldman PH. Social support, home health service use, and outcomes among four racial-ethnic groups. Gerontologist. 2003; 43:503–13. [PubMed: 12937329]
34. Morrow-Howell N, Proctor E. Discharge destinations of Medicare patients receiving discharge planning: who goes where? Med Care. 1994; 32:486–97. [PubMed: 8182976]
35. Sands LP, Landefeld CS, Ayers SM, et al. Disparities between black and white patients in functional improvement after hospitalization for an acute illness. J Am Geriatr Soc. 2005; 53:1811–6. [PubMed: 16181184]
36. Al-Khatib SM, Hellkamp AS, Hernandez AF, et al. Trends in Use of Implantable Cardioverter Defibrillator Therapy Among Patients Hospitalized for Heart Failure: Have the Previously Observed Sex and Racial Disparities Changed Over Time? Circulation. 2012
37. Richards CA, Kerker BD, Thorpe L, et al. Increased screening colonoscopy rates and reduced racial disparities in the New York Citywide campaign: an urban model. Am J Gastroenterol. 2011; 106:1880–6. [PubMed: 22056567]
38. Robbins AS, Siegel RL, Jemal A. Racial disparities in stage-specific colorectal cancer mortality rates from 1985 to 2008. J Clin Oncol. 2012; 30:401–5. [PubMed: 22184373]
39. McWilliams JM, Meara E, Zaslavsky AM, Ayanian JZ. Differences in control of cardiovascular disease and diabetes by race, ethnicity, and education: U.S. trends from 1999 to 2006 and effects of medicare coverage. Ann Intern Med. 2009; 150:505–15. [PubMed: 19380852]
40. U.S. Department of Health and Human Services. National Partnership for Action to End Health Disparities. HHS Action Plan to Reduce Racial and Ethnic Health Disparities. http://minorityhealth.hhs.gov/npa/templates/content.aspx?lvl=1&lvlid=33&ID=285 Last Modified: 09/19/2011. 2011. (Accessed 03/29/2012)
41. Chin MH. Quality improvement implementation and disparities: the case of the health disparities collaboratives. Med Care. 2010; 48:668–75. [PubMed: 20613665]
42. Chin MH, Walters AE, Cook SC, Huang ES. Interventions to reduce racial and ethnic disparities in health care. Med Care Res Rev. 2007; 64:7S–28S. [PubMed: 17881624]
43. Long JA, Jahnle EC, Richardson DM, Loewenstein G, Volpp KG. Peer mentoring and financial incentives to improve glucose control in african american veterans: a randomized trial. Ann Intern Med. 2012; 156:416–24. [PubMed: 22431674]
44. Ogedegbe GO, Boutin-Foster C, Wells MT, et al. A randomized controlled trial of positive-affect intervention and medication adherence in hypertensive african americans. Arch Intern Med. 2012; 172:322–6. [PubMed: 22269592]
45. Schlotthauer AE, Badler A, Cook SC, Perez DJ, Chin MH. Evaluating interventions to reduce health care disparities: an RWJF program. Health Aff (Millwood). 2008; 27:568–73. [PubMed: 18332515]

