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Evidence-based Perioperative Practice Utilization among Various Racial Populations—A Retrospective Cohort Trending Analysis of Lower Extremity Total Joint Arthroplasty Patients

Jiabin Liu, M.D., Ph.D., F.A.S.A., Haoyan Zhong, M.P.A., Michael Reynolds, M.D., Alex Illescas, M.P.H., Crispiana Cozowicz, M.D., Christopher L. Wu, M.D., Jashvant Poeran, M.D., Ph.D., Stavros Memtsoudis, M.D., Ph.D., M.B.A.

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ABSTRACT

Background: Various studies have demonstrated racial disparities in perioperative care and outcomes. The authors hypothesize that among lower extremity total joint arthroplasty patients, evidence-based perioperative practice utilization increased over time among all racial groups, and that standardized evidence-based perioperative practice care protocols resulted in reduction of racial disparities and improved outcomes.

Methods: The study analyzed 3,356,805 lower extremity total joint arthroplasty patients from the Premier Healthcare database (Premier Healthcare Solutions, Inc., USA). The exposure of interest was race (White, Black, Asian, other). Outcomes were evidence-based perioperative practice adherence (eight individual care components; more than 80% of these implemented was defined as "high evidence-based perioperative practice"), any major complication (including acute renal failure, delirium, myocardial infarction, pulmonary embolism, respiratory failure, stroke, or in-hospital mortality), in-hospital mortality, and prolonged length of stay.

Results: Evidence-based perioperative practice adherence rate has increased over time and was associated with reduced complications across all racial groups. However, utilization among Black patients was below that for White patients between 2006 and 2021 (odds ratio, 0.94 [95% CI, 0.93 to 0.95]; 45.50% *vs.* 47.90% on average). Independent of whether evidence-based perioperative practice components were applied, Black patients exhibited higher odds of major complications (1.61 [95% CI, 1.55 to 1.67] with high evidence-based perioperative practice; 1.43 [95% CI, 1.39 to 1.48] without high evidence-based perioperative practice), mortality (1.70 [95% CI, 1.29 to 2.25] with high evidence-based perioperative practice; 1.29 [95% CI, 1.10 to 1.51] without high evidence-based perioperative practice), and prolonged length of stay (1.45 [95% CI, 1.42 to 1.48] with high evidence-based perioperative practice; 1.38 [95% CI, 1.37 to 1.40] without high evidence-based perioperative practice) compared to White patients.

Conclusions: Evidence-based perioperative practice utilization in lower extremity joint arthroplasty has been increasing during the last decade. However, racial disparities still exist with Black patients consistently having lower odds of evidence-based perioperative practice adherence. Black patients (compared to the White patients) exhibited higher odds of composite major complications, mortality, and prolonged length of stay, independent of evidence-based perioperative practice use, suggesting that evidence-based perioperative practice did not impact racial disparities regarding particularly the Black patients in this surgical cohort.

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EDITOR'S PERSPECTIVE

What We Already Know about This Topic

- Racial disparities in postsurgical outcomes have previously been reported
- A wide variety of evidence-based perioperative practice utilization exists across institutions and healthcare systems, which could potentially account for differences in postsurgical outcomes

What This Article Tells Us That Is New

- This study investigated outcomes in more than 3 million lower extremity joint surgery patients using the Premier Healthcare database (Premier Healthcare Solutions, Inc., USA) to investigate differences in outcomes among races, and found that evidence-based perioperative practice, although increasingly used, was less likely to be applied in the care of Black than White patients
- Even when accounting for the lower use of evidence-based perioperative practice, outcomes were worse among Black patients

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Jiabin Liu, M.D., Ph.D., F.A.S.A.: Department of Anesthesiology, Critical Care & Pain Management, Hospital for Special Surgery, New York, New York; Department of Anesthesiology, Weill Cornell Medicine, New York, New York.

Haoyan Zhong, M.P.A.: Department of Anesthesiology, Critical Care & Pain Management, Hospital for Special Surgery, New York, New York.

