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Patient–surgeon racial and ethnic concordance and outcomes of older adults operated on by California licensed surgeons: an observational study

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ABSTRACT

Objective To examine the association of patient–surgeon racial and ethnic concordance with postoperative outcomes among older adults treated by surgeons with California medical licences.

Design Retrospective cohort study.

Setting US acute care and critical access hospitals in 2016–2019.

Participants 100% Medicare fee-for-service beneficiaries aged 65–99 years who underwent one of 14 common surgical procedures (abdominal aortic aneurysm repair, appendectomy, coronary artery bypass grafting, cholecystectomy, colectomy, cystectomy, hip replacement, hysterectomy, knee replacement, laminectomy, liver resection, lung resection, prostatectomy and thyroidectomy), who were operated on by surgeons with self-reported race and ethnicity (21.4% of surgeons) in the Medical Board of California database. We focused our primary analysis on black and Hispanic beneficiaries.

Primary outcomes measure The outcomes assessed included (1) patient postoperative 30-day mortality, defined as death within 30 days after surgery including during the index hospitalisation, (2) 30-day readmission and (3) length of stay. We adjusted for patient, physician and hospital characteristics.

Results Among 1858 black and 4146 Hispanic patients treated by 746 unique surgeons (67 black, 98 Hispanic and 590 white surgeons; includes surgeons who selected multiple backgrounds), 977 (16.3%) patients were treated by a racially or ethnically concordant surgeon. Hispanic patients treated by concordant surgeons had lower 30-day readmission (adjusted readmission rate, 4.2% for concordant vs 6.6% for discordant dyad; adjusted risk difference, −2.4 percentage points (pp); 95% CI, −4.3 to −0.5 pp; p=0.014) and length of stay (adjusted length of stay, 4.1 d vs 4.6 days (d); adjusted difference, −0.5 d; 95% CI, −0.8 to −0.2 d; p=0.003) than those treated by discordant surgeons. We found no evidence that patient–surgeon racial and ethnic concordance was associated with surgical outcomes among black patients or mortality among Hispanic patients.

Conclusions Patient–surgeon racial and ethnic concordance was associated with a lower postoperative readmission rate and length of stay for Hispanic patients. Increasing Hispanic surgeon representation may contribute to narrowing of racial and ethnic disparities in surgical outcomes.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ Novel assessment of impact of concordance on clinical outcomes.
⇒ Use of physician-reported race and ethnicity data.
⇒ Limited number of surgeons in California that report self-identified race and ethnicity.
⇒ Limited sample size, especially among black and Hispanic surgeons.
⇒ Analysis of surgeons with California medical board licences and older Medicare patients, potentially limiting generalisability.

INTRODUCTION

A preponderance of evidence suggests racial and ethnic disparities in surgical care quality and patient outcomes. Research has demonstrated that black patients receive lower quality surgical care and experience worse outcomes, such as higher rates of postoperative readmissions,[1 2] complications[3–7] and mortality[3 8–14] compared with white patients. Previous research has also revealed disparities in the quality of surgical care received by Hispanic compared with white patients.[15–19] Evidence on disparities in surgical outcomes between Hispanic and white patients is mixed, with some studies suggesting worse outcomes for Hispanic patients,[4 20–22] while others indicate outcomes are comparable or even superior (known as the 'Hispanic paradox[23 24]') to those of white patients.[19 25–33]

The concept of patient–clinician racial and ethnic concordance has been garnering growing attention due to its potential to improve the quality of care and patient outcomes through improved communication, trust and culturally appropriate behaviour stemming from shared background and experience.[34–38] Studies focusing on non-surgical care have shown that patient–clinician racial and ethnic concordance is associated with improved healthcare quality measures such as patient satisfaction,[35 37–42] engagement in care[35 43] and shared decision-making[35 37 44] for black and Hispanic patients and clinicians, and improved visit length for black patients and clinicians.[35] However, evidence is limited regarding the benefit of patient–clinician racial and ethnic concordance in surgical care. Studies on the effect of patient–surgeon racial and ethnic concordance on quality suggest potential improved communication and shared decision-making.[36 44] This could presumably contribute towards improved outcomes; for example, higher quality bidirectional communication could improve adherence to postoperative care instructions and reduce postoperative complications, readmissions and mortality.[45] However, there is a dearth of studies investigating the impact of concordance on surgical outcomes. This knowledge gap has hindered efforts to develop interventions that could effectively mitigate racial and ethnic disparities in surgical care and outcomes.

To address this knowledge gap, we examined the association of patient–surgeon racial and ethnic concordance on 30-day patient mortality, readmission and length of stay (LOS) following 14 common surgical procedures in a contemporary cohort of older US adult patients treated by surgeons with California medical licences and with self-reported race and ethnicity available in the Medical Board of California database. We hypothesised that for black and Hispanic patients, concordance is associated with lower adjusted estimates for these outcomes.

METHODS

Data sources

We linked three databases: (1) 100% Medicare inpatient claims data, (2) the 2019 Medicare Data on Provider Practice and Specialty (MD-PPAS, which includes data on clinician gender, years in practice and specialty) and (3) the 2022 Medical Board of California (MBC) Physician and Surgeon Database. We analysed the data on Medicare fee-for-service beneficiaries aged 65–99 continuously enrolled in Part A and B, who underwent 1 of 14 of the most common surgical procedures performed in Medicare (abdominal aortic aneurysm repair (AAA repair), appendectomy, coronary artery bypass grafting (CABG), cholecystectomy, colectomy, cystectomy, hip replacement, hysterectomy, knee replacement, laminectomy, liver resection, lung resection, prostatectomy and thyroidectomy) between January 2016 and December 2019. The majority of these procedures occur in older adults.[46] We restricted the analysis to patients operated on by surgeons in the MBC data who self-reported their race and ethnicity (21.4%). We included patients with procedures performed within 3 days of admission to avoid potential adverse outcomes due to delays in surgery.[47] We excluded patients who underwent procedures in December 2019 (to allow for sufficient follow-up after surgery), who were discharged against medical advice and patients treated by surgeons without a specialty listed and those with negative values for years in practice (suggesting trainee status).

