ORIGINAL ARTICLE

Racial and Ethnic Differences in the Use of High-Volume Hospitals and Surgeons

Andrew J. Epstein, PhD; Bradford H. Gray, PhD; Mark Schlesinger, PhD

Objective: To examine racial/ethnic differences in the use of high-volume hospitals and surgeons for 10 surgical procedures with documented associations between volume and mortality.

Design: Cross-sectional regression analysis.

Setting: New York City area hospital discharge data, 2001-2004.

Patients: Adults from 4 racial/ethnic categories (white, black, Asian, and Hispanic) who underwent surgery for cancer (breast, colorectal, gastric, lung, or pancreatic resection), cardiovascular disease (coronary artery bypass graft, coronary angioplasty, abdominal aortic aneurysm repair, or carotid endarterectomy), or orthopedic conditions (total hip replacement).

Main Outcome Measure: Treatment by a high-volume surgeon at a high-volume hospital.

Results: There were 133 821 patients who underwent 1 of the 10 procedures. For 9 of the 10 procedures, black patients were significantly ($P < .05$) less likely (after adjustment for sociodemographic characteristics, insurance type, proximity to high-volume providers, and comorbidities) to be operated on by a high-volume surgeon at a high-volume hospital and more likely to be operated on by a low-volume surgeon at a low-volume hospital. Asian and Hispanic patients, respectively, were significantly less likely to use high-volume surgeons at high-volume hospitals for 5 and 4 of the 10 procedures and more likely to use low-volume surgeons at low-volume hospitals for 3 and 5 of the 10 procedures.

Conclusions: Minority patients in New York City are doubly disadvantaged in their surgical care; they are substantially less likely to use both high-volume hospitals and surgeons for procedures with an established volume-mortality association. Better information is needed about which providers minority patients have access to and how they select them.

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Author Affiliations: Division of Health Policy and Administration, School of Public Health, Yale University, New Haven, Connecticut (Drs Epstein and Schlesinger); and Urban Institute, Washington, DC (Dr Gray).

RACIAL AND ETHNIC DIFFERences in medical care delivery and outcomes have been documented across many settings.[1] These differences generally remain even after accounting for socioeconomic status, health insurance status, and other access-related factors. Broadly speaking, racial/ethnic differences in practice patterns and outcomes could arise via 2 avenues: the use of different providers (whose practice styles or quality levels also differ) and different treatment by the same providers. Evidence exists for both the former[2-8] and latter[9-11] avenues. Gaining a better understanding of the underlying causes of these differences is essential to ameliorating them.

See Invited Critique at end of article

One specific concern is whether minorities disproportionately receive treatment from lower-quality providers. While measuring quality accurately is difficult, research has shown mortality to be inversely related to hospital and surgeon volume for many surgical procedures. Following media coverage of these findings and promotion by quality-improvement initiatives such as the Leapfrog Group, two-thirds of individuals surveyed reported that the number of past procedures would tell them "a lot" about the quality of both hospitals and clinicians.[12] However, there is growing evidence that surgery for minorities is more likely to occur at lower-volume hospitals.[13-15] Less is known about racial/ethnic differences in the use of higher-volume surgeons,[16] though surgeon volume accounts for much of the hospital-volume effect.[17] It is equally striking that no published research has examined how racial/ethnic patterns in the use of high-volume hospitals might be related to the use of high-volume surgeons.

Table 1. Hospitals and Surgeons Meeting Volume Thresholds

	Surgeons				Hospitals				
Procedure	Volume Threshold, No. of Cases	Source	No. of Cases	High Volume, %	Volume Threshold, No. of Cases	Source	No. of Cases	High Volume, %	With High-Volume Surgeon, %
Cancer Surgery									
Breast cancer	50	Halm et al,[18] 2002[a]	659	1.8	151	Halm et al,[18] 2002[a]	90	6.7	12.2
Colorectal cancer	22	Halm et al,[18] 2002[a]	718	3.6	115	Halm et al,[18] 2002[a]	90	10.0	24.4
Gastric cancer	2	Halm et al,[18] 2002[b]	327	20.5	63	Halm et al,[18] 2002[a]	84	1.2	45.2
Lung cancer	32.5	Hannan et al,[22] 2002[c]	133	15.8	19	Halm et al,[18] 2002[a]	84	25.0	28.6
Pancreatic cancer	10	Halm et al,[18] 2002[b]	103	4.9	11	Birkmeyer and Dimick,[21] 2004[d]	47	17.0	8.5
Cardiovascular Surgery									
Coronary artery bypass graft	150	Halm et al,[18] 2002[a]	177	8.5	450	Birkmeyer and Dimick,[21] 2004[d]	21	42.9	52.4
Angioplasty	138	Halm et al,[18] 2002[a]	539	10.4	400	Birkmeyer and Dimick,[21] 2004[d]	31	58.1	71.0
Abdominal aortic aneurysm repair	10	Halm et al,[18] 2002[a]	190	5.3	50	Birkmeyer and Dimick,[21] 2004[d]	65	4.6	20.0
Carotid endarterectomy	30	Halm et al,[18] 2002[a]	222	8.6	50	Halm et al,[18] 2002[a]	77	23.4	36.4
Orthopedic Surgery									
Total hip replacement	27	Halm et al,[18] 2002[a]	536	15.9	100	Halm et al,[18] 2002[a]	90	31.1	62.2

