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Trends in Racial Disparities Among the Elderly for Selected Procedures

Jayasree Basu
Agency for Healthcare Research and Quality, Rockville, Maryland
Lee R. Mobley
RTI International, Research Triangle Park, North Carolina

The authors examine trends over 1997-2001 in racial or ethnic disparities in the utilization of three costly, referral-sensitive procedures among the elderly—coronary artery bypass grafting (CABG), percutaneous transluminal coronary angioplasty (PTCA), and hip/joint replacement. Using a multivariate framework, they undertake a simultaneous examination of the relationships between patient, local area context, and health systems on these admission types after comparing them to a control group. This period spans the implementation of the Balanced Budget Act and a major Department of Health and Human Services initiative to reduce disparities in cardiovascular and other diseases. Findings suggest increasing disparities for African Americans relative to Whites in their lower utilization of CABG and PTCA over time, and increasing disparities in the utilization of hip/joint replacement among other races' relative to Whites. The authors find that racial or ethnic disparities in use of referral-sensitive procedures did not narrow over 1997-2001.

Keywords: *racial disparities; CABG; PTCA; hip/joint replacement; referral-sensitive procedures; elderly*

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Racial differences in health care utilization across a variety of conditions and clinical settings have been widely documented. Data from *The National Healthcare Disparities Report*, released to the U.S. Congress in December 2003, indicate that performance is worse for racial and ethnic minority groups in many aspects of health care, including indicators of access, quality, and clinical outcomes (U.S. Department of Health and Human Services [DHHS], 2003). In 1993, the National Institutes of Health started requiring that minority patients be equally represented in clinical trials, and in 1996, DHHS launched major initiatives with the Office of Minority Health to eliminate disparities in health care, including a major initiative to reduce disparities in cardiovascular disease (Jha, Fisher, Li, Orav, & Epstein, 2005; DHHS, 1998).

We chose coronary heart disease and hip/joint replacement for this study because coronary heart disease, the leading cause of death in the United States, and osteoarthritis, another prevalent and potentially debilitating condition, have been used as research foci to understand the underlying causes of disparities. Invasive cardiovascular procedures, such as coronary catherization, percutaneous transluminal coronary angioplasty (PTCA), and coronary artery bypass grafting (CABG), improve diagnostic accuracy, delay death, and provide symptom relief. For patients with osteoarthritis, hip/joint replacement has proven to be effective in improving quality of life, personal independence, and ability to perform one's ordinary functions of daily living. However, numerous studies have shown that African Americans and members of other racial and ethnic minority groups are less likely to receive the cardiovascular and orthopedic procedures that enable longer and higher quality elderly lives. Even in the absence of differences in clinical factors, and controlling for sociodemographic characteristics, race has been shown to play a role in physicians' recommendations for cardiac procedures (Cooper-Patrick et al., 1999; Ibrahim et al., 2003; Schulman et al., 1999). Disparities in procedure utilization have been shown to persist despite having health insurance (Giles, Anda, Casper, Escobedo, & Taylor, 1995; Mitchell & Khandker, 1995; Philbin et al., 2000), although some studies find that insurance reduces the disparity gap (Carlisle, Leake, & Shapiro, 1997; Daumit, Hermann, Coresh, & Powe, 1999). Similarly, studies show racial and ethnic disparities in the rates of joint arthroplasty, with minorities—especially men—considerably less likely to undergo these procedures than White patients (Dunlop, Manheim, Song, & Chang, 2003a; Skinner, Weinstein, Sporer, & Wenberg, 2003). These disparities have persisted despite lack of difference in pain perception and joint functionality (Ang, Ibrahim, Burant, & Kwoh, 2003) and higher prevalence rates for osteoarthritis among minority patients than Whites (Dunlop, Manheim, Song, & Chang, 2001).

New Contribution

While there is plenty of evidence of racial or ethnic disparities in utilization of both cardiac and joint arthroplasty procedures, existing studies are equivocal as to

the factors that underlie such disparities, and conflicting evidence exists regarding whether progress has been made in reducing disparities among traditional Medicare beneficiaries. The existing studies did not employ multivariate analysis, and their study populations were restricted to fee-for-service (FFS) Medicare (Escarce & McGuire 2004; Jha et al., 2005; R. D. Williams, 2004). The present study uses multivariate analysis to understand relationships between three types of factors—patient, local area context, and health systems—and includes all elderly admitted to hospital as the study population. Using hospital discharge data for two states (New York and Pennsylvania), we find that less than 80% of the elderly discharged from hospitals had FFS Medicare as their primary payer (see Table 1) for selected procedures. Other groups included Medicare or private health maintenance organization (HMO) coverage, Medicaid or the uninsured, and all others (including commercial FFS). Understanding disparities among all elderly, not just those with traditional FFS Medicare, is a new contribution to the literature. The present study examines disparities in the use of referral-sensitive procedures relative to a group of urgent procedures that serve as stable benchmarks, exhibiting much less variation over time, race, or ethnicity than the referral-sensitive conditions. This approach has not been used before to assess trends in disparities in referral-sensitive procedures among the elderly.