Outcome variables

Our outcomes included 30-day postoperative mortality rate, defined as death within 30 days of procedure date (including in-hospital mortality), 30-day postoperative readmission rate, defined as readmission after hospital discharge within 30 days of a procedure and LOS for the hospital admission associated with the given procedure. These outcomes are commonly used in other studies as a measure of surgical quality.[48–51] Death dates are available in Medicare Beneficiary Summary Files and are verified using death certificates and validated for 99% of these data.[52] Patients without validated death dates were excluded.

Exposure variable

We created a binary variable to indicate whether a patient and surgeon had concordant race or ethnicity as the primary predictor in our analysis. Patient race and ethnicity were determined by Medicare enrolment data and are typically collected from the Social Security Administration followed by use of the Research Triangle Institute (RTI) algorithm. The RTI variable in the Medicare Beneficiary Summary File is classified as American Indian or Alaska Native (AIAN), Asian or Pacific Islander, black (ie, black, non-Hispanic), Hispanic, non-Hispanic white, other and unknown. Surgeon race and ethnicity were gathered from the MBC database, as described above. The MBC physician surgeon survey includes a question regarding 'cultural background' from which respondents may select among various racial and ethnic backgrounds. These responses were re-categorised to RTI categories (online supplemental eTabale 1). Respondents who selected multiple cultural backgrounds were considered concordant with the patient if they shared any re-categorised RTI categories with a patient.

For our primary analysis, we focused on black and Hispanic patients as these racial and ethnic groups have the strongest evidence of disparities in surgical outcomes and are the two largest racial and ethnic minoritised in the USA. We excluded other racial and ethnic categories (eg, AIAN, Asian American Pacific Islander, Native Hawaiian or other Pacific Islander) due to small sample sizes that would prevent us from drawing reasonable conclusions.

Adjustment variables

We adjusted for patient, surgeon and hospital characteristics. Patient characteristics included age, sex (as designated in Medicare data), race and ethnicity, chronic

conditions (indicator variables for 27 conditions in the Medicare Master Beneficiary Summary File[53]) median household income estimated from residential zip codes (operationalised as tertiles), dual-eligibility for Medicaid, type of procedure (indicator variable for each of the 14 surgical procedures), weekend versus weekday surgery (patients undergoing procedures during weekends may have higher mortality[54]) month and year. We also adjusted for surgery electiveness (elective vs non-elective (emergency or urgent)) based on admission type code.[55] This was done to partially control for patient preference and selection of a racially or ethnically concordant surgeon, which would be rare for non-elective procedures.

Surgeon characteristics included age, gender (as designated in MD-PPAS, in which selection was limited to male or female) and procedure volume (tertiles of procedure-specific surgical volume in our data set). We identified the surgeon performing the procedure from the operating physician field of the inpatient claim.[55] Hospital characteristics included hospital size (number of beds), teaching, urban/rural and ownership (private, non-profit or public) statuses.

Statistical analysis

We first calculated the unadjusted outcomes by concordance category. We then examined if patient–surgeon racial and ethnic concordance was associated with 30-day postoperative mortality for black and Hispanic patients using linear probability models with Huber-white heteroscedasticity-robust SEs (for binary outcomes, to account for within-surgeon correlation), adjusting for patient age (as a continuous variable), surgeon, procedure and hospital characteristics. Models were performed separately for black and Hispanic patients. After fitting regression models, we calculated adjusted patient mortality by estimating predicted probabilities of death for each patient, fixing the racial and ethnic concordance indicator variable at each categorical level and averaging over our sample, known as the marginal standardisation form of predictive margins.[56] We repeated this analysis for 30-day postoperative readmissions and LOS. We then repeated this for each outcome for surgeons.

Sensitivity analyses

To address the possibility that surgeons with missing race and ethnicity data were different from those self-reporting race and ethnicity, we evaluated measured characteristics of surgeons with and without self-reported race and ethnicity. To test how surgeons' non-response regarding their race and ethnicity influenced our findings, we built a weighted regression model in which weights were generated on the basis of the inverse probability of surgeons' race and ethnicity data being reported.[57]

To avoid attributing race and ethnicity identification to surgeons who selected multiple cultural identities in the MBC, we performed a sensitivity analysis excluding all surgeons who selected multiple backgrounds and those who selected multiple backgrounds across racial or ethnic categories, but including those who selected white and Hispanic in keeping with US census categorisation schemas. To test whether hospitals without concordant surgeons for black and Hispanic patients influenced our findings, we conducted a sensitivity analysis excluding all hospitals that had no procedures performed by black or Hispanic surgeons.

Given the relatively small sample size and number of potential confounders, we repeated our analysis using a single continuous indicator variable for number of chronic conditions, rather than individual indicator variables for each chronic condition. We also performed an analysis to determine the association of concordance and 30-day readmission defined as readmission within 30 days of discharge from the initial procedure hospitalisation.