[a] Based on the median threshold reported in a study by Halm et al.[18]
[b] Based on the lower threshold (only 2 studies available) reported in a study by Halm et al.[18]
[c] Based on annualized 75th percentile of physician volume of lobectomy of the lung in a study by Hannan et al.[22] This was the one lung cancer surgery study with physician volume cited by Halm et al.[18]
[d] The Leapfrog Group–recommended volume standard as presented in a study by Birkmeyer and Dimick.[21]

This study explores whether white patients are more likely than minority patients to be treated by high-volume surgeons at high-volume hospitals for 10 surgical procedures for which there is published evidence of volume-mortality association. Using data from the New York City metropolitan area, we explored treatment patterns in a racially and ethnically diverse population located near hospitals and surgeons across the volume range. By examining use of both high-volume hospitals and surgeons, we can identify distinctive patterns of disparities across minority groups.

METHODS

STUDY SAMPLE

We analyzed use of high-volume hospitals and surgeons by patients in the New York City metropolitan area for 10 procedures during 2001-2004. Our analysis is based on New York's Statewide Planning and Research Cooperative System database of all discharges from nongovernmental, acute-care hospitals. We also used information from the American Hospital Association Annual Survey of Hospitals, the American Medical Association Masterfile, and the 2000 US Census.

We focused on 10 procedures for which recent literature has documented significant associations between short-term patient mortality and both hospital and surgeon volume.[18-20] We created 10 separate, procedure-specific cohorts of patients whose principal procedure code indicated surgery for breast, colorectal, gastric, lung, or pancreatic cancer; coronary artery bypass graft; coronary angioplasty; abdominal aortic aneurysm repair; carotid endarterectomy; or total hip replacement. The *International Classification of Diseases, Ninth Revision*, codes used to identify eligible patients are available from the authors on request.

We limited our analysis to patients aged at least 18 years who resided in and were treated at hospitals in the 5 boroughs of New York City and adjacent Westchester and Nassau Counties. To limit misattribution of procedures to physicians, we excluded patients whose surgeons had invalid reported license numbers, could not be matched to the American Medical Association Masterfile, or did not perform at least 1 procedure per year on average during 2001-2004. Finally, we excluded patients not identified in the Statewide Planning and Research Cooperative System data as Hispanic or as white, black, or Asian/Pacific Islander. Averaging across the 10 procedures, 7.4% of patients were excluded because of the physician criteria (range, 3.4%-18.1%), and 14.7% were excluded because of the patient race criteria (range, 9.2%-28.4%).

STATISTICAL ANALYSIS

Patient characteristics, including sociodemographics, insurance type, comorbidity count, admission urgency and source, and travel distance were compared in the 10-procedure pooled sample across the 4 race/ethnicity categories in a pairwise fashion using *t* tests, with white race as the referent. The primary outcome is a 4-category measure of whether a patient was treated at a high-volume hospital and by a high-volume surgeon (ie, both high volume, neither high volume, high-volume hospital only, or high-volume surgeon only). Mean annual procedure volumes were calculated for each hospital and surgeon using the full Statewide Planning and Research Cooperative System database during 2001-2004. Hospitals and surgeons were categorized as high-volume for a particular procedure if their average volume met or exceeded an evidence-based threshold. Annual hospital volume thresholds established by the Leapfrog Group were used for coronary artery bypass graft, coronary angioplasty, abdominal aortic aneurysm repair, and pancreatic cancer surgery.[21] For the remaining hospital-level thresholds and all 10 physician-level thresholds, we used the median volume threshold associated with better outcomes in the studies reviewed by Halm et al.[18,22] **Table 1** lists the volume thresholds by procedure.