Background

The time interval chosen for study (1997-2001) follows the 1996 DHHS initiative to reduce health care disparities and spans implementation of the Balanced Budget Act (BBA) of 1997. There was rapid expansion in managed care during the 1990s, including Medicare managed care plan availability. However, following the implementation of the BBA in 1998, many Medicare managed care plans were dissatisfied with changes in their capitation payment rates and withdrew, leaving many elderly beneficiaries stranded as they were involuntarily disenrolled (Abt Associates, 2002; Dubow, 2000). Research using surveys of Medicare beneficiaries involuntarily disenrolled from their health plans found minorities to be more adversely affected (Booske, Lynch, & Riley, 2002; Schoenman et al., 2005) than Whites. This was supported in case studies of six communities, including New York and Pennsylvania (Abt Associates, 2002). Also, minorities may have been more likely to enroll in Medicare HMOs than Whites in some regions of the United States, which is obscured by national statistics (Morgan, 2000). This is consistent with our New York–Pennsylvania sample, where we find that minorities, especially Blacks, were indeed more likely to enroll in Medicare HMOs in the New York–Pennsylvania region.[1] Thus, consistent with the literature, our data supports the assumption that Medicare HMO withdrawals might have more adversely affected referrals for minorities, who were more dependent on them and thus more likely to be affected by involuntary disenrollment.

Table 1
Unadjusted Means of Selected Variables by Types of Hospitalization

	Bypass Surgery		Angioplasty		Hip/Joint Replacement		Marker	
	1997	2001	1997	2001	1997	2001	1997	2001
No. of admissions	17,395	15,562	20,329	31,032	31,545	39,873	80,744	82,717
Patient sociodemographics								
White	0.916	0.918	0.901	0.915	0.912	0.925	0.902	0.898
African American	0.031	0.029	0.034	0.032	0.052	0.044	0.052	0.055
Hispanic	0.017	0.014	0.018	0.015	0.021	0.015	0.023	0.019
Other races	0.036	0.039	0.048	0.038	0.015	0.016	0.023	0.028
All non-White	0.084	0.082	0.099	0.085	0.088	0.075	0.098	0.102
Ages 75-84	0.34	0.38	0.33	0.38	0.39	0.41	0.42	0.43
Age 85 and older	0.02	0.03	0.03	0.05	0.06	0.07	0.29	0.32
Ages 65-74	0.64	0.59	0.64	0.57	0.55	0.52	0.29	0.25
Metro resident	0.89	0.94	0.91	0.95	0.87	0.89	0.88	0.90
Nonadjacent rural resident	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02
Metro-adjacent resident	0.09	0.05	0.08	0.04	0.11	0.09	0.10	0.08
Distance from home to hospital	17.62	17.49	16.64	17.54	10.58	12.00	7.66	9.08
Male	0.66	0.67	0.58	0.59	0.35	0.35	0.36	0.36
Female	0.34	0.33	0.42	0.41	0.65	0.65	0.64	0.64
Median family income ($000)	37.38	52.06	37.65	52.32	37.11	51.52	36.80	51.97

(continued)

Table 1 (continued)

	Bypass Surgery		Angioplasty		Hip/Joint Replacement		Marker	
	1997	2001	1997	2001	1997	2001	1997	2001
Patient clinical characteristics								
Severity score (RDSCALE)	5.13	4.18	3.97	2.06	2.55	2.05	2.31	1.82
Transferred	0.24	0.19	0.28	0.24	0.01	0.01	0.13	0.13
Admitted through emergency room	0.13	0.15	0.19	0.23	0.03	0.03	0.71	0.76
Admitted through other	0.63	0.66	0.53	0.53	0.96	0.96	0.16	0.11
Health systems factors								
Medicare HMO	0.07	0.18	0.06	0.16	0.06	0.16	0.04	0.13
Medicaid + uninsured	0.02	0.03	0.02	0.02	0.01	0.01	0.02	0.02
Commercial HMO	0.09	0.07	0.08	0.06	0.07	0.06	0.04	0.03
All other insurance	0.09	0.05	0.09	0.05	0.08	0.05	0.05	0.04
Medicare FFS	0.73	0.67	0.75	0.71	0.78	0.72	0.85	0.78
Admitted to teaching hospitals	0.64	0.57	0.66	0.59	0.35	0.47	0.30	0.29
Admitted to nonteaching hospitals	0.36	0.43	0.34	0.41	0.65	0.53	0.70	0.71
PCPs per 1,000 population	0.52	0.57	0.53	0.57	0.52	0.55	0.52	0.54
% cardiologists and pulmonary specialists	9.18	10.23	9.42	10.23	9.20	9.79	9.21	9.71
% orthopedics	6.79	6.78	6.78	6.80	6.95	6.91	6.69	6.52
Specialists per 1,000	1.29	1.52	1.35	1.54	1.29	1.43	1.30	1.41
Outpatient visits/capita	2.45	3.09	2.46	3.02	2.53	3.09	2.51	2.92
Inpatient days per capita	1.01	1.07	1.04	1.08	1.03	1.02	1.03	0.98
Contextual factors								
Isolation African Americans	0.34	0.37	0.35	0.39	0.33	0.34	0.35	0.35
Isolation Hispanics	0.17	0.18	0.18	0.20	0.16	0.17	0.19	0.18
Commuter intensity	2.06	0.75	1.81	0.70	2.21	1.73	2.09	1.76

Note: HMO = Health maintenance organization; FFS = fee for service; PCP = primary care physician.