Secondary analyses

We conducted stratified analyses by patient factors and procedure electiveness and report p values for effects across subgroups using a test for heterogeneity (interaction). We conducted stratified analyses by procedure and by procedure morbidity wherein we classified procedures as high morbidity (cholecystectomy, colectomy, CABG, lobectomy, appendectomy, prostatectomy, AAA repair, cystectomy, liver resection, hysterectomy) and low morbidity (knee replacement, hip replacement, laminectomy, thyroidectomy). We also examined if racial and ethnic concordance was associated with surgical outcomes separately for white patients. Finally, to account for possible competing risk between mortality and readmission, we created a composite outcome of mortality or readmission within 30 days of procedure date.

For all analyses, the threshold for statistical significance was set at $p<0.05$ based on two-tailed comparisons. All analyses were performed using Stata V.16.1 (StataCorp, College Station, Texas, USA). This study followed the Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines.[58]

Patient and public involvement

Neither patients nor members of the public were involved in the development of the central research question, outcome measures, analysis plan, interpretation of results of authoring of the manuscript. Our group is supportive of patient and public involvement in research, but for our secondary data analysis of proprietary Medicare data, this would not be practical.

RESULTS

Participants

Among 1858 black and 4146 Hispanic patients treated by 746 unique surgeons (67 black, 98 Hispanic, 590 white; includes surgeons who selected multiple backgrounds), 977 (16.3%) patients were treated by a racially or ethnically concordant surgeon. Table 1 summarises measured demographic and clinical characteristics of our sample. Black patients in racially concordant and discordant

Table 1 Baseline characteristics of study cohort, according to patient–surgeon racial and ethnic concordance

Total=6004	Black patients			Hispanic patients		
Characteristic	Concordant patient–surgeon	Discordant patient–surgeon	P value	Concordant patient–surgeon	Discordant patient–surgeon	P value
Patients, No. (%)	222 (11.9)	1636 (88.1)	NA	755 (18.2)	3391 (81.8)	NA
Patient characteristics						
Patient age, y, mean (SD)	73.9 (7.0)	73.6 (6.2)	0.99	74.8 (6.8)	74.3 (6.5)	0.08
Patient sex						
Male	83 (37.4)	629 (38.5)	0.76	299 (39.6)	1408 (41.5)	0.33
Female	139 (62.6)	1007 (61.6)		456 (60.4)	1983 (58.5)	
Dual Medicare Medicaid	98 (44.1)	435 (26.6)	<0.001	206 (27.3)	905 (26.7)	<0.001
Median household income*, US$, mean (SD)	55 355 (24 342.9)	66 953 (29 425.9)	<0.001	66 326 (24 546.7)	71 751 (26 673.7)	<0.001
Coexisting conditions						
CHF	107 (48.2)	552 (33.7)	<0.001	206 (27.3)	905 (26.7)	0.74
COPD	86 (38.7)	486 (29.7)	0.006	162 (21.5)	780 (23.0)	0.36
Diabetes	142 (64.0)	865 (52.9)	0.002	453 (60.0)	1813 (53.5)	0.001
CKD	119 (53.6)	751 (45.9)	0.03	306 (40.5)	1325 (39.1)	0.46
Neurological disorders	54 (24.3)	354 (21.6)	0.36	170 (22.5)	660 (19.5)	0.06
Cancer	69 (31.1)	403 (24.6)	0.04	117 (15.5)	608 (17.9)	0.11
Surgeon characteristics						
Surgeon age, y, mean (SD)	49.8 (10.7)	51.9 (10.3)	0.15	48.9 (10.7)	53.2 (10.6)	<0.001
Surgeon gender						
Male	40 (88.9)	360 (92.8)	0.35	83 (92.2)	520 (91.1)	0.72
Female	5 (11.1)	28 (7.2)		7 (7.8)	51 (8.9)	
Surgical volume (tertiles)						
1 (lowest)	12 (5.4)	101 (6.2)	<0.001	62 (8.2)	251 (7.4)	<0.001
2	103 (46.4)	398 (24.3)		286 (37.9)	938 (27.7)	
3 (highest)	107 (48.2)	1137 (69.5)		407 (53.9)	2202 (64.9)	
Hospital characteristics hospital size, beds						
≤399	118 (53.2)	1019 (62.3)	0.009	474 (62.8)	2467 (72.8)	<0.001
>399	104 (46.9)	617 (37.7)		281 (37.2)	924 (27.3)	
Teaching hospital						
Yes	136 (61.3)	1181 (72.2)	<0.001	437 (57.9)	2063 (60.8)	0.13
No	86 (38.7)	455 (27.8)		318 (42.1)	1328 (39.2)	
Hospital ownership						
For-profit	80 (36.0)	247 (15.1)	<0.001	133 (17.6)	467 (13.8)	0.002
Not-for-profit	133 (59.9)	1189 (72.7)		493 (65.3)	2431 (71.7)	
Public	9 (4.1)	200 (12.2)		129 (17.1)	493 (14.5)	
Urban area						
Yes	222 (100.0)	1636 (100.0)	NA	755 (100.0)	3382 (99.7)	0.16
No	0 (0.0)	0 (0.0)		0 (0.0)	9 (0.3)	

Continued

Table 1 Continued

Total=6004	Black patients	Hispanic patients

*Median household income estimated from the beneficiary's zip code of residency.
CHF, congestive heart failure; CKD, chronic kidney disease; COPD, chronic obstructive pulmonary disease; y, year.

patient–surgeon dyads had similar characteristics across age and patient sex, but concordant dyads had higher rates of dual-Medicaid insured status and greater prevalence of coexisting conditions. Hispanic patients in ethnically concordant and discordant patient–surgeon dyads were similar across most patient characteristics. Surgeons in concordant dyads with Hispanic patients were on average younger, and concordant surgeons for black and Hispanic patients had lower surgical volume.