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Racial and ethnicity disparities in care and outcomes have been drawing extensive attention in recent years. Indeed, such disparities in care have been described in various surgical specialties, such as colorectal,[1] cardiac,[2] and other settings.[3] The existence of such disparities has been associated with worse surgical outcomes among racial minority groups.[4,5]

One proposed intervention to reduce the risk for disparate care is the establishment of protocolized care approaches such as Enhanced Recovery after Surgery protocols.[6] These interdisciplinary, standardized protocols aim at hastening recovery, optimizing patient outcomes, and minimizing complications after surgery. These protocols typically involve preoperative education, optimization of pain management, early mobilization, and various other components as supported by evidence-based perioperative practice.

To date, there is a paucity of data to show how evidence-based perioperative practice has been implemented across patient groups of different racial backgrounds, and specifically if they can improve disparities and thus outcomes among orthopedic patients, such as lower extremity total joint arthroplasty. We hypothesize that among lower extremity total joint arthroplasty patients, evidence-based perioperative practice utilization increased over time among all racial groups, and that such standardized evidence-based perioperative practice care protocols resulted in reduction of racial disparities and improved outcomes.

Materials and Methods

Study Design, Data Source, and Patient Population

This retrospective cohort study was approved by the institutional review board of the Hospital for Special Surgery (New York, New York; No. 2017-0169). The requirement for written informed consent was waived given the deidentified nature of the data. From the Premier Healthcare claims database (Premier Healthcare Solutions, Inc., USA; 2006 to 2021), we identified patients who underwent elective knee or hip total joint arthroplasty using a standard set of International Classification of Diseases, Ninth and Tenth Revisions codes that have been previously published.[7] The Premier Healthcare database is one of the most comprehensive electronic healthcare databases. It is service-level, all-payer claims data, representing about 20 to 25% of all U.S. hospitals. This manuscript adhered to the Strengthening the Reporting of Observational Studies in Epidemiology and Enhancing the Quality and Transparency of Health Research guidelines.

Michael Reynolds, M.D.: Department of Anesthesiology, Critical Care & Pain Management, Hospital for Special Surgery, New York, New York.

Alex Illescas, M.P.H.: Department of Anesthesiology, Critical Care & Pain Management, Hospital for Special Surgery, New York, New York.

Crispiana Cozowicz, M.D.: Department of Anesthesiology, Perioperative Medicine and Intensive Care Medicine, Paracelsus Medical University, Salzburg, Austria.

Christopher L. Wu, M.D.: Department of Anesthesiology, Critical Care & Pain Management, Hospital for Special Surgery, New York, New York; Department of Anesthesiology, Weill Cornell Medicine, New York, New York.

Jashvant Poeran, M.D., Ph.D.: Institute for Healthcare Delivery Science, Department of Population Health Science & Policy/ Department of Orthopedics/Department of Medicine, Icahn School of Medicine at Mount Sinai, New York, New York.

Stavros Memtsoudis, M.D., Ph.D., M.B.A.: Department of Anesthesiology, Critical Care & Pain Management, Hospital for Special Surgery, New York, New York; Department of Anesthesiology, Weill Cornell Medicine, New York, New York.

Inclusion and Exclusion Criteria

The study sample included adult patients from January 2006 to December 2021 who were admitted to the hospital for elective total joint arthroplasty surgery (N = 3,449,941). Exclusion criteria were age less than 18 yr (n = 863), unknown sex (N = 59), unknown race (n = 27,561), or outpatient surgery (n = 64,532).

Study Variables

The main "exposure" of interest was race categorized as Asian, Black, White, or Other. "Other" race included any patient who was not categorized as an Asian patient, Black patient, or White patient per Premier Healthcare. Race is patient self-reported, and the information on race is submitted by the hospitals directly to Premier Healthcare as part of electronic health records. Premier Healthcare only validates that the value submitted by the hospital is a valid entry appropriate for race categories. We elected to focus on race in this study due to the fact that race is a well-defined and consistent variable in the Premier Healthcare database. The ethnicity variable was introduced into Premier Healthcare data collection in 2011, which was categorized as Hispanic or non-Hispanic ethnicity. The changes in the way Hispanic race is reported over time are a product of changes mandated by Centers for Medicare & Medicaid Services (Baltimore, Maryland), whereby Hispanic race was discontinued and instead reported as Hispanic ethnicity. Therefore, patients of Hispanic ethnicity could be White patients, Black patients, Asian patients, and so forth. The change of Hispanic race to Hispanic ethnicity makes the analysis on Hispanic patients uninterpretable. Therefore, we excluded Hispanic patients from this analysis. The reporting and discussion of race followed medical journal guidance as described.[8]