The 1990s were also a time when the number of uninsured persons increased nationally (Fronstin, 2000). Increased price pressures from managed care plans and other competitive forces reduced hospitals' ability or willingness to provide indigent care (Cunningham, Grossman, St. Peter, & Lessor, 1999). The BBA appeared to have exacerbated the pressure on hospitals, as it brought forth significant changes in hospital payments (American Association of Medical Colleges, n.d.), including a phased reduction in the disproportionate share (DSH) adjustment through 2002[2] and a reduction in supplemental Medicare payments to major teaching hospitals that served the majority of the nation's indigent patients (Moy, Valente, Levin, & Griner, 1996). The tighter financial conditions for providers could have affected access to care for the elderly in general, and for minorities in particular, at a time when national efforts were focused on reducing disparities. Because minorities are more dependent on physician referrals (Basu & Clancy, 2001; Kressin et al., 2002), one might expect this period of financial constraint to exhibit widening disparities in the observed utilization of referral-sensitive versus marker conditions among the elderly. On the other hand, the 1996 DHHS initiative is expected to have reduced disparities, so the net result cannot be determined a priori. With these conflicting forces in the policy environment, an empirical study is necessary to determine the net impact on disparities. It should be noted that the DHHS initiative targeted cardiac procedures but did not target joint procedures. Including both thus gives us the opportunity to interpret the findings in the context of the DHHS initiative.

The study population includes elderly residents of two contiguous states, New York and Pennsylvania, who were admitted to hospital for one of three referral-sensitive conditions (described below) or one of several urgent conditions (the reference group). The selected states are similar in representing a predominantly urban population with significant proportions of racial and ethnic minorities, and both ranked high among other U.S. states in terms of undocumented immigrant populations, many of whom are uninsured and ineligible for Medicare (Fernandez & Robinson, 1994; Mold, Fryer, & Thomas, 2004; U.S. Census Bureau, 2007). These states also had substantial penetration by Medicare managed care plans by 2001, with about 15% of the New York and about 23% of the Pennsylvania eligibles in Medicare HMO plans (Centers for Medicare and Medicaid Services, 2001). Thus, both states were vulnerable to the financial constraints imposed on Medicare HMO plans following the BBA and tighter fiscal environments facing providers of care to uninsured people.

Possible explanations for disparities in referral-sensitive procedure use include underlying group differences in patient characteristics, access to care, patient preferences, provider resources, and provider referral behavior. Part may also be explained by differences in the incidence of disease across racial or ethnic groups (Dunlop, Song, Manheim, & Chang, 2003b; Vladeck, Van de Water, & Eichner, 2006). Patient characteristics such as race and gender together have been related to disparities (Epstein et al., 2003; Giacomini, 1996; Schulman et al., 1999). Differential patterns of access to care may be driven by the combination of race, rural location, and ability or

willingness to travel for care (Blustein & Weitzman, 1995; McClellan, McNeil, & Newhouse, 1994). Patient preferences may explain why some groups seem absolutely less likely to use health care services of all kinds (Cooper-Patrick et al., 1999; Ibrahim et al., 2003; Ibrahim, Siminoff, Burant, & Kwoh, 2002; Schulman et al., 1999). This may manifest as different patterns of referral behaviors by physicians across races (Basu & Clancy, 2001), while availability of provider resources may also be a factor (Bach, Pham, Schrag, Tate, & Hargraves, 2004). To the extent that these factors and proclivities divide along racial or ethnic lines, they may explain some of the observed disparities.

Conceptual Model

Kressin and Petersen (2001) developed these possible explanations into a conceptual model for cardiovascular disease, based on their review of the literature. This model posits that three types of factors—those that influence the patient, those that influence the physician, and health system factors—directly or indirectly drive variations in service utilization. We expand this model to include area contextual factors that are thought important in mainstream behavioral health models of utilization (Phillips, Morrison, Andersen, & Aday, 1998).

We include patient characteristics that may be associated with intensity of health-seeking behavior such as race, gender, age, urban intensity of county of residence, and distance from residence to admitting hospital. Rural residential location has been associated with disparities and differences in travel behavior (Blustein & Weitzman, 1995), while including distance to hospital may reduce apparent racial disparities (McClellan et al., 1994). Thus, we include both distance to hospital and urban–rural location of residence so that the independent effects of race or ethnicity can be estimated. We define four racial or ethnic groups: White (non-Hispanic), African American (non-Hispanic), Hispanic, and other races. Age is grouped into three categories: 65 through 74, 75 through 84, and 85 and older. We also include a measure of socioeconomic status in the county, median family income, as locations with higher incomes have exhibited higher rates of CABG (Anderson et al., 1993). Data on personal income are not available.

We include factors affecting physicians' medical decision making and treatment indirectly, using patient clinical characteristics such as severity of illness, as partially reflected in source of admissions, as well as a direct measure of severity. Three major sources of admissions were considered: admission from emergency rooms, transfer from another facility, and all others. Emergency and transfer admissions indicate a relatively high severity of illness. The direct measure of severity of illness was calculated using the variable RDSCALE, a development of the Disease Staging System (Christoffersson, Conklin, & Gonnella, 1988; Gonnella, Hornbrook, & Louis, 1984).