Patient–surgeon racial and ethnic concordance and surgical outcomes

The overall unadjusted 30-day mortality rate in our final sample was 1.5%. Adjusted mortality rates were 1.2% for black, 1.7% for Hispanic and 1.6% for white patients (no significant difference for black and Hispanic compared with white patients). Adjusted surgical mortality rates were 1.5% for black, 1.9% for Hispanic and 1.5% for white surgeons (no significant difference for black and Hispanic compared with white surgeons). For black patients, unadjusted mortality was 1.8% for those with concordant surgeons compared with 1.2% for those with discordant surgeons; for Hispanic patients, respective rates were 1.6% compared with 1.7%. After adjusting for potential confounders, the postoperative mortality rate did not differ for black and Hispanic patients with racially and ethnically concordant surgeons compared with patients with discordant surgeons (black patients: adjusted risk difference (aRD) for concordance vs discordance, −0.5 percentage points (pp); 95% CI, −2.6 to +1.6 pp; p=0.63; Hispanic patients: aRD, −0.5 pp; 95% CI, −1.6 to +0.5 pp; p=0.32) (figure 1, online supplemental eTable 2).

Adjusted 30-day readmission rates were 6.5% for black, 5.3% for Hispanic and 6.7% for white patients (p=0.005 for Hispanic compared with white patients; no significant difference for black compared with white patients). Adjusted readmission rates were 9.1% for black, 8.1% for Hispanic and 6.3% for white surgeons (p<0.001 for Hispanic and black compared with white patients). For black patients, unadjusted readmission was 11.7% for those with concordant surgeons compared with 7.2% for those with discordant surgeons; for Hispanic patients, respective rates were 5.3% compared with 6.4%. We found that among Hispanic patients, ethnic concordance was associated with lower 30-day readmission rate (adjusted readmission rates, 4.2% for concordant vs 6.6% for discordant dyads; aRD, −2.4 pp; 95% CI, −4.3 to −0.5 pp; p=0.014). For black patients, there was no significant difference for black patients treated by racially concordant surgeons (aRD +3.1 pp; 95% CI, −1.5 to +7.6 pp; p=0.19) (figure 1, online supplemental eTable 2).

Adjusted LOS (aLOS) was 4.9 days for black, 4.4 days for Hispanic and 4.2 days for white patients (p=0.001 for black compared with white patients; no significant difference for Hispanic compared with white patients). aLOS was 4.3 for black, 34 for Hispanic and 4.27 for white surgeons (p<0.001 for Hispanic compared with white patients; no significant difference for black compared with white patients). For black patients, unadjusted LOS was 6.3 days for those with concordant surgeons compared with

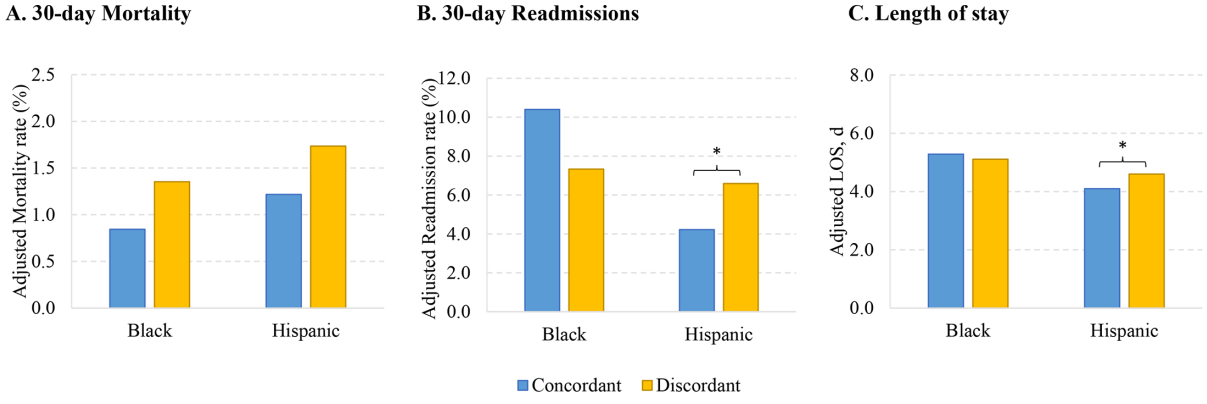

Figure 1 Association of patient–surgeon racial and ethnic concordance with postoperative outcomes among black and Hispanic patients. Association between patient–surgeon racial and ethnic concordance and 30-day mortality, 30-day readmissions and length of stay among black and Hispanic patients using Medicare data from 2016 to 2019 calculated using marginal standardisation from generalised linear probability models, controlling for patient (age, sex, race and ethnicity, 27 chronic conditions, median household income, dual-eligibility for Medicaid) procedure (procedure type, weekend surgery, electiveness of surgery, month, year), surgeon (age, sex, procedure volume) and hospital (size, teaching, urban/rural and ownership status) characteristics. d, day; LOS, length of stay.

5.0 days for those with discordant surgeons; for Hispanic patients, respective LOS was 4.3 days compared with 4.6 days. Among Hispanic patients, ethnic concordance was associated with shorter postoperative LOS (aLOS, 4.1 days for concordant vs 4.6 days for discordant dyads; aLOS −0.5 days; 95% CI, −0.8 days to −0.2 days; p=0.003). There were no significant associations between racial concordance and aLOS for black patients (aLOS+0.2 days; 95% CI, −1.1 to +1.5 days, p=0.79) (figure 1, online supplemental eTable 2).

Sensitivity analyses

Compared with surgeons with self-reported race and ethnicity, surgeons without this information were on average younger and had small differences in surgical volume (online supplemental eTable 3). The association between patient–surgeon racial and ethnic concordance and patient mortality was qualitatively unchanged by using inverse probability weights to account for missing surgeon race and ethnicity (online supplemental eTable 4).