Table 2. Descriptive Statistics of Study Population, 2001-2004

Characteristic	Patients by Race/Ethnicity: White (n=100 798)	Black (n=17 499)	Asian (n=4249)	Hispanic (n=11 275)
Socioeconomic and demographic characteristics				
Mean age, y	68.3	62.8[a]	63.1[a]	62.3[a]
Female sex, %	45.4	61.4[a]	43.7[a]	50.5[a]
Median household income of zip code, ×$1000	59.4	37.4[a]	43.6[a]	36.7[a]
<High school education in zip code, %	17.7	30.5[a]	27.6[a]	33.2[a]
College educated in zip code, %	56.9	42.8[a]	48.2[a]	42.9[a]
Insurance characteristics, %				
Self-insured	0.8	2.6[a]	5.0[a]	2.1[a]
Covered by commercial insurance	35.4	34.7	32.4[a]	27.5[a]
Covered by Medicare	57.9	43.6[a]	34.5[a]	42.3[a]
Covered by Medicaid	5.3	17.9[a]	27.7[a]	27.1[a]
Enrolled in health maintenance organization	25.9	31.6[a]	32.8[a]	23.7[a]
Treatment characteristics				
Mean No. of Elixhauser comorbidities	1.8	1.9[a]	1.5[a]	1.8[a]
Scheduled admission, %	48.7	48.9	46.6[a]	42.7[a]
Transferred from other hospital, %	10.0	10.9[a]	8.8[a]	15.2[a]
Mean extra distance to nearest high-volume hospital, km	4.3	4.5[a]	3.9[a]	3.4[a]
Mean extra distance to nearest hospital with high-volume surgeon, km	3.0	3.0	2.2[a]	2.1[a]

[a] Difference from white race is statistically significant at $P<.05$.

For each procedure cohort, we compared crude rates of combined high-volume hospital and high-volume surgeon use across the 4 race/ethnicity categories using exact Pearson χ^2 analyses estimated with Monte Carlo simulation to avoid concerns regarding low expected frequencies due to small numbers of minority patients.[23] To assess the independent association of race/ethnicity and use of high-volume hospitals and physicians, we estimated multinomial logistic regression models that adjusted the standard errors for the clustering of patients in residential zip codes. In addition to patient race/ethnicity, the model specification contained a range of patient characteristics thought to influence provider selection, including age, age^2, sex, the interaction of insurance status (Medicare, Medicaid, commercial insurance, or no insurance) and whether the insurance involved a health maintenance organization, whether the admission was scheduled, whether the patient was transferred from another hospital, and whether the patient was coded as having 0, 1, 2, or 3 or more comorbidities.[24,25] The models also controlled for the incremental distances from the hospital nearest the patient's residence to both the nearest high-volume hospital and the nearest hospital with a high-volume surgeon, which were entered as quadratics and calculated from the patient's residential zip code centroid, as well as zip code–level census data on educational attainment (proportions of the population aged ≥25 years with <high school education, high school completion, and at least some college) and median household income.

We present racial/ethnic differences in the use of high-volume providers from the regression analysis in the form of absolute risk differences instead of odds ratios or relative risks. There is an ongoing, inconclusive debate over how to report logistic regression results between the proponents of odds ratios[26] and of relative risks.[27] Because the prevalence of the use of high-volume hospitals and surgeons varies greatly across procedures, comparisons using either odds ratios or relative risks could be misleading. Accordingly, consistent with recent advice,[28] we present absolute risk differences in conjunction with baseline rates for the referent group (white race). Using Stata's *margeff* command,[29] we computed absolute risk differences following the method of recycled predictions (ie, as the average across all patients in the procedure cohort of the patient-specific difference in the regression-adjusted predicted probabilities between pairs of race/ethnicity categories holding the other covariates constant), and standard errors were calculated using the delta method.

All analyses used SAS, version 9.1.3 (SAS Institute, Cary, North Carolina), and Stata, version 9.2 (Stata Corporation, College Station, Texas). Two-tailed $P<.05$ was considered statistically significant. Our study was approved by the institutional review board at the New York Academy of Medicine, where the study was initiated.

RESULTS

The high-volume threshold and the proportion of providers classified as high-volume varied considerably (Table 1). For surgeons and hospitals, respectively, the average high-volume threshold across procedures was 47.2 (range, 2-150) and 140.9 (range, 11-450), and the average proportion classified as high-volume was 9.5% (range, 1.8%-20.5%) and 22.0% (range, 1.2%-58.1%). Moreover, on average 36.1% (range, 8.5%-71.0%) of hospitals had at least 1 high-volume surgeon.