Health system factors include the reimbursement and financing reflected in patients' insurance status,[3] organizational characteristics such as attributes of their admitting hospital (such as hospital's urban/rural location, teaching status, and number of hospital beds[4]) and county health care resources including hospital capacity measures (inpatient days and outpatient visits per capita), physician supply variables (primary care physicians and specialists per 1,000 population, and the percentage of cardiac and orthopedic specialists among total specialists practicing in the county). One possible barrier to the supply of referrals might be low supply of specialists in areas where minorities live (Schulz, Williams, Israel, & Lempert, 2002; D. R. Williams & Collins, 2001).

Because health care utilization models should include socioecological factors in addition to health systems variables (Phillips et al., 1998), we expand the Kressin and Peterson model to include a measure of racial or ethnic segregation, using the isolation index developed by Massey and Denton (1988),[5] which is widely recognized as a valid indicator sensitive to changes in social structure over time (Logan, Stults, & Farley, 2004). People living in more racially segregated communities have exhibited sometimes worse and sometimes better outcomes, with no consistent findings across studies (Mobley, Kuo, & Andrews, in press; Mobley, Root, Finkelstein, Khavjou, & Will, 2006; Palloni & Arias, 2004; Schulz et al., 2002; D. R. Williams & Collins, 2001). We also include a transportation impedance factor that has been found important in work assessing utilization of primary care services by the elderly (Mobley, Root, Anselin, Lozano-Gracia, & Koschinsky, 2006).[6]

Method

An important question to be answered with this research is whether there was an increase over 1997 through 2001 in observed disparities between racial or ethnic minorities and Whites in the utilization of referral-sensitive cardiac and orthopedic procedures relative to more urgent marker conditions. We selected three high-tech and cost-intensive procedures with demonstrated disparities for more in-depth study. These include two cardiac procedures (CABG and PTCA) and one orthopedic procedure (hip/joint replacement); admissions for these procedures have been recognized as referral sensitive in previous research (Billings et al., 1993). Referral-sensitive admissions are fairly discretionary, high-technology procedures that require a referral from a primary care physician to a procedural specialist. For benchmarking, we identified a control group of procedures, known as marker conditions, which are urgent and nondiscretionary in nature (Billings et al., 1993). We then examine utilization patterns in the referral-sensitive cardiac or orthopedic procedures relative to these urgent, nondiscretionary marker conditions using a multivariate framework that adjusts for other covariates. This approach allows us to implicitly standardize for unmeasurable behavioral factors while controlling statistically for other demand and supply factors that may help explain these utilization patterns.

It should be noted that admissions for marker conditions might also be characterized by racial disparities, which could potentially confound the analysis. However, because of their urgent nature, these admissions are less likely to be related to health system factors and behavioral influences by patients and physicians (Basu, Friedman, & Burstin, 2002) and are expected to be relatively more stable than most other admission types. For example, between 1997 and 2001, marker admissions increased only 2.4%, while admissions for CABG, PTCA, and hip/joint replacement changed respectively by –10.0%, 52.6%, and 26.4% (derived from data in Table 1). Because marker conditions are urgent, they are not expected to be affected by policy changes such as the BBA or DHHS initiatives. The study builds on methods used in previous studies that used marker admissions as a control group for referral-sensitive admissions (Basu & Clancy 2001; Basu et al., 2002).[7]

Sample characteristics. Table 1 provides the number of admissions and means of covariates for each admission type used in the regression models for each year. The number of admissions for both PTCA and hip/joint replacement increased over time, while number of CABG admissions declined, and marker admissions were relatively stable over the 2 years. As noted above, this stability in the marker conditions over time underscores their reliability as a reference category for this work. Hip/joint replacement was more common among African Americans compared to the other two procedures. This procedure also occurred more frequently among Medicare patients and patients 85 years and older, while bypass surgery and angioplasty were more common among men, patients enrolled in health plans (both Medicare and commercial) and in Medicaid, and those at teaching hospitals. As opposed to cardiac procedures, admissions for hip/joint replacement are more discretionary, as evidenced by a much lower percentage of cases admitted through emergency rooms or transferred from another facility.

Data sources. The study focuses on elderly (age 65 and older), with hospital discharge information during 1997 and 2001 drawn from the Healthcare Cost and Utilization Project (HCUP) State Inpatient Database (SID) of the Agency for Healthcare Research and Quality (AHRQ, 2004). All hospitals and all discharges are included in the database for each year. Other data are from the Area Resource File (ARF), the American Hospital Association's (AHA) survey of hospitals, and the U.S. Census of Populations.

Analytic framework. We used multinomial logit models for each individual year, 1997 and 2001, to compare each procedural admission with a referent group of marker admissions. This model allows the simultaneous estimation of parameters for three referral-sensitive procedures compared to the benchmark group of marker condition admissions. We assume that all types of hospital admissions depend on the same set of independent variables. A suitable model for a simultaneous testing of hypotheses across these three procedures is the mutinomial logit model; simultaneous estimation improves efficiency and statistical power to detect significant associations

(Greene, 1993). Comparison with a referent group of marker admission offers a potential improvement over comparing each type of admission with a heterogeneous group of "all other" admissions (Basu et al., 2002) or simply comparing rates of procedures by racial or ethnic group (Escarce & McGuire, 2004; Jha et al., 2005).