When surgeons who selected multiple backgrounds across different racial and ethnic categories were excluded, the estimated effect of association was qualitatively similar to the findings of the primary analysis (online supplemental eTable 5). Hospitals with any concordant dyads for black or Hispanic patients had similar outcomes to hospitals without any concordant dyads (online supplemental eTable 6); excluding hospitals without any black or Hispanic surgeons resulted in qualitatively similar findings to the primary analysis (online supplemental eTable 7). When a continuous indicator variable was used for the number of chronic conditions, the results were qualitatively similar to the primary analysis (online supplemental eTable 8). Using an alternative definition of 30-day readmission (online supplemental eTable 9) resulted in similar findings compared with the primary definition of readmission.

Secondary analyses

Among subgroups of patient age, gender, dual Medicaid eligibility, median household income, number of chronic conditions or electiveness of surgery on our outcomes of interest, effect estimates favoured lower mortality for concordance, though these estimates were not statistically significant (figure 2). While overall Hispanic patients experienced lower readmissions and LOS, there were no differences within subgroups of patient characteristics and procedure electiveness. Similarly, there were no subgroup differences among black patients (figures 3–4).

In the subgroup analysis by procedure, we found no evidence of an association between racial and ethnic patient–surgeon concordance and postoperative mortality among procedures for black patients. There was a significant increased adjusted risk of readmission after CABG among black patients treated by racially and ethnically concordant surgeons (aRD for readmission, +58.4 pp; 95% CI, +7.6 to +109.3 pp; p=0.03) (online supplemental eTable 10C); all other procedures were not significant for black patients. Hispanic patients undergoing knee replacement had a significantly lower adjusted risk of readmission when treated by racially and ethnically concordant surgeons (aRD, −2.5 pp; 95% CI, −4.9 to −0.2 pp; p=0.04) (online supplemental eTable 10D); all other procedures were not significant. In the subgroup analysis by procedure morbidity, for high morbidity procedures, concordance was associated with shorter LOS among Hispanic patients (aLOS −0.89 days; 95% CI, −1.7 to −0.1 days; p=0.027); for low morbidity procedures, concordance was associated with lower readmission among Hispanic patients (aRD −2.4 pp, 95% CI, −4.6 to –0.3 pp; p=0.029) (online supplemental eTable 11).

Among white patients (online supplemental eTable 12), we found no evidence that racial and ethnic concordance was associated with patient postoperative mortality, readmissions or LOS (online supplemental eTable 13,eFigure 1). See online supplemental file 1 for secondary analyses performed for white patients (online supplemental eTable 14,eFigure 2).

For the composite outcomes of 30-day readmission or mortality, among Hispanic patients, concordance was associated with a lower adjusted rate (aRD −3.0 pp; 95% CI, −5.0 to −0.9 pp; p=0.005) (online supplemental eTable 15).

DISCUSSION

Using a sample of older black and Hispanic Medicare beneficiaries who underwent 1 of 14 common surgical procedures performed by surgeons with California medical licences, we found that patient–surgeon ethnic concordance was associated with lower 30-day readmission and length of stay for Hispanic patients, whereas we found no association for patient mortality. Among black patients, we found no evidence that patient outcomes differ between patients treated by racially and ethnically concordant versus discordant surgeons—although this may be due to insufficient sample size. Taken together, these findings suggest that patient–surgeon racial and ethnic concordance may be associated with improved surgical outcomes for Hispanic patients.

There are several mechanisms that can potentially explain our findings. We found that Hispanic patients treated by concordant surgeons experienced a lower readmission rate and LOS compared with those treated by discordant surgeons. It is possible that ethnic concordance between patients and their surgeons fosters increased patient engagement with and trust in clinicians, which may then contribute to an increased likelihood of patients' adherence to surgeon recommendations, including with preoperative and postoperative management, thus leading to lower readmission. While plausible, previous research investigating the association between concordance and engagement or trust for black and Hispanic patients has been mixed, with some studies

Variable	Black patients aRD (95% CI)	Black patients test for heterogeneity P value	Hispanic patients aRD (95% CI)	Hispanic patients test for heterogeneity P value
Patient age, y				
65-74	-1.2 (-3.1 to 0.6)	0.64	-0.04 (-1.0 to 0.9)	0.55
75-84	-1.8 (-5.3 to 1.7)		-1.2 (-3.1 to 0.6)	
85-99	10.8 (-12.4 to 34.0)		-0.04 (-7.4 to 7.4)	
Patient gender				
Male	-0.3 (-4.4 to 3.7)	0.48	-0.8 (-2.6 to 0.9)	0.78
Female	-0.9 (-3.4 to 1.7)		0.2 (-1.1 to 1.5)	
Medicaid dual eligibility				
Yes	-0.9 (-5.0 to 3.3)	0.83	-0.1 (-1.5 to 1.3)	0.86
No	-0.7 (-3.2 to 1.8)		-0.7 (-2.4 to 1.1)	
Median household income (tertiles)				
1 (Lowest)	-1.2 (-3.9 to 1.5)	0.77	-1.0 (-2.7 to 0.6)	0.27
2	0.1 (-1.2 to 1.4)		-0.2 (-2.2 to 1.7)	
3 (Highest)	4.0 (-2.8 to 10.7)		0.5 (-0.9 to 1.9)	
Number of Chronic conditions				
0-5	2.0 (-1.7 to 5.8)	0.38	-0.6 (-1.6 to 0.4)	0.90
6-10	-0.9 (-2.1 to 0.4)		-0.7 (-2.2 to 0.8)	
>10	-3.5 (-9.7 to 2.6)		0.4 (-2.7 to 3.4)	
Electiveness				
Elective	-1.7 (-3.1 to -0.2)	0.08	-0.2 (-0.8 to 0.4)	0.87
Non-elective	4.1 (-4.1 to 12.2)		-0.9 (-4.3 to 2.5)	