Of the 133 821 patients in the 10 procedure cohorts combined, 100 798 (75.3%) were white, 17 499 (13.1%) were black, 4249 (3.2%) were Asian, and 11 275 (8.4%) were Hispanic (**Table 2**). White patients tended to be older and from wealthier and more educated zip codes, were more likely to be covered by Medicare, and were less likely to be covered by Medicaid or to lack insurance than black, Asian, and Hispanic patients.

White patients accounted for most cases in all 10 procedure cohorts, ranging from 54.7% (gastric cancer surgery) to 86.4% (carotid endarterectomy). Black patients were the second-largest group, followed by Hispanic and Asian patients (**Table 3**). Although unadjusted rates of

Table 3. Patients Treated by HVSs and at HVHs by Race/Ethnicity

Procedure	Race/Ethnicity	% Sample	% HVH and HVS	% HVS Only	% HVH Only	% Neither HVH nor HVS	χ^2 *P* Value
Cancer Surgery							
Breast cancer (n=13 057)	White	63.0	19.0	3.4	19.4	58.1	<.001
	Black	22.4	8.1	2.7	10.0	79.2	
	Asian	4.6	12.0	0.5	11.2	76.3	
	Hispanic	10.0	15.5	2.1	9.6	72.8	
Colorectal cancer (n=12 519)	White	69.1	18.9	6.9	21.4	52.9	<.001
	Black	18.5	6.0	2.2	11.0	80.9	
	Asian	4.2	11.2	1.7	22.2	64.8	
	Hispanic	8.2	9.0	2.6	11.9	76.5	
Gastric cancer (n=1506)	White	54.7	16.3	46.0	0.7	37.0	<.001
	Black	19.0	10.1	29.4	0.3	60.1	
	Asian	13.1	4.0	67.2	0.0	28.8	
	Hispanic	13.1	11.6	30.8	0.5	57.1	
Lung cancer (n=5026)	White	79.0	59.6	1.8	26.1	12.5	<.001
	Black	11.9	32.9	2.0	20.2	44.9	
	Asian	3.7	40.3	3.2	34.9	21.5	
	Hispanic	5.4	45.0	4.4	23.6	26.9	
Pancreatic cancer (n=570)	White	72.5	36.1	0.7	41.6	21.5	<.001
	Black	14.7	10.7	1.2	32.1	56.0	
	Asian	4.6	19.2	0.0	34.6	46.2	
	Hispanic	8.2	19.1	0.0	23.4	57.4	
Cardiovascular Surgery							
Coronary artery bypass graft (n=18 470)	White	77.3	47.9	2.1	31.9	18.1	<.001
	Black	9.8	18.1	3.4	27.6	50.8	
	Asian	3.2	15.7	16.7	22.5	45.2	
	Hispanic	9.7	20.0	3.4	33.7	42.9	
Angioplasty (n=48 015)	White	75.0	60.7	0.7	38.2	0.4	<.001
	Black	12.0	48.8	2.1	47.7	1.5	
	Asian	3.2	52.4	5.2	39.9	2.5	
	Hispanic	9.8	52.7	0.8	46.1	0.4	
Abdominal aortic aneurysm repair (n=1467)	White	83.9	15.6	13.6	9.7	61.1	<.001
	Black	9.6	3.5	16.3	2.1	78.0	
	Asian	1.8	11.1	18.5	22.2	48.1	
	Hispanic	4.6	8.8	11.8	5.9	73.5	
Carotid endarterectomy (n=7593)	White	86.4	46.0	3.0	31.9	19.1	<.001
	Black	6.3	16.0	5.4	27.2	51.4	
	Asian	1.4	38.0	0.9	40.7	20.4	
	Hispanic	5.8	17.7	8.6	33.6	40.0	
Orthopedic Surgery							
Total hip replacement (n=25 598)	White	80.6	55.7	6.1	22.5	15.6	<.001
	Black	12.1	51.8	9.5	13.4	25.3	
	Asian	1.6	39.6	5.0	20.4	35.0	
	Hispanic	5.6	54.9	9.0	13.1	23.0	

Abbreviations: HVH, high-volume hospital; HVS, high-volume surgeon.

use of high-volume hospitals and surgeons varied greatly across procedures, there was a clear pattern of lower use of high-volume providers by minority patients. For all 10 procedures, white patients were more frequently treated by both high-volume hospitals and surgeons than were black, Asian, and Hispanic patients. Additionally, for 8 of 10 procedures, white patients were least often treated by both lower-volume hospitals and surgeons; Asian patients were the least frequently treated for gastric cancer surgery and abdominal aortic aneurysm repair.