The multinomial method requires that the admission types be mutually exclusive. However, appropriate coronary artery disease (CAD) treatment could include either open-heart surgery to graft blood vessels to create a bypass around blocked coronary arteries (CABG) or use of artery-expanding balloons to open blockages (PTCA), and these two procedures may not be independent. PTCA began to be adopted as a lower cost substitute for CABG in the 1990s, which was demonstrated to reduce cost growth and improve outcomes in New York state (Cutler & Huckman, 2003). However, PTCA is not a perfect substitute for CABG.[8] We coded admissions for PTCA, CABG, and hip/joint replacement according to the principal procedure codes used on the discharge records. The coding of marker conditions were likewise limited to the principal diagnoses codes. Based on clinical judgment (Basu et al., 2002), admissions with both marker conditions and in which a procedure was performed (e.g., a CABG or PTCA as well as a myocardial infarction/heart attack) were assigned to marker admissions. With these adjustments, the study focuses on cardiac and orthopedic procedures that are more discretionary than those driven by urgent admissions.

The relative risk ratios (RRRs) of a coefficient in the mutinomial logit model indicate how the relative risk of the outcome changes with the explanatory variable. An RRR greater than 1 indicates that the relative risk of the outcome increases as the variable increases (for continuous variables) or when the patient is in the dichotomous group relative to the reference group (for binary variables, such as race). Conversely, an RRR less than 1 indicates that the relative risk of the outcome decreases as the explanatory variable increases. For example, if the African American race coefficient estimate in the CABG model is 0.51, this is interpreted as African Americans being less likely than Whites to utilize CABG *relative to marker services*.

We estimate a mutinomial logit model for each year, 1997 and 2001, and compare the coefficient estimates in a qualitative test of change in disparities. Estimating each year separately allows all model coefficients to change over time. Due to limits on statistical power, an alternative method for assessing whether the observed change in racial and ethnic disparities over time was statistically significant was to use a restricted model, pooling over years and forcing all coefficient estimates to be the same over time and introducing a time interaction on the race and ethnicity variables. A likelihood ratio test found that these restrictions significantly reduced explanatory power in the system, so we conclude that the separately estimated years in Table 2 are a better fit to these data.[9] The parameters of the multinomial model were estimated by maximum likelihood methods in the STATA software release 8.0 (STATA Corporation, College Station, Texas), allowing for correlated errors across individuals within county of residence ("clustering"). Without this allowance for

correlated errors, the precision of estimation with a large sample of cases would be overestimated (i.e., the reported standard errors of coefficients would be too low).

Principal Findings

Racial or ethnic disparities. In Table 2, we present the two (separately estimated) cross-sectional models side by side to allow comparison of coefficient estimates over time. The sizes of the race or ethnicity coefficients appear to vary over time. Using multivariate modeling to adjust for other covariates such as distance to hospital, urban/rural residence, social isolation, and area income levels, racial disparities existed in the utilization of these procedures in both years and appear to have increased over time. As compared to marker admissions, African Americans were 37% less likely than Whites to have received a PTCA in 1997 (RRR = 0.63), and 48% less likely than Whites to have had this procedure in 2001 (RRR = 0.52). Likewise, odds of CABG admissions declined among African Americans, from 0.65 to 0.51 ($p < .01$) in this period. Thus, African Americans were 35% and 49% less likely than Whites to have received a CABG in 1997 and 2001, respectively, compared to marker admissions. The disparities in CABG use between Whites and other races were not statistically significant in either year.

The literature finds that Hispanics are less likely than Whites to use CABG (Giacomini, 1996) or about equal in CABG rates but showing lower use rates for other heart procedures (Mayberry et al., 1999). We find no differences in CABG or PTCA rates for Hispanics versus Whites in 1997, but in 2001 the Hispanics showed significantly lower PTCA rates. Hispanics were 34% less likely to have received a PTCA in 2001 (RRR = 0.66, $p < .01$). The differences between Hispanics and Whites were not statistically significant for hip/joint replacement in either year.

Similar to the other two racial or ethnic minority groups, the utilization patterns by other races showed increased differences from Whites over time. While they were found 39% more likely that Whites to have received PTCA in 1997, the difference became nonsignificant in 2001. The members of this subgroup had lower odds of receiving hip/joint replacement procedures than Whites, and the difference increased over time from 24% (RRR = 0.76) in 1997 to 46% in 2001 (RRR = 0.54).