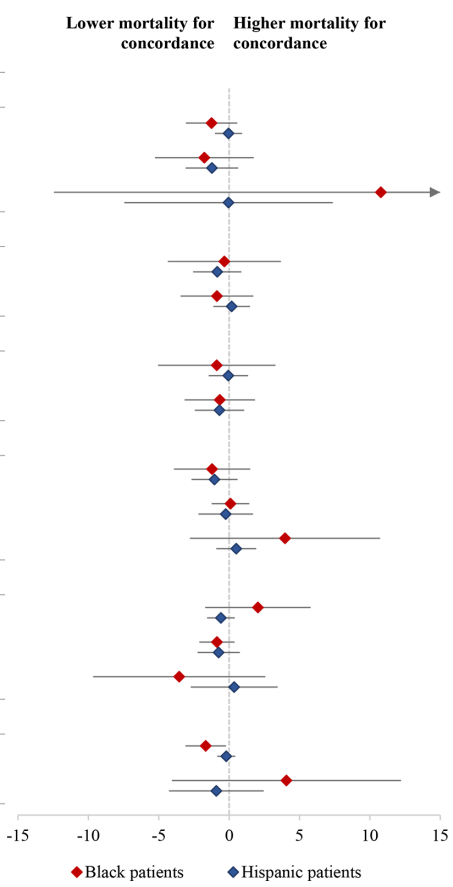

Figure 2 Subgroup analysis of 30-day postoperative mortality by patient and procedure characteristics among black and Hispanic patients. Subgroup analysis shows the associations between patient–surgeon racial and ethnic concordance and outcomes 30-day postoperative mortality using Medicare data from 2016 to 2019 by patient characteristics (age, gender, Medicaid dual eligibility, median household income estimated from beneficiary zip codes, number of chronic conditions) and procedure characteristics (elective vs non-elective). Diamonds represent point estimates for the adjusted outcomes for black (red) and Hispanic (blue) following 14 common procedures (abdominal aortic aneurysm repair, appendectomy, coronary artery bypass grafting, cholecystectomy, cystectomy, hip replacement, hysterectomy, knee replacement, laminectomy, liver resection, lung resection, prostatectomy and thyroidectomy), calculated using marginal standardisation from linear probability models, controlling for patient (age, sex, 27 chronic conditions, median household income, dual-eligibility for Medicaid) procedure (procedure type, weekend surgery, electiveness of surgery, month, year), surgeon (age, sex, procedure volume) and hospital (size, teaching, urban/rural and ownership status) characteristics. Horizontal lines indicate the associated 95% CIs. aRD, adjusted risk difference; y, year.

suggesting a significant association[35 37 43] and others suggesting no association.[59] It is also possible that ethnic concordance leads to improved quality or perceived quality of communication, possibly due to bidirectional communication in the patient's native language. This could confer benefit to patients by better ensuring that they understand aspects of the perioperative course, leading to improved outcomes. Again, the evidence basis for this is mixed, with some work suggesting racial and ethnic concordance is associated with improved quality of communication[60] and increased visit length[37] and others studies finding no association.[36] Relatedly, there is mixed evidence on the impact of language concordance on process and clinical outcomes.[43 61] Determining the mechanisms for our findings through further research could meaningfully contribute to improving surgical care, especially for racially and ethnically discordant patient–surgeon interactions.

We found no evidence that patient–surgeon racial and ethnic concordance was associated with improved outcomes among black patients. In the surgical literature, studies investigating concordance among black patients are scant. A prior study similarly did not detect an association between racial concordance and survival after orthotopic heart transplant.[62] In the non-surgical literature, a randomised control trial in which black men were randomised to receive a consultation with a black or non-black male physician found that racial concordance was associated with increased patient uptake of preventative services.[63] In another study conducted among newborns in Florida, infant–physician racial concordance was associated with improvement in neonatal mortality rates.[64]

Black surgeons are overall under-represented compared with the general US population[65]; for example, an estimated 6.1% of general surgeons are black[66] despite black people comprising 13.7% of the US population.

Variable	Black patients aRD (95% CI)	Black patients test for heterogeneity P value	Hispanic patients aRD (95% CI)	Hispanic patients test for heterogeneity P value
Patient age, y				
65-74	3.2 (-2.5 to 8.9)		-2.0 (-4.1 to 0.1)	
75-84	4.1 (-4.3 to 12.5)	0.74	-1.6 (-5.3 to 2.1)	0.83
85-99	14.1 (-29.9 to 58.1)		-2.5 (-12.0 to 6.9)	
Patient gender				
Male	6.4 (-2.0 to 14.8)	0.41	-4.0 (-7.2 to -0.8)	0.20
Female	1.4 (-3.7 to 6.5)		-1.3 (-3.7 to 1.1)	
Medicaid dual eligibility				
Yes	4.2 (-4.7 to 13.2)	0.40	-2.0 (-4.5 to 0.5)	0.71
No	1.6 (-3.6 to 6.8)		-2.8 (-5.9 to 0.3)	
Median household income (tertiles)				
1 (Lowest)	2.0 (-3.4 to 7.4)		-2.3 (-5.6 to 1.0)	
2	7.6 (-5.0 to 20.2)	0.47	-2.6 (-5.4 to 0.3)	0.70
3 (Highest)	4.9 (-12.5 to 22.3)		-0.9 (-5.9 to 4.1)	
Number of Chronic conditions				
0-5	2.0 (-5.1 to 9.1)		0.4 (-2.4 to 3.3)	
6-10	3.8 (-3.3 to 10.8)	0.41	-3.5 (-6.3 to -0.7)	0.43
>10	6.7 (-3.3 to 16.7)		-0.7 (-5.5 to 4.0)	
Electiveness				
Elective	3.3 (-1.7 to 8.3)	0.97	-2.5 (-4.5 to -0.5)	0.49
Non-elective	-0.4 (-13.0 to 12.2)		-1.9 (-6.2 to 2.5)	