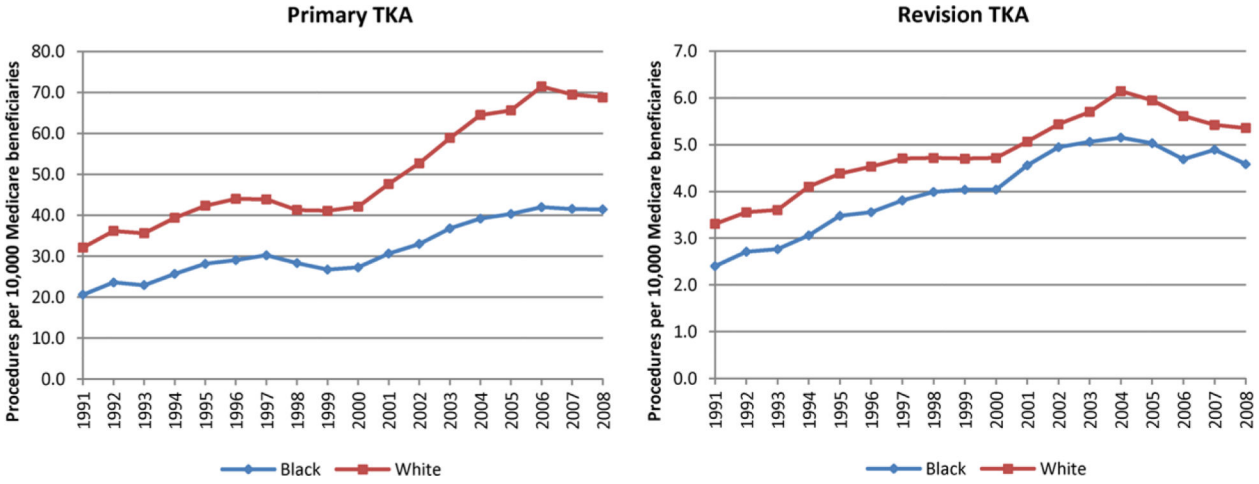


Figure 1.

Standardized utilization rates per 10,000 enrollees for primary and revision TKA for Blacks and Whites