Other covariates. Men were more likely to have CABG and PTCA, whereas women were more likely to undergo hip/joint replacement. All three procedures were less likely to occur among people 75 years and older than among persons aged 65-74. Personal illness severity increased the likelihood of a CABG admission relative to marker, and increasingly so over time, with RRR rising from 1.61 in 1997 to 2.24 in 2001. For persons with PTCA admissions, odds increase with severity in 1997, but decrease with severity in 2001, relative to marker (RRR = 1.34 in 1997 and

Table 2
Results of Mutinomial Logit Regression: Elderly (≥65) Relative Risk Ratios (RRRs) for Individual Procedures Versus Marker Admission, 1997 and 2001

	Bypass Surgery				Angioplasty				Hip/Joint Replacement			
	1997		2001		1997		2001		1997		2001	
Variable	RRR	*p* value	RRR	*p* value	RRR	*p* value	RRR	*p* value	RRR	*p* value	RRR	*p* value
Patient sociodemographics												
African American	0.65	.00	0.51	.00	0.63	.00	0.52	.00	1.02	.91	0.92	.40
Hispanic	0.80	.14	0.81	.12	0.78	.19	0.66	.00	0.98	.91	1.00	.99
Other races	1.06	.52	0.96	.78	1.39	.00	0.89	.40	0.75	.02	0.54	.00
Ages 75-84	0.49	.00	0.44	.00	0.47	.00	0.49	.00	0.61	.00	0.55	.00
Ages 85 and older	0.08	.00	0.07	.00	0.11	.00	0.11	.00	0.14	.00	0.14	.00
Metro resident	2.15	.00	2.17	.01	2.23	.00	2.89	.00	1.55	.01	1.44	.23
Nonadjacent rural resident	1.03	.92	1.28	.61	0.97	.93	1.60	.38	1.20	.47	1.49	.30
Distance from home to hospital	1.02	.00	1.00	.09	1.02	.00	1.00	.00	1.01	.00	1.00	.75
Male	2.04	.00	2.08	.00	1.57	.00	1.89	.00	0.69	.00	0.65	.00
Median family income	1.01	.22	1.00	.03	1.01	.35	1.00	.08	1.01	.15	1.00	.00
Patient clinical characteristics												
Severity score (RDSCALE)	1.61	.00	2.24	.00	1.34	.00	0.77	.00	0.85	.00	0.76	.00
Transferred	0.22	.00	0.14	.00	0.37	.00	0.38	.00	0.01	.00	0.01	.00
Admitted through ER	0.06	.00	0.03	.00	0.11	.00	0.07	.00	0.01	.00	0.00	.00

(continued)

Table 2 (continued)

	Bypass Surgery				Angioplasty				Hip/Joint Replacement			
	1997		2001		1997		2001		1997		2001	
Variable	RRR	*p* value	RRR	*p* value	RRR	*p* value	RRR	*p* value	RRR	*p* value	RRR	*p* value
Health systems factors												
Medicare HMO	1.24	.06	1.23	.00	1.09	.34	1.08	.22	1.16	.14	1.23	.00
Medicaid and uninsured	1.10	.57	1.25	.07	0.74	.02	0.79	.03	0.65	.00	0.64	.00
Commercial HMO	1.36	.00	1.40	.00	1.28	.01	1.15	.12	1.28	.01	1.31	.00
All other insurance	1.13	.03	0.99	.87	1.16	.03	0.88	.09	1.18	.03	1.22	.00
Admitted to teaching	2.82	.00	2.33	.00	3.21	.00	3.20	.00	1.20	.28	0.82	.18
PCPs per 1,000 population	2.43	.19	4.18	.22	4.72	.08	7.77	.15	0.75	.71	2.82	.23
Specialists per 1,000 population	0.76	.16	0.65	.16	0.69	.15	0.56	.12	1.06	.79	0.82	.38
% cardiology and pulmonary specialists	1.03	.03	1.03	.26	1.04	.01	1.03	.39	1.03	.06	1.01	.77
% orthopedic specialists	1.06	.00	0.98	.50	1.06	.00	1.02	.46	1.05	.01	1.03	.09
Outpatient visits per capita	0.95	.23	1.02	.63	0.90	.06	0.99	.80	0.93	.19	1.05	.27
Inpatient days per capita	0.93	.62	1.13	.54	1.07	.66	1.33	.29	1.10	.52	0.75	.16
Contextual factors												
Isolation index for African Americans	0.69	.12	0.52	.06	0.62	.14	0.42	.10	0.47	.02	1.16	.63
Isolation index for Hispanics	1.24	.60	1.09	.87	1.37	.51	1.96	.27	1.28	.62	2.88	.04
Commuter intensity	1.01	.09	0.99	.43	1.01	.10	1.00	.77	1.01	.06	1.01	.15

Note: ER = emergency room; HMO = health maintenance organization; PCP = primary care physician. For 1997 data, the number of observations = 147,384 and pseudo R^2 = .37. For 2001 data, the number of observations = 153,634 and pseudo R^2 = .40.

0.77 in 2001). This reversal in the relationship between severity and PTCA use over time is consistent with trends in medical practice, whereby as the PTCA technology spread, the sickest CAD patients received CABG while those less severely ill received PTCA. Illness severity reduces the odds of hip or joint replacement relative to marker, which is not surprising given the very traumatic nature of these procedures and necessity for rehabilitation following the procedures.

Persons enrolled in commercial HMO plans were generally more likely than Medicare FFS enrollees to have received one of these procedures (relative to marker admissions). Seniors who were Medicaid beneficiaries or uninsured were much less likely to undergo a PTCA or a hip/joint replacement procedure than those in Medicare FFS. A notable change that occurred over time was that compared to 1997, Medicare HMO patients in 2001 had statistically significant and higher odds of hip/joint replacement admissions (relative to marker) than did Medicare FFS patients (see Table 2). Patients with private HMO insurance had, similar to the Medicare HMO patients, higher relative odds of CABG and hip/joint replacement in both years relative to FFS Medicare.