The unadjusted differences in high-volume provider use by patient race/ethnicity were substantial (**Table 4**). Black patients' unadjusted rates of use of both high-volume hospitals and surgeons were significantly lower than white patients' for all 10 procedures, and their use of both lower-volume hospitals and surgeons was significantly higher for 8 procedures. Averaging across the 10 procedure cohorts, white patients used both high-volume hospitals and surgeons in 37.6% of cases, while black patients' unadjusted use was 17.0 percentage points lower. Similarly, white patients used both lower-volume hospitals and surgeons in 29.6% of cases, while black patients' unadjusted use was 23.2 percentage points higher.

The unadjusted Asian-white and Hispanic-white differences, though smaller than the black-white differences, were also large. Unadjusted rates of use of both high-volume hospitals and surgeons were significantly lower than white patients' for 7 procedures for Asian pa-

Table 4. Adjusted Percentage Point Differences in Likelihood of Treatment at an HVH and/or by an HVS[a]

	Percentage Point Difference											
	Black-White				Asian-White				Hispanic-White			
Procedure	HVH and HVS	HVS Only	HVH Only	Neither HVH nor HVS	HVH and HVS	HVS Only	HVH Only	Neither HVH nor HVS	HVH and HVS	HVS Only	HVH Only	Neither HVH nor HVS
Cancer Surgery												
Breast cancer												
White baseline use rate	19.0	3.4	19.4	58.1	19.0	3.4	19.4	58.1	19.0	3.4	19.4	58.1
Unadjusted difference	–10.9[b]	–0.8	–9.4[b]	21.0[b]	–7.0[b]	–3.0[b]	–8.2[b]	18.2	–3.5	–1.4[b]	–9.8[b]	14.7
Adjusted difference	–6.9[b]	–0.4	–6.8[b]	14.1[b]	–5.9[b]	–2.9[b]	–7.1[b]	15.8	–0.6	–1.3[b]	–7.3[b]	9.1
Colorectal cancer												
White baseline use rate	18.9	6.9	21.4	52.9	18.9	6.9	21.4	52.9	18.9	6.9	21.4	52.9
Unadjusted difference	–13.0[b]	–4.7[b]	–10.4[b]	28.0[b]	–7.7[b]	–5.2[b]	0.9	12.0	–9.9[b]	–4.2[b]	–9.5[b]	23.6[b]
Adjusted difference	–10.4[b]	–4.1[b]	–6.6[b]	21.1[b]	–8.3[b]	–5.2[b]	–1.6	15.1	–8.1[b]	–4.2[b]	–6.4[b]	18.7
Gastric cancer												
White baseline use rate	16.3	46.0	0.7	37.0	16.3	46.0	0.7	37.0	16.3	46.0	0.7	37.0
Unadjusted difference	–6.1[b]	–16.6[b]	–0.4	23.1[b]	–12.2[b]	21.2	–0.7[b]	–8.2	–4.7	–15.2[b]	–0.2	20.1[b]
Adjusted difference	–2.3	–13.0[b]	–0.2	15.5[b]	–10.3[b]	21.3	–0.7[b]	–10.3	–2.7	–12.4	0.0	15.1[b]
Lung cancer												
White baseline use rate	59.6	1.8	26.1	12.5	59.6	1.8	26.1	12.5	59.6	1.8	26.1	12.5
Unadjusted difference	–26.7[b]	0.2	–5.9[b]	32.4[b]	–19.3[b]	1.4	8.9	9.0[b]	–14.6[b]	2.6	–2.5	14.4[b]
Adjusted difference	–16.0[b]	–1.3[b]	–1.2	18.5[b]	–9.1	–0.6	8.0	1.7	–6.9	0.1	0.5	6.3[b]
Pancreatic cancer												
White baseline use rate	36.1	0.7	41.6	21.5	36.1	0.7	41.6	21.5	36.1	0.7	41.6	21.5
Unadjusted difference	–25.4[b]	0.5	–9.5	34.4	–16.8	–0.7[b]	–7.0	24.6[b]	–16.9	–0.7[b]	–18.2	35.9[b]
Adjusted difference	–17.0[b]	–0.8	–0.1	17.9[b]	–7.4	–0.7[b]	–4.2	12.3	–1.8	–0.7[b]	–13.2	15.7
Cardiovascular Surgery												
Coronary artery bypass graft												
White baseline use rate	47.9	2.1	31.9	18.1	47.9	2.1	31.9	18.1	47.9	2.1	31.9	18.1
Unadjusted difference	–29.8[b]	1.3[b]	–4.2[b]	32.7[b]	–32.2[b]	14.5[b]	–9.4[b]	27.1[b]	–27.9[b]	1.3[b]	1.9	24.8[b]
Adjusted difference	–18.5[b]	0.1	1.7	16.7[b]	–20.2[b]	6.9[b]	–1.2	14.5[b]	–13.0[b]	1.3[b]	2.8	8.9[b]