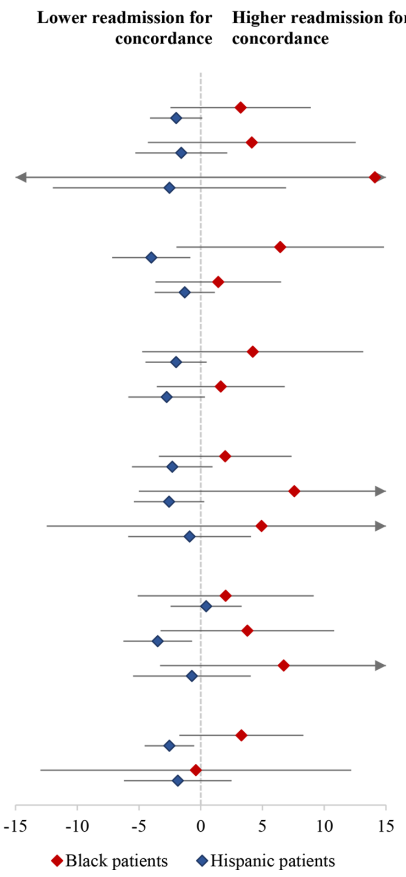

Figure 3 Subgroup analysis of 30-day postoperative readmissions by patient and procedure characteristics among black and Hispanic patients. Subgroup analysis shows the associations between patient–surgeon racial and ethnic concordance and outcomes 30-day postoperative readmission using Medicare data from 2016 to 2019 by patient characteristics (age, gender, Medicaid dual eligibility, median household income estimated from beneficiary zip codes, number of chronic conditions) and procedure characteristics (elective vs non-elective). Diamonds represent point estimates for the adjusted outcomes for black (red) and Hispanic (blue) following 14 common procedures (abdominal aortic aneurysm repair, appendectomy, coronary artery bypass grafting, cholecystectomy, cystectomy, hip replacement, hysterectomy, knee replacement, laminectomy, liver resection, lung resection, prostatectomy and thyroidectomy), calculated using marginal standardisation from linear probability models, controlling for patient (age, sex, 27 chronic conditions, median household income, dual-eligibility for Medicaid) procedure (procedure type, weekend surgery, electiveness of surgery, month, year), surgeon (age, sex, procedure volume) and hospital (size, teaching, urban/rural and ownership status) characteristics. Horizontal lines indicate the associated 95% CIs. aRD, adjusted risk difference; y, year.

Our findings may be due to black patients in concordant dyads comprising less than 4% of our sample, thus any suggested differences did not reach statistical significance with this small sample size. Given that so few black patients had concordance, this lack of representation limits our ability to extrapolate our findings. It is possible that in the surgical episode of care, there may be different dynamics than in studies of primary care that demonstrate a benefit of racial concordance for black patients.[67 68] For example, given the multidisciplinary care inherent in surgery, the influence of other hospital staff (ie, trainees, advanced practice providers, nurses) may mitigate the effects of surgeon concordance on our outcomes. It remains unclear why this influence would differ for black compared with Hispanic patients. Another intermediate factor influencing readmissions for black patients may be their primary care physician, and whether this individual is racially concordant, since follow-up care may help mitigate outcomes, including readmissions after certain surgeries.[69 70] One potential explanation for why our findings differ between black and Hispanic patients is that language concordance for Hispanic patient–surgeon dyads has a mechanistic role in our observed association.

While this observational study cannot determine causation, our findings contribute to evidence of the potential benefit of ongoing efforts to increase Hispanic representation in the physician workforce.[71] Despite comprising approximately 19% of the overall US population, only 5.8% of practicing physicians identify as Hispanic.[72] Dedicated programmes, including loan repayment programmes, institutional salary support and specialised benefits to recruit and retain underrepresented in medicine (URiM) surgeons, mentorship programmes and outreach efforts to encourage undergraduate and high school students to pursue surgical careers[34] should be offered at scale to improve surgeon

Variable	Black patients adjusted LOS (95% CI)	Black patients test for heterogeneity P value	Hispanic patients adjusted LOS (95% CI)	Hispanic patients test for heterogeneity P value
Patient age, y				
65-74	-0.2 (-1.8 to 1.5)		-0.03 (-0.4 to 0.4)	
75-84	1.2 (-0.9 to 3.2)	0.84	-1.3 (-2.0 to -0.7)	0.01
85-99	4.8 (0.6 to 8.9)		-0.1 (-1.5 to 1.4)	
Patient gender				
Male	-0.7 (-2.6 to 1.1)	0.32	-0.6 (-1.1 to -0.1)	0.52
Female	0.7 (-0.9 to 2.4)		-0.5 (-0.9 to 0.01)	
Medicaid dual eligibility				
Yes	0.5 (-2.5 to 3.5)	0.36	-0.6 (-1.0 to -0.1)	0.96
No	-0.2 (-1.3 to 0.8)		-0.5 (-1.0 to 0.04)	
Median household income (tertiles)				
1 (Lowest)	0.4 (-1.3 to 2.1)		-0.02 (-0.5 to 0.5)	
2	-0.6 (-2.1 to 0.8)	0.44	-0.7 (-1.2 to -0.1)	0.38
3 (Highest)	-0.1 (-2.7 to 2.5)		-0.6 (-1.2 to 0.1)	
Number of Chronic conditions				
0-5	-0.5 (-2.2 to 1.3)		-0.1 (-0.6 to 0.3)	
6-10	-0.7 (-3.1 to 1.6)	0.24	-0.2 (-0.7 to 0.3)	0.05
>10	1.2 (-0.9 to 3.2)		-0.9 (-1.8 to -0.1)	
Electiveness				
Elective	0.1 (-1.5 to 1.6)	0.47	-0.4 (-0.7 to -0.1)	0.88
Non-elective	0.2 (-2.9 to 3.2)		-0.7 (-1.6 to 0.2)	