People living in urban areas had higher relative odds of admission for all three referral-sensitive conditions than persons living in rural areas adjacent to urban areas. These findings are consistent with higher densities of pulmonary, cardiology, and orthopedic specialists in the urban areas, and the higher odds ratios for all three procedures associated with these factors. Some of the county sociodemographic factors were also found important. People living in areas with greater African American isolation (residential segregation) exhibited lower relative odds of admissions for hip/joint replacement in 1997, while people living in areas with greater Hispanic isolation exhibited higher relative odds of admissions for hip/joint replacement in 2001. These findings are consistent with an emerging health outcomes literature that finds racial residential segregation effects to be quite variable (Mobley et al., in press; Mobley, Root, Finkelstein, et al., 2006; Palloni & Arias, 2004; Schulz et al., 2002; D. R. Williams & Collins, 2001). Thus, for example, outcomes associated with living in a place with a more segregated Black population may differ from one place to another or from a place with more segregated Hispanic population. We are not aware of any studies that have looked at the impact of same-race isolation (interaction), but this is an interesting area of future research. Commuter intensity was not significant, suggesting that traffic congestion conditions are more important for preventive care services utilization (Mobley, Root, Anselin, et al., 2006) than they are for planned, referral-sensitive hospitalizations.

Study Limitations

Because our study is based on individual patient data, population-based measures of admission rates are not examined. Also, we cannot include information about

people who were not admitted to hospitals, so this analysis is conditional upon hospital admission. Also, because the study uses only two states, New York and Pennsylvania, the generalizabilty of findings is limited. Finally, we cannot assess the statistical significance of changes over time in disparities by race or ethnicity unless we impose an overly restrictive form of the model, which biases other coefficient estimates of interest (forces these to remain constant over time).

Discussion

Although some studies using patient-level data analyzed racial and ethnic variations across individuals hospitalized with specific diagnoses (Andrews & Elixhauser, 2000; Elixhauser, Weinick, Betancourt, & Andrews, 2002; Harris, Andrews, & Elixhauser, 1997), most previous studies used aggregate measures instead of individual data (Escarce & McGuire, 2004; Jha et al., 2005; DHHS, 2003). This study departs from others by using a multivariate design with individual data to make simultaneous comparisons of admission patterns between procedures with respect to marker admissions. Although our data do not permit population-based analyses of disparities because they are limited to people who were admitted to hospital in two states, comparing referral-sensitive to marker conditions within race classes allows robust assessment of disparities among the hospitalized population that we study.

We control statistically for a variety of factors that can affect the propensity to utilize referral-sensitive procedures, including both patient-specific and contextual environmental-specific factors. This allows robust assessment of disparities by race, not confounded by context or composition in the local environment, and reveals meaningful patterns over time. The findings suggest interesting comparative results across procedures and time. We find no evidence of decreasing disparities over time between any races or ethnicities and Whites for the three referral-sensitive procedures. In summary, disparities existed and persisted between 1997 and 2001, worsening for African Americans in the utilization of CABG and PTCA, and worsening for other races in the utilization of hip/joint replacement.

As we compare these findings with previous research, we find both similarities and differences. The study results are consistent with a recent report by Jha et al. (2005) that examined rates of CABG, carotid endarterectomy, and total hip replacement in 158 hospital-referral regions between 1992 and 2001. The authors concluded that for the decade of the 1990s, no evidence was found, either nationally or locally, that efforts to eliminate racial disparities in the use of high-cost surgical procedures were successful. On the other hand, Escarce and McGuire (2004) found that White–African American disparity in procedure use in Medicare had narrowed during 1986-1997, although clinically important racial disparities in the rates of several procedures (including CABG and total hip and knee replacement) still remained in 1997. Both the Jha and Escarce studies were national in scope but examined rates of

use by Medicare FFS elderly subpopulations, with no multivariate analysis to control for factor influences that could be confounded with race or ethnicity.

Our study, though limited in scope to New York and Pennsylvania, adds to the evidence that sizable racial or ethnic disparities existed among all elderly in both 1997 and 2001 for all three procedures studied. The magnitudes of some aspects of racial disparities also seemed to increase between 1997 and 2001, a finding that is consistent with our expectations for the post-BBA period with significant financial constraints and Medicare managed care plan disruptions that were expected to have differentially affected minorities. However, the period was also marked by DHHS initiative to reduce disparities, and because cardiovascular disease was targeted by the DHHS initiative, we expected to see some reduction in cardiovascular disparities over time. Perhaps this would have obtained in the absence of any BBA disruption effects, but in this disrupted environment the net effect was increased disparities in cardiac admissions. Also, because cardiac care was targeted by DHHS and osteoarthritis was not, we expected to see decreasing disparities in cardiac versus osteoarthritis admissions for minorities over time. Results did not support this—the magnitude of racial disparities was less for hip/joint replacement (than cardiac admissions) and mostly statistically nonsignificant when Whites versus African Americans and Hispanics were compared.