Outcomes were modeled sequentially; we first assessed the outcome of evidence-based perioperative practice adherence. Evidence-based perioperative practice use was defined by eight components commonly used in such protocols, identified using billing and Current Procedural Terminology codes as previously described[9,10] (appendix 1): (1) use of multimodal anesthesia (including peripheral nerve block, nonsteroidal anti-inflammatory drugs, cyclooxygenase-2 inhibitors, paracetamol or acetaminophen, gabapentin or pregabalin, or ketamine) on the day of surgery or postoperative day 1, (2) use of tranexamic acid on the day of surgery or postoperative day 1, (3) use of antiemetics on the

day of surgery or postoperative day 1, (4) use of steroids on the day of surgery, (5) physical therapy on the day of surgery or postoperative day 1, (6) avoidance of urinary catheters, (7) avoidance of patient-controlled analgesia, and (8) avoidance of wound drains. Evidence-based perioperative practice use was operationalized as previously described.[9–12] The frequencies of utilization of each component of evidence-based perioperative practice exhibited similar patterns across White, Black, and Asian patients (appendix 2).

An evidence-based perioperative practice adherence variable was created by categorizing the number of evidence-based perioperative practice components applied. A binary outcome variable was generated based on whether a patient received more than 80% of evidence-based perioperative practice components. Secondary outcome variables include any major complication defined by International Classification of Diseases, Ninth and Tenth Revisions codes (including acute renal failure, delirium, myocardial infarction, pulmonary embolism, respiratory failure, stroke, in-hospital mortality, and prolonged length of stay [more than 3 days]; appendix 3).

Patient-level variables included age, sex (male, female), insurance type (commercial, Medicaid, Medicare, uninsured, other), and Elixhauser Comorbidity Index (categorized as 0, 1, 2, 3+). Healthcare-level variables included hospital location (urban, rural), hospital size (fewer than 300, 300 to 499, 500 or more beds), hospital teaching status, procedure type (hip/knee total joint arthroplasty), and year of procedure.

Statistical Analysis

The primary model was specified *a priori*. We did not perform sample size calculation before data access. No minimum clinical difference was defined *a priori*. This study is motivated to use all data from 2006 to 2021 available in the Premier Healthcare database.

We first assessed (unadjusted) trends in "high evidence-based perioperative practice" use by racial subgroups. Descriptive analysis of all study variables was stratified by race. Categorical variables were presented as counts and percentages, and continuous variables were presented as median and interquartile ranges.

Mixed-effects models were applied to compare associations between race and the use of more than 80% of evidence-based perioperative practice components, *i.e.*, "high evidence-based perioperative practice." We subsequently modeled the association between race and "high evidence-based perioperative practice" and the outcomes of any major complication, in-hospital mortality, and prolonged length of stay. We next modeled all covariates to estimate effects for each race groups. Finally, we applied an interaction term between race and evidence-based perioperative practice to assess whether the association between evidence-based perioperative practice and outcomes was any different across racial subgroups, *i.e.*, to assess whether evidence-based perioperative practice protocols exerted a stronger effect in the White patient subgroup *versus* all other racial subgroups (including Asian patients, Black patients, and other patients), assuming higher odds of complications for all other racial subgroups that would require a stronger impact of evidence-based perioperative practice protocols to reduce potential racial disparities in outcomes. Race is a progressive social construct without biologic meaning. However, genetic admixture and its potential interaction with evidence-based perioperative practice could influence the outcome. We therefore conducted this analysis to further challenge our findings. Models were adjusted for all available covariates. A random intercept term that varies at the level of each hospital was included in the model, accounting for the cluster effect of patients within hospitals as they are likely to experience similar care. Odds ratios and 95% CIs were reported. A P value <0.05 was used as the cutoff for statistical significance. Analyses were performed with SAS version 9.4 (SAS Institute, USA).