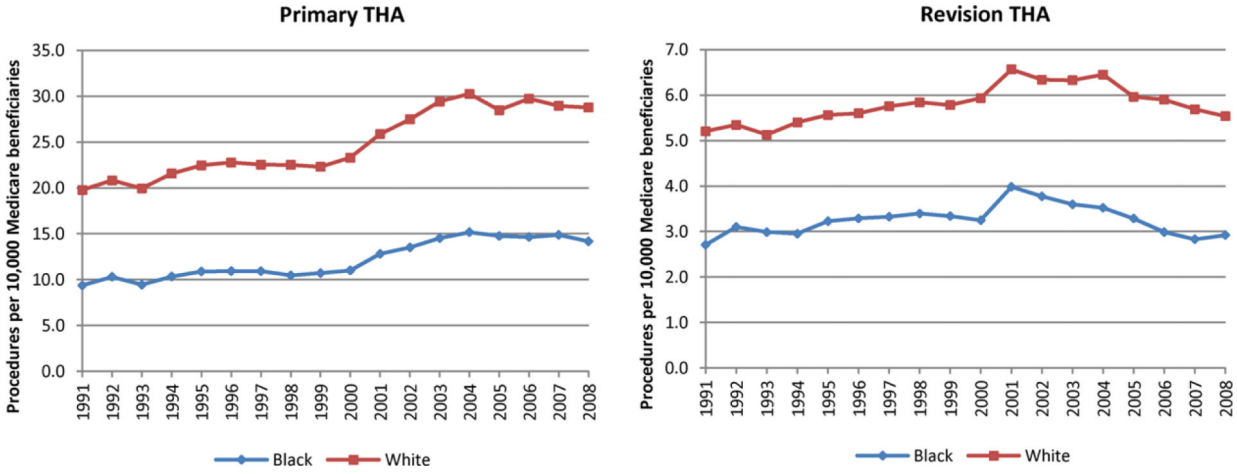
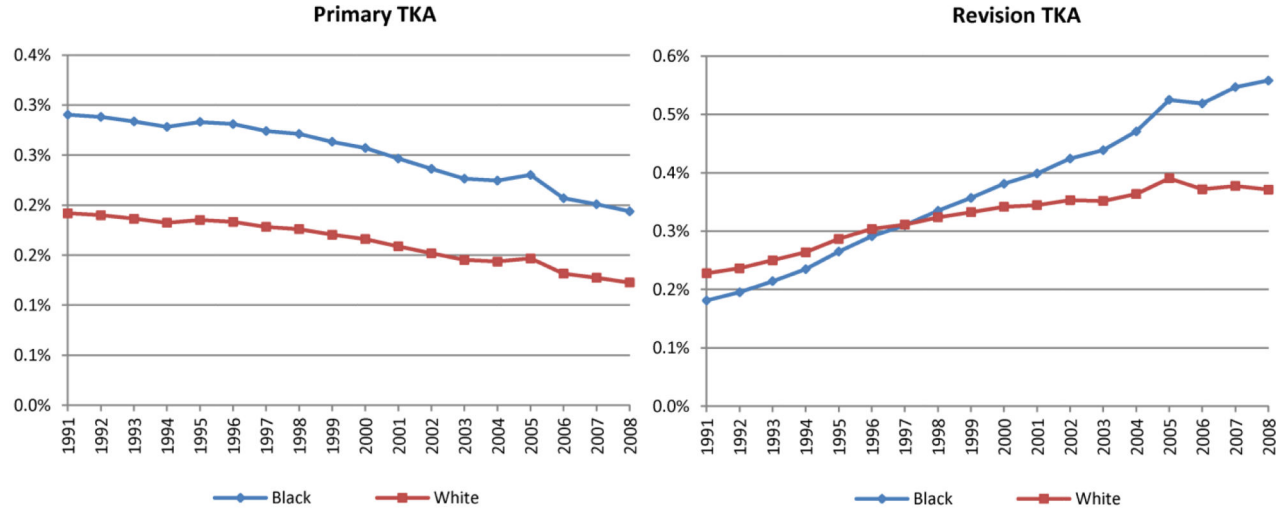
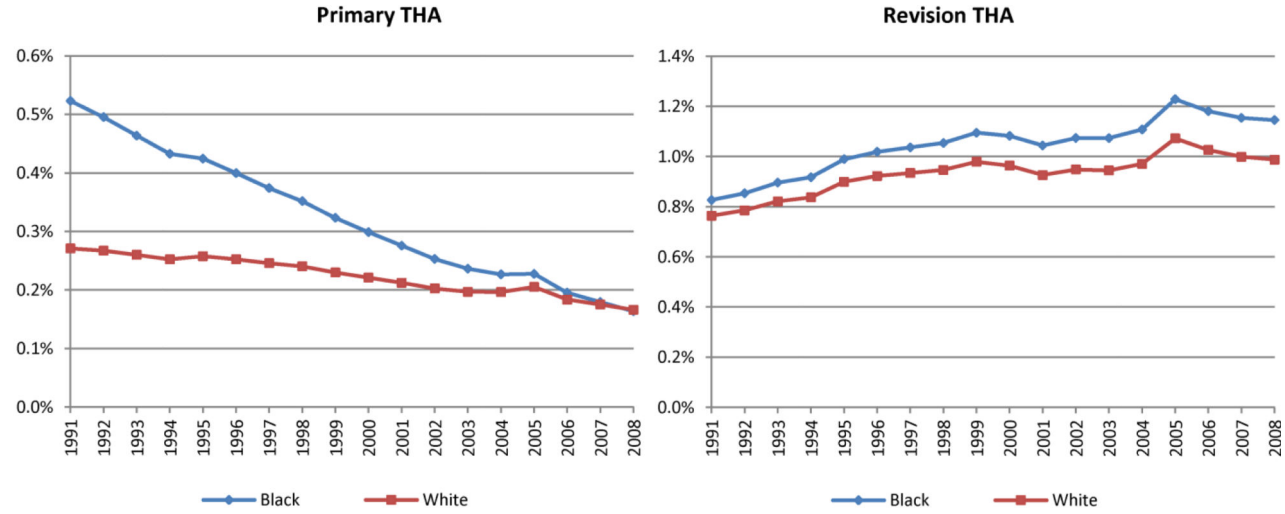


Figure 2.
Standardized utilization rates per 10,000 enrollees for primary and revision THA for Blacks and Whites