Another interesting aspect of this puzzle is the role played by managed care (HMO) insurers. In our findings, we note that both Medicare and private HMO patients seem more apt to utilize referral-sensitive procedures, which is interesting because this period spanned a backlash against managed care (Enthoven & Singer, 1999; Hurley, Grossman, Lake, & Casalino, 2002). Utilization control is one of the features of HMO plans that proved especially unpopular. Our findings suggest that despite the payment rate cuts to Medicare managed care plans implemented by the BBA, Medicare HMOs did not appear to be curtailing utilization of the referral-sensitive procedures we study, relative to FFS Medicare, and their relative performance seemed to actually have improved over time. Thus, despite the disruption of disenrollment that disproportionately affected minorities, the BBA may have actually strengthened performance of the Medicare HMO program by weeding out weaker plans.

Conclusion

For the three referral-sensitive procedures examined, our findings add to the evidence that racial and ethnic disparities among elderly patients did not narrow between 1997 and 2001 in two states, New York and Pennsylvania. The period was marked by the near congruence of a major DHHS initiative to reduce disparities in health care (1996) with passage of the BBA of 1997, implemented in 1998. Reduced payments to plans resulted in plan withdrawals and involuntary disenrollment, disproportionately affecting minority beneficiaries, and increased financial constraints

in the system at a time when the DHHS was striving to reduce disparities. Therefore, the net impact on disparities over this period cannot be determined a priori. This period 1997-2001 saw Medicare managed care plan contraction and a general HMO backlash—yet we see beneficial effects for patients holding HMOs as primary insurers throughout the period. Thus, we conjecture that the disparity gap might have worsened without these influences in the HMO markets. The study underscores the need for further investigation into the causes of continued racial and ethnic disparities in procedure use and continued efforts to understand the sources of these disparities. Further research across other states with low HMO penetration, more or less contraction in Medicare managed care plan availability, and different degrees of racial or ethnic heterogeneity and immigration are needed, to draw conclusions that generalize to wider populations.

Notes

1. For example, Medicare health maintenance organization (HMO) enrollees with a marker admission in 1997 were 5.15% of Blacks, 3.75% of Hispanics, and 4.38% of Whites. For those with all admissions in our sample, these percentages were respectively 6.05, 5.21, and 5.23.

2. Medicare disproportionate share (DSH) payment adjustments are intended to compensate hospitals with higher operating costs due to treating a larger share of low-income patients, who tend to be sicker and more costly to treat. The Balanced Budget Act of 1997 cut DSH payments 5%, to be phased in 1998 through 2002.

3. Insurance status of patients was determined by primary payer category in the discharge data. Although Medicare is the major insurance carrier for the elderly, a nontrivial number of the elderly in New York and Pennsylvania have other forms of private insurance coverage, including plans such as private fee for service (FFS), preferred provider organizations (PPOs), and special demonstration plans (Centers for Medicare and Medicaid Services, 2001). The primary insurance categories include Medicare FFS, Medicare HMOs, Medicaid and uninsured (combined), commercial HMO, and all other types of insurance (which include commercial FFS insurance and a small group of other types of public programs). Uninsured and Medicaid were combined because a large number of hospitalized Medicaid patients could be previously uninsured (Basu, Friedman, & Burstin, 2004), and many are recent immigrants to the United States who do not qualify for Medicare (Mold, Fryer, & Thomas, 2004).

4. Except for teaching status, the other facility attributes were subsequently dropped because of collinearity with other variables and low predictive power. Teaching status is indicated by membership in the Council of Teaching Hospitals.

5. The Isolation Index is an exposure measure that represents the propensity for a minority member to be exposed only to other minority members. It is actually a sort of probability and ranges in value from 0 to 1. Higher values represented greater isolation/segregation. For the county-level measure, the Isolation Index is computed as the minority-weighted average of each tract's minority population:

$$P^{jm} = \sum_{i=1}^{N} \frac{x_i}{X} \frac{x_i}{t_i}$$

where j represents the county unit,

i represents the tract unit,

N is the number of tracts within the county,

m is the minority group,

x_i is the minority population in tract i,
t_i is the total population (all races) in tract i, and
X is the total minority population in the county.

6. Traffic congestion is approximated by the proportion of the county workforce commuting more than 60 min each way to work on a daily basis, derived from the Census Transportation to Work file, 2000.

7. Marker conditions include appendicitis with appendectomy, gastrointestinal obstruction, fracture of hip/femur, and acute myocardial infarction. These conditions have been defined and validated in past research by Billings et al. (1993). The conditions are defined by principal diagnosis codes from the International Classification of Diseases, Ninth Revision (ICD-9-CM) System.

8. Percutaneous transluminal coronary angioplasty (PTCA) is not a viable treatment option for the most advanced stages of coronary artery disease (CAD) because there are simply too many locations needing expansion for this approach to work. On the other hand, extremely frail patients may receive PTCA because they are too ill to withstand open-heart surgery. In emergent cases of CAD, PTCA is often administered first, followed by coronary artery bypass grafting in more advanced stages.

9. A likelihood ratio variant of the Chow test (in STATA version 8) found that restricting the beta coefficients to be the same across years was rejected at greater than the 99% level of significance.

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