Angioplasty												
White baseline use rate	60.7	0.7	38.2	0.4	60.7	0.7	38.2	0.4	60.7	0.7	38.2	0.4
Unadjusted difference	–11.9[b]	1.4[b]	9.5[b]	1.1[b]	–8.3[b]	4.5[b]	1.7	2.1[b]	–8.0[b]	0.1	7.9[b]	0.0
Adjusted difference	–8.1[b]	0.3	7.2[b]	0.5[b]	–3.3	1.5[b]	1.0	0.8[b]	–3.3	–0.4[b]	4.0[b]	–0.2[b]
Abdominal aortic aneurysm repair												
White baseline use rate	15.6	13.6	9.7	61.1	15.6	13.6	9.7	61.1	15.6	13.6	9.7	61.1
Unadjusted difference	–12.1[b]	2.8	–7.6[b]	16.9	–4.5	5.0	12.5	–12.9	–6.8	–1.8	–3.9	12.4
Adjusted difference	–9.7[b]	1.8	–8.4[b]	16.3	–0.1	–2.5	9.0	–6.4	–5.5	–2.2	–5.8[b]	13.5
Carotid endarterectomy												
White baseline use rate	46.0	3.0	31.9	19.1	46.0	3.0	31.9	19.1	46.0	3.0	31.9	19.1
Unadjusted difference	–30.0[b]	2.4	–4.6	32.3[b]	–8.1	–2.1[b]	8.9	1.3	–28.3[b]	5.6[b]	1.8	20.9[b]
Adjusted difference	–20.4[b]	–0.1	9.3[b]	11.1[b]	–6.8	–2.1[b]	8.1	0.7	–22.6[b]	2.5	9.6[b]	10.5[b]
Orthopedic Surgery												
Total hip replacement												
White baseline use rate	55.7	6.1	22.5	15.6	55.7	6.1	22.5	15.6	55.7	6.1	22.5	15.6
Unadjusted difference	–3.9[b]	3.3[b]	–9.1[b]	9.7[b]	–16.1[b]	–1.1	-2.2	19.4[b]	–0.8	2.9[b]	–9.4[b]	7.3[b]
Adjusted difference	–8.2[b]	3.2[b]	–1.6	6.6[b]	–8.9[b]	–1.7	1.4	9.2[b]	–5.9[b]	1.6	–1.5	5.8[b]

Abbreviations: HVH, high-volume hospital; HVS, high-volume surgeon.
[a] Adjusted comparisons control for age, age^2, sex, insurance type and health maintenance organization status, scheduled admission status, transfer status, Elixhauser comorbidity count, incremental distances to nearest HVH and hospital with an HVS, and zip code–level education attainment and household income.
[b] Difference is significantly different from 0 at $P < .05$.

tients and 5 for Hispanic patients, and, compared with white patients' use, were 13.2 percentage points lower for Asian patients and 12.1 percentage points lower for Hispanic patients when averaged across the 10 procedures. Moreover, unadjusted rates of use of both lower-volume hospitals and surgeons were higher than white patients' use for 5 and 6 procedures, respectively, with rates for Asian patients 9.3 percentage points larger and for Hispanic patients 17.4 percentage points higher than white patients' rates averaged across all 10 procedures

Even after adjusting for patients' demographic, socioeconomic, and insurance characteristics; comorbidity; scheduled admission status; transfer status; and proximity to higher-volume hospitals and surgeons, the combined use of high-volume providers remained considerably lower for the 3 minority groups than for white patients (Table 4). Relative to white patients' use, adjusted rates of combined use of high-volume hospitals and surgeons were significantly lower for 9 procedures in black patients, for 5 procedures in Asian patients, and for 4 procedures in Hispanic patients, and were 11.8, 8.0, and 7.0 percentage points lower, respectively, when averaged across the 10 procedures. Adjusted combined use of lower-volume hospitals and surgeons was significantly higher for 9, 3, and 5 procedures, respectively, in black, Asian, and Hispanic patients, and were 13.8, 5.3, and 10.3 percentage points higher, respectively, when averaged for the 10 procedures.