[a]Mortality adjusted for age, sex, hospital procedure volume, and comorbidity

Figure 3.
Adjusted[a] mortality for primary and revision TKA for Blacks and Whites



[a]Mortality adjusted for age, sex, hospital procedure volume, and comorbidity

Figure 4.
Adjusted mortality[a] for primary and revision THA for blacks and whites

Table 1

Patient characteristics for Black and White patients undergoing Primary and Revision TKA 1991-2008

	PRIMARY TKA			REVISION TKA		
	BLACK (N=145888, 5.4%)	**WHITE (N=2538687, 94.6%)**	**P-value**	**BLACK (N=18717, 7.0%)**	**WHITE (N=248927, 93.0%)**	**P-value**
Demographics						
Age, mean (SD)	73.5 (5.8)	74.6 (5.9)	<0.001	73.8 (6.1)	75.2 (6.2)	<0.001
Sex, women (%)	117327 (80.4)	1637435 (64.5)	<0.001	14583 (77.9)	144327 (58.0)	<0.001
Comorbidity, number (%)						
Diabetes	38163 (26.2)	389098 (15.3)	<0.001	5003 (26.7)	42462 (17.1)	<0.001
CHF	8006 (5.5)	105177 (4.1)	<0.001	1688 (9.0)	18568 (7.5)	<0.001
Obesity	16340 (11.2)	170627 (6.7)	<0.001	1902 (10.2)	15299 (6.2)	<0.001
Renal failure	4035 (2.8)	30555 (1.2)	<0.001	971 (5.2)	5365 (2.2)	<0.001
Number of comorbid conditions, mean (SD)	2.0 (1.4)	1.7 (1.4)	<0.001	2.1 (1.5)	1.8 (1.4)	<0.001

Table 2

Patient characteristics for Black and White patients undergoing Primary and Revision THA 1991-2008

	PRIMARY THA			REVISION THA		
	BLACK (N=56018, 4.2%)	**WHITE (N=1272884, 95.8%)**	**P-value**	**BLACK (N=14851, 4.7%)**	**WHITE (N=302557, 95.3%)**	**P-value**
Demographics						
Age, mean (SD)	73.5 (6.0)	75.1 (6.2)	<0.001	75.0 (7.1)	77.0 (6.9)	<0.001
Sex, women (%)	39371 (70.3)	806148 (63.3)	<0.001	9809 (66.1)	189695 (62.7)	<0.001
Comorbidity, number (%)						
Diabetes	11839 (21.1)	139427 (11.0)	<0.001	3140 (21.1)	33865 (11.2)	<0.001
CHF	2837 (5.1)	52390 (4.1)	<0.001	1294 (8.7)	25492 (8.4)	0.22
Obesity	4458 (8.0)	55448 (4.4)	<0.001	687 (4.6)	8177 (2.7)	<0.001
Renal failure	1774 (3.2)	15524 (1.2)	<0.001	932 (6.3)	6346 (2.1)	<0.001
Number of comorbid conditions, mean (SD)	1.8 (1.4)	1.6 (1.3)	<0.001	2.1 (1.6)	1.8 (1.5)	<0.001

Table 3

Unadjusted outcomes for Black and White patients undergoing Primary and Revision TKA 1991-2008