All these analyses were the primary analysis. In addition, we conducted a secondary sensitivity analysis on the primary and secondary outcomes by sequentially dropping several components of the evidence-based perioperative practice, including use of tranexamic acid on the day of surgery or postoperative day 1, use of steroids on the day of surgery, and avoidance of patient-controlled analgesia. Each sensitivity analysis was executed exactly as described for the main eight-component analysis.

Results

Our study included 3,356,805 lower extremity total joint arthroplasty patients between 2006 to 2021 (table 1). High evidence-based perioperative practice components utilization was associated with decreased odds of composite major complications, mortality, and prolonged length of stay across all racial groups (table 2).

Evidence-based perioperative practice utilization increased across all racial groups over time, with major changes starting around 2012, and plateauing around 2019 (fig. 1). However, the Black patients consistently had lower evidence-based perioperative practice utilization compared to White patients (odds ratio, 0.94; 95% CI, 0.93 to 0.95). Black patients exhibited higher odds of composite major complications, mortality, and prolonged length of stay compared to the White patients after adjusting high evidence-based perioperative practice use and other variables (table 3). Further stratification on evidence-based perioperative practice utilization indicated that high evidence-based perioperative practice utilization did not seem to improve the worse outcomes associated with Black patients (table 4). Similar patterns of differences between Black patients and White patients were also confirmed with our sensitivity analysis (appendix 4).

Asian patients had lower utilization rates than White patients as well (fig. 1); however, this did not reach statistical

Table 1. Patient Demographic Information and Comorbidity by Race

	Race							
	White		Black		Asian		Other	
	N = 2,733,835	(%)	N = 268,606	(%)	N = 30,758	(%)	N = 323,606	(%)
Evidence-based perioperative practice >80%								
0	1,423,376	52.1%	146,465	54.5%	14,635	47.6%	236,522	73.1%
1	1,310,459	47.9%	122,141	45.5%	16,123	52.4%	87,084	26.9%
Procedure group								
Hip	997,272	36.5%	92,682	34.5%	8,669	28.2%	100,269	31.0%
Knee	1,736,563	63.5%	175,924	65.5%	22,089	71.8%	223,337	69.0%
Sex								
Female	1,612,712	59.0%	178,794	66.6%	20,717	67.4%	197,253	61.0%
Male	1,121,123	41.0%	89,812	33.4%	10,041	32.6%	126,353	39.0%
Insurance								
Commercial	973,938	35.6%	96,517	35.9%	9,759	31.7%	115,706	35.8%
Medicaid	84,359	3.1%	25,335	9.4%	2,527	8.2%	19,762	6.1%
Medicare	1,570,074	57.4%	130,460	48.6%	17,470	56.8%	173,441	53.6%
Uninsured	11,840	0.4%	2,302	0.9%	187	0.6%	2,243	0.7%
Unknown	93,624	3.4%	13,992	5.2%	815	2.6%	12,454	3.8%
Urban or rural								
Rural	309,572	11.3%	23,615	8.8%	2,059	6.7%	28,876	8.9%
Urban	2,424,263	88.7%	244,991	91.2%	28,699	93.3%	294,730	91.1%
Teaching								
No	1,547,944	56.6%	137,245	51.1%	14,367	46.7%	168,041	51.9%
Yes	1,185,891	43.4%	131,361	48.9%	16,391	53.3%	155,565	48.1%
Bed size								
Large	700,191	25.6%	85,602	31.9%	8,156	26.5%	103,210	31.9%
Medium	836,455	30.6%	92,977	34.6%	7,486	24.3%	105,756	32.7%
Small	1,197,189	43.8%	90,027	33.5%	15,116	49.1%	114,640	35.4%
Region								
Midwest	631,511	23.1%	44,459	16.6%	2,955	9.6%	55,617	17.2%
Northeast	467,883	17.1%	44,838	16.7%	5,009	16.3%	76,064	23.5%
South	1,176,982	43.1%	165,231	61.5%	5,881	19.1%	105,404	32.6%
West	457,459	16.7%	14,078	5.2%	16,913	55.0%	86,521	26.7%
Year								
2006	82,402	3.0%	7,252	2.7%	0	0	23,540	7.3%
2007	89,105	3.3%	7,992	3.0%	0	0	24,253	7.5%
2008	96,572	3.5%	8,715	3.2%	5	0.0%	22,945	7.1%
2009	114,871	4.2%	10,971	4.1%	46	0.1%	23,900	7.4%
2010	139,912	5.1%	14,132	5.3%	734	2.4%	28,182	8.7%
2011	165,440	6.1%	16,996	6.3%	1,692	5.5%	28,596	8.8%
2012	185,542	6.8%	18,651	6.9%	1,985	6.5%	27,136	8.4%
2013	202,322	7.4%	19,014	7.1%	2,212	7.2%	28,988	9.0%
2014	225,042	8.2%	20,320	7.6%	2,737	8.9%	25,859	8.0%
2015	243,141	8.9%	22,300	8.3%	3,383	11.0%	18,990	5.9%
2016	265,190	9.7%	25,616	9.5%	3,935	12.8%	14,440	4.5%
2017	274,962	10.1%	27,087	10.1%	4,486	14.6%	17,288	5.3%
2018	238,832	8.7%	24,647	9.2%	3,363	10.9%	15,197	4.7%
2019	225,130	8.2%	23,394	8.7%	3,120	10.1%	13,932	4.3%
2020	117,559	4.3%	12,906	4.8%	1,602	5.2%	6,484	2.0%
2021	67,813	2.5%	8,613	3.2%	1,458	4.7%	3,876	1.2%
Elixhauser comorbidity								
0	1,017,692	37.2%	82,768	30.8%	11,401	37.1%	141,273	43.7%
1	806,405	29.5%	79,702	29.7%	10,556	34.3%	89,181	27.6%
2	504,169	18.4%	56,685	21.1%	5,477	17.8%	53,703	16.6%
3	243,915	8.9%	29,201	10.9%	2,177	7.1%	24,735	7.6%
4	161,654	5.9%	20,250	7.5%	1,147	3.7%	14,714	4.5%
Obesity								
0	2,124,578	77.7%	183,653	68.4%	26,957	87.6%	263,847	81.5%
1	609,257	22.3%	84,953	31.6%	3,801	12.4%	59,759	18.5%
Sleep apnea								
0	2,356,105	86.2%	229,454	85.4%	28,270	91.9%	293,410	90.7%
1	377,730	13.8%	39,152	14.6%	2,488	8.1%	30,196	9.3%