COMMENT

We found substantial racial/ethnic differences in the New York metropolitan area in the use of high-volume hospitals and surgeons for procedures for which there is evidence of a volume-outcome relationship. Differences between white and black patients were especially large and consistent; Asian and Hispanic patients exhibited similar patterns of differences, but of lesser magnitude and consistency. Even after adjusting for a broad range of relevant factors, compared with white patients, treatment at high-volume hospitals by high-volume surgeons was lower by 11.8 percentage points for black patients, 8.0 percentage points for Asian patients, and 7.0 percentage points for Hispanic patients on average across the 10 study procedures. To our knowledge, ours is the first study to describe differences in the use of both high-volume hospitals and surgeons among white, black, Asian, and Hispanic patients for a broad set of surgical procedures.

It is striking that, when examining use of both high-volume hospitals and surgeons, the crude and adjusted racial/ethnic differences exhibited a persistent pattern, with differences largest for black patients and smallest for Asian patients, with Hispanic patients falling in between. This reinforces previous studies that showed that the factors that induce disparities play out differently for different minority groups[30] but does not support the common suggestion that health care disparities are driven primarily by differences in socioeconomic status.[31] In our sample, Asian patients were most likely to be enrolled in Medicaid or uninsured (though the socioeconomic status of their neighborhoods was slightly higher than for black and Hispanic patients). Relative to black patients, Hispanic patients came from neighborhoods with equal income levels and were more likely to be covered by Medicaid.

A second pattern is evident in the findings in Table 4. The racial/ethnic differences are about the same size for all 3 minority groups in fewer than half of our 10 procedures; hip replacement, colorectal cancer surgeries, and coronary artery bypass grafts represent the most consistent patterns of disparities. For the other procedures, the magnitudes of the racial/ethnic differences vary across minority groups. For example, for breast cancer surgery, black and Asian patients are doubly disadvantaged by limited use of both high-volume hospitals and surgeons, whereas Hispanic patients are not. For carotid endarterectomy, by contrast, Asian patients are least subject to a double disadvantage. This suggests that the causal processes that produce disparities may differ among minority groups.

Two possible explanations for racial/ethnic differences in provider selection patterns are discussed in the literature. The first involves systematic barriers that might limit minority use of both high-volume hospitals and surgeons that are not intrinsic to race/ethnicity. These could include geography (eg, higher-quality providers may be located in areas inconvenient for minority patients) and financial incentives (eg, higher-quality providers can attract relatively more patients with better-paying insurance coverage, who are disproportionately white[32]). By focusing on the New York City metropolitan area and controlling for a range of variables that could affect which providers are used, we have reduced the likelihood that these systematic barriers are primarily responsible for the racial/ethnic differences we found. Residual barriers to minority patients' access may continue to play a role, however. According to housing data from the 2000 census, New York City was among the top 5 most-segregated metropolitan areas by race/ethnicity.[33] Moreover, few providers are high volume. On average across the 10 procedures we studied, fewer than 10% of surgeons and 22% of hospitals were classified as high-volume, and only about one-third of hospitals had at least 1 high-volume surgeon practicing. It is an open question whether minority patients are less likely to be treated by high-volume surgeons than white patients at the same hospitals.

Another hypothesis posits racial/ethnic differences in access to or use of information about provider quality. There is evidence for this from the case of coronary artery bypass graft surgery in New York, which has a well-regarded and publicized report card program for hospitals and surgeons. While both white patients' and black patients' choices of cardiac surgeon responded to the ratings after the first report card was published in 1991, white patients were treated by better-rated surgeons on average in the year prior to initial publication.[34] By 2003, black coronary artery bypass graft patients' use of low-mortality surgeons had increased substantially but remained lower than white patients'.[32] For major surgical procedures, referring physicians help steer patients to particular hospitals and surgeons,[35] so it may be that white patients have access to better-informed referral networks. Our hospital discharge data do not track the referral process directly, but future research should explore the extent of racial/ethnic differences in the referral processes that lead to surgery.