	PRIMARY TKA			REVISION TKA		
	BLACK	WHITE	P-VALUE*	BLACK	WHITE	P-VALUE*
Length of Stay (# days, mean [SD])						
1991-1993	9.7 (5.7)	8.3 (4.0)	<0.001	11.8 (10.8)	9.2 (8.0)	<0.001
1994-1996	6.4 (3.9)	5.7 (2.8)	<0.001	8.0 (7.3)	6.6 (6.1)	<0.001
1997-1999	4.8 (2.6)	4.5 (2.1)	<0.001	6.1 (6.6)	5.4 (4.7)	<0.001
2000-2002	4.5 (2.8)	4.2 (2.0)		6.0 (5.9)	5.4 (4.8)	
2003-2005	4.2 (2.2)	3.9 (1.9)		5.8 (5.2)	5.2 (4.9)	
2006-2008	3.9 (2.1)	3.6 (1.7)		5.9 (6.6)	5.0 (4.6)	
30-day mortality, n (%)						
1991-1993	55 (0.4)	642 (0.2)	<0.01	6 (0.3)	104 (0.4)	0.81
1994-1996	69 (0.3)	850 (0.2)	<0.01	7 (0.3)	138 (0.4)	0.20
1997-1999	71 (0.3)	893 (0.3)	0.64	12 (0.4)	188 (0.5)	0.29
2000-2002	73 (0.3)	828 (0.2)		26 (0.7)	226 (0.5)	
2003-2005	86 (0.3)	1068 (0.2)		20 (0.5)	282 (0.6)	
2006-2008	87 (0.3)	1093 (0.2)		30 (0.8)	286 (0.6)	
30-day readmission, n (%)						
1991-1993	717 (4.7)	12056 (4.4)	0.02	122 (6.9)	2047 (7.3)	0.46
1994-1996	920 (4.6)	14984 (4.3)	<0.001	168 (6.9)	2592 (7.1)	<0.001
1997-1999	1042 (4.9)	15143 (4.2)	<0.001	218 (7.4)	2940 (7.3)	<0.001
2000-2002	1086 (4.6)	16987 (4.2)		274 (7.8)	3337 (7.5)	
2003-2005	1474 (4.8)	23618 (4.4)		367 (9.2)	4198 (8.2)	
2006-2008	3088 (8.8)	40698 (6.7)		545 (13.6)	5440 (11.2)	
30-day composite outcome, n (%)						
1991-1993	293 (1.9)	4382 (1.6)	<0.001	45 (2.5)	932 (3.3)	0.07
1994-1996	392 (2.0)	5727 (1.6)	<0.001	78 (3.2)	1195 (3.3)	0.03
1997-1999	384 (1.8)	5793 (1.6)	0.17	127 (4.3)	1560 (3.9)	0.02
2000-2002	415 (1.8)	6462 (1.6)		174 (4.9)	1870 (4.2)	
2003-2005	559 (1.8)	8249 (1.6)		212 (5.3)	2446 (4.8)	
2006-2008	863 (2.5)	11647 (1.9)		280 (7.0)	2979 (6.1)	
Discharged to Home, n (%)						
1991-1993	10349 (68.3)	195535 (70.5)	<0.001	1223 (68.8)	20283 (72.6)	<0.001
1994-1996	9967 (49.5)	190682 (54.2)	<0.001	1369 (55.9)	21506 (58.8)	<0.001
1997-1999	7394 (34.7)	151393 (42.3)	<0.001	1176 (39.7)	18767 (46.4)	<0.001
2000-2002	6675 (28.2)	165610 (40.5)		1157 (32.8)	19593 (44.1)	
2003-2005	9025 (29.6)	232055 (43.6)		1284 (32.1)	22760 (44.7)	

	PRIMARY TKA			REVISION TKA		
	BLACK	WHITE	P-VALUE*	BLACK	WHITE	P-VALUE*
2006-2008	15025 (42.7)	336101 (55.1)		1615 (40.4)	24731 (51.0)	

*For each set of P-Values: 1) the first p-value denotes White-Black disparity in 1991-1993; 2) the second p-value denotes White-Black disparity in 2006-2008; and 3) the last p-value denotes change in the disparity magnitude between 1991-93 and 2006-2008.