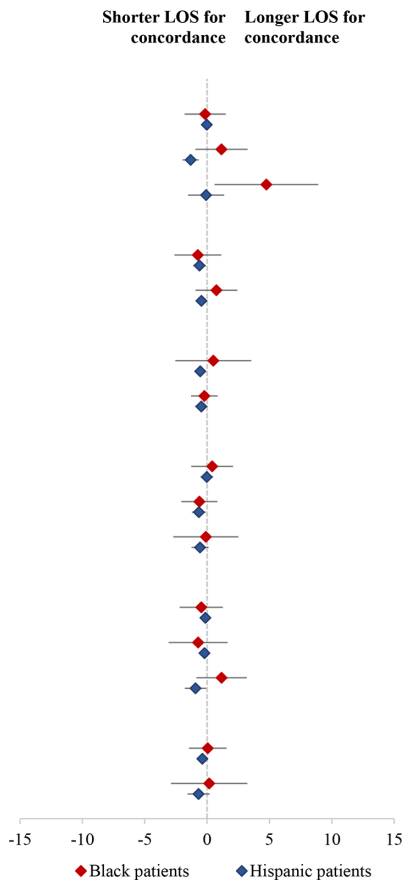

Figure 4 Subgroup analysis of length of stay by patient and procedure characteristics among black and Hispanic patients. Subgroup analysis shows the associations between patient–surgeon racial and ethnic concordance and length of stay using Medicare data from 2016 to 2019 by patient characteristics (age, gender, Medicaid dual eligibility, median household income estimated from beneficiary zip codes, number of chronic conditions) and procedure characteristics (elective vs non-elective). Diamonds represent point estimates for the adjusted outcomes for black (red) and Hispanic (blue) following 14 common procedures (abdominal aortic aneurysm repair, appendectomy, coronary artery bypass grafting, cholecystectomy, cystectomy, hip replacement, hysterectomy, knee replacement, laminectomy, liver resection, lung resection, prostatectomy and thyroidectomy), calculated using marginal standardisation from linear probability models, controlling for patient (age, sex, 27 chronic conditions, median household income, dual-eligibility for Medicaid) procedure (procedure type, weekend surgery, electiveness of surgery, month, year), surgeon (age, sex, procedure volume) and hospital (size, teaching, urban/rural and ownership status) characteristics. Horizontal lines indicate the associated 95% CIs. LOS, length of stay; y, year.

workforce diversity and reduce attrition among URiM surgeons.[73] These types of programmes will take time to result in workforce diversification. In the short term, training in cultural humility[74] (ie, a lifelong commitment to self-evaluation, self-critique and the development of clinical and advocacy partnerships with patients and their communities) for surgeons may improve the patient–surgeon therapeutic alliance and contribute to improved outcomes for discordant dyads. Studies that investigate the role of such training on surgical outcomes are warranted.[75]

Our study has limitations. First, as is the case with any observational studies, we are unable to preclude the possibility of unmeasured confounding. For example, it is possible that black and Hispanic patients who are cared for by racially and ethnically concordant surgeons are sicker or healthier than patients who are cared for by discordant surgeons in unmeasurable ways. Also, our use of claims data precludes our ability to determine what procedures or procedural approaches (eg, open vs minimally invasive) were offered by surgeons to patients, which may confound our findings. Second, we have race and ethnicity data for only about one-fifth of MBC-licensed surgeons, which may introduce non-response bias. For our primary analysis, we performed a complete case analysis, assuming surgeon race or ethnicity was missing at random. We attempted to account for missingness at random in our sensitivity analysis using non-response weighting (online supplemental etable 3), though there may be an additional impact of non-random missing data. Third, we relied on billing codes that identified the surgeon who performed the surgical procedure. Therefore, we are not able to account for contributions to the patient–surgeon dynamic by physician trainees, consulting physicians, advanced practice providers and nurses. Fourth, our sample size limited our ability to assess for intersectional

concordance (ie, concordance across multiple identities including gender, race, ethnicity, sexual orientation), which requires further research to investigate. Finally, our analysis focused on postoperative outcomes of Medicare fee-for-service beneficiaries receiving inpatient surgery treated by surgeons with California medical licences. Therefore, our findings may not be generalisable to younger populations, Medicare advantage beneficiaries, patients treated by surgeons with medical licences from other states, ambulatory surgery, specialised practice or other outcome measures.

In summary, patient–surgeon racial and ethnic concordance was not associated with lower 30-day postoperative mortality for older black and Hispanic patients treated by surgeons with California medical licences; however, it was associated with lower 30-day readmission and reduced LOS for Hispanic patients. While observational, these findings support the role of increasing the number of Hispanic surgeons in the USA and programmes to improve cultural humility among surgeons. Further studies are necessary to determine the mechanisms through which patient–surgeon racial and ethnic concordance, including patient engagement, bidirectional communication and prompt recognition of potential complications, may lead to improved patient outcomes.

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