Our study has a number of limitations. First, our data may contain measurement errors, especially for patient characteristics and physician license numbers. Prior work suggests that race and ethnicity are sometimes misclassified, particularly for nonblack and nonwhite patients.[36] We see no reason, however, why this would differentially affect use rates across hospital and physician volume categories. Our excluding patients whose physicians had not performed a minimum number of procedures during our study period increased confidence in the integrity of our physician sample, but likely excluded some very-low-volume and new physicians.

Second, studying only patients who resided in the New York City metropolitan area and were treated there clearly limits generalizability, but ensures that the patients were geographically proximal to high-volume hospitals and surgeons. One notable feature of New York is the public availability of risk-adjusted mortality report cards for hospitals and surgeons performing coronary artery bypass graft and coronary angioplasty. For these 2 procedures, it is possible that the report card ratings were more influential than provider volume data in guiding patients to providers.

Third, although there is a documented inverse relationship between mortality and hospital and surgeon procedure volume for the 10 procedures considered here,[18-20] our findings provide no direct evidence that minority patients received lower-quality treatment or had worse outcomes because of their use of lower-volume hospitals and surgeons. The reliability and usefulness of procedure volume as a quality metric is debated,[37-39] in part because of uncertainty around causal mechanisms as well as variation in the strength of the association across procedures.[17]

Nevertheless, there has been a widespread perception, supported by studies of many procedures, that higher-volume providers are better.[12] Whether this perception is fully justified is less important than the fact that there were significant racial/ethnic differences in the use of hospitals and surgeons believed to be superior. Our study found that minority patients, especially black patients, less frequently underwent surgery at high-volume hospitals performed by high-volume surgeons. In addition to efforts to improve the quality of care among providers serving minority patients, policymakers and clinicians may be able to improve outcomes by encouraging minority patients and their surrogates to consider comparative performance information when choosing hospitals and surgeons.

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Correspondence: Andrew J. Epstein, PhD, Yale University School of Public Health, 60 College St, New Haven, CT 06520 (andrew.epstein@yale.edu).
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INVITED CRITIQUE

More Than Size Matters

Delivering high-quality health care is a priority, as is reducing health care disparities. Dr Epstein and colleagues build on earlier work that demonstrated that racial/ethnic minorities are less likely to be treated by high-volume providers, a proxy measure for expert, high-quality care. It is not surprising that numerous studies have found that in the current US health care system the disenfranchised tend to receive worse care and have worse outcomes. How to use these findings to improve health care quality for underserved populations is the challenge, and certain recommendations may be difficult to implement in practice. Regionalization—the blanket rerouting of use to a limited number of high-volume surgeons and/or hospitals—represents one approach. However, as demonstrated by Epstein and colleagues, there is categorical disparity in who sees high-volume providers. Hence, advancing this selective referral strategy to more procedures would likely increase racial/ethnic health care disparities.

Are there alternatives? Many believe the focus should be on improving the underlying quality of care by all providers in all settings regardless of procedure volume. On a national level, the Surgical Care Improvement Project has started by identifying basic process measures that reduce complications such as infection and thromboembolism. Approximately 4000 hospitals participate, and adherence to the measures has risen substantially since their inception. Currently, there is a strong push to further these efforts by using risk-adjusted, clinically derived outcomes to promote high-quality care. In the Veterans Administration and now the private sector, the National Surgical Quality Improvement Program has demonstrated improved surgical outcomes, and interestingly, improvement and high-quality outcomes occurred in both high- and low-volume facilities.

Recommendations based on the volume-outcomes relationship have long concentrated on increasing use of high-volume providers by all patients. For particular procedures, this strategy is likely appropriate (eg, esophagectomy and pancreatectomy). However, for most surgical procedures, "raising the tide to lift all boats" is probably how we should try to proceed.

Formosa Chen, MD
David Zingmond, MD
Clifford Ko, MD, MSHS

Author Affiliations: Department of Surgery, University of California–Los Angeles, Los Angeles.
Correspondence: Dr Ko, Department of Surgery, University of California–Los Angeles, Box 956904, 72-215 CHS, Los Angeles, CA 90095-6904 (cko@mednet.ucla.edu).
Author Contributions: *Study concept and design:* Chen, Zingmond, and Ko. *Drafting of the manuscript:* Chen, Zingmond, and Ko. *Critical revision of the manuscript for important intellectual content:* Ko. *Statistical analysis:* Ko. *Administrative, technical, and material support:* Ko. *Study supervision:* Ko.
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