Table 4

Unadjusted outcomes for Black and White patients undergoing Primary and Revision THA 1991-2008

	PRIMARY THA			REVISION THA		
	BLACK	WHITE	P-VALUE	BLACK	WHITE	P-VALUE*
Length of Stay (# days, mean [SD])						
1991-1993	9.9 (5.5)	8.6 (4.4)	<0.001	14.8 (14.9)	11.6 (10.2)	<0.001
1994-1996	6.6 (4.3)	5.9 (3.1)	<0.001	10.1 (11.4)	7.9 (7.3)	<0.001
1997-1999	5.0 (3.0)	4.6 (2.3)	<0.001	7.8 (8.4)	6.3 (5.6)	<0.001
2000-2002	4.6 (3.4)	4.4 (2.2)		7.1 (6.8)	6.2 (5.4)	
2003-2005	4.3 (2.4)	4.0 (2.1)		7.0 (7.0)	6.1 (5.3)	
2006-2008	4.1 (2.5)	3.8 (1.9)		7.0 (6.8)	5.9 (5.4)	
30-day mortality, n (%)						
1991-1993	44 (0.7)	585 (0.4)	<0.001	32 (1.7)	550 (1.3)	0.24
1994-1996	36 (0.5)	628 (0.3)	0.36	34 (1.5)	656 (1.4)	0.26
1997-1999	46 (0.6)	639 (0.3)	<0.001	40 (1.6)	783 (1.6)	0.79
2000-2002	34 (0.4)	645 (0.3)		44 (1.6)	884 (1.6)	
2003-2005	34 (0.3)	716 (0.3)		45 (1.7)	943 (1.7)	
2006-2008	28 (0.2)	700 (0.3)		52 (2.2)	953 (1.8)	
30-day readmission, n (%)						
1991-1993	429 (6.5)	9470 (5.9)	0.02	196 (9.9)	3951 (9.4)	0.51
1994-1996	420 (5.4)	10068 (5.4)	<0.001	200 (8.7)	4370 (9.4)	<0.001
1997-1999	474 (5.9)	9850 (5.1)	0.09	255 (10.2)	4860 (9.6)	0.02
2000-2002	461 (4.7)	10308 (4.6)		279 (9.7)	5341 (9.5)	
2003-2005	551 (4.7)	12094 (4.8)		298 (10.9)	5723 (10.4)	
2006-2008	1103 (9.0)	19704 (7.6)		420 (17.1)	7585 (14.5)	
30-day composite outcome, n (%)						
1991-1993	178 (2.7)	3570 (2.2)	<0.01	83 (4.2)	1713 (4.1)	0.51
1994-1996	169 (2.2)	3939 (2.1)	0.19	103 (4.5)	2110 (4.5)	<0.001
1997-1999	189 (2.4)	3866 (2.0)	0.28	161 (6.4)	2601 (5.2)	0.02
2000-2002	176 (1.8)	3921 (1.8)		174 (6.1)	3071 (5.5)	
2003-2005	216 (1.9)	4523 (1.8)		191 (7.0)	3314 (6.0)	
2006-2008	300 (2.4)	5838 (2.3)		243 (9.9)	3925 (7.5)	
Discharged to Home, n (%)						
1991-1993	4326(65.9)	106121 (65.8)	0.80	1138 (57.4)	23012 (55.0)	0.04
1994-1996	3638 (46.7)	92249 (49.3)	<0.001	1007 (43.9)	20188 (43.2)	<0.001
1997-1999	2562 (32.1)	71431 (37.3)	<0.001	816 (32.5)	16895 (33.5)	<0.001
2000-2002	2537 (26.2)	75537 (34.0)		717 (25.0)	17727 (31.6)	
2003-2005	3139 (26.9)	92466 (36.7)		657 (24.0)	17269 (31.3)	

	PRIMARY THA			REVISION THA		
	BLACK	**WHITE**	**P-VALUE**	**BLACK**	**WHITE**	**P-VALUE***
2006-2008	4701 (38.2)	121689 (47.1)		685 (27.8)	18390 (35.1)	

* For each set of P-Values: 1) the first p-value denotes White-Black disparity in 1991-1993; 2) the second p-value denotes White- Black disparity in 2006-2008; and 3) the last p-value denotes change in the disparity magnitude between 1991-93 and 2006-2008.