Table 2. Odds Ratios of Composite Major Complications, Mortality, and Prolonged Length of Stay between High Evidence-based Perioperative Practice Component Utilization *versus* None across Various Racial Groups

	EBPOP	Odds Ratio	Lower	Upper	Pr > |t|
Major complication					
Asian	Yes *vs.* no	0.71	0.61	0.82	< 0.001
Black	Yes *vs.* no	0.72	0.69	0.76	< 0.001
Other	Yes *vs.* no	0.72	0.68	0.76	< 0.001
White	Yes *vs.* no	0.65	0.63	0.66	< 0.001
Overall	Yes *vs.* no	0.70	0.67	0.73	< 0.001
Mortality					
Asian	Yes *vs.* no	0.219	0.079	0.61	0.034
Black	Yes *vs.* no	0.386	0.286	0.52	< 0.001
Other	Yes *vs.* no	0.340	0.236	0.49	< 0.001
White	Yes *vs.* no	0.293	0.262	0.327	< 0.001
Overall	Yes *vs.* no	0.303	0.228	0.40	< 0.001
Prolonged length of stay					
Asian	Yes *vs.* no	0.49	0.46	0.52	< 0.001
Black	Yes *vs.* no	0.64	0.63	0.66	< 0.001
Other	Yes *vs.* no	0.62	0.61	0.64	< 0.001
White	Yes *vs.* no	0.62	0.61	0.62	< 0.001
Overall	Yes *vs.* no	0.59	0.58	0.60	< 0.001

"Other" race included any patient who was not categorized as an Asian patient, Black patient, or White patient per Premier Healthcare (Premier Healthcare Solutions, Inc., USA).
EBPOP, evidence-based perioperative practice, Pr > |t|, probability of observing any value equal or larger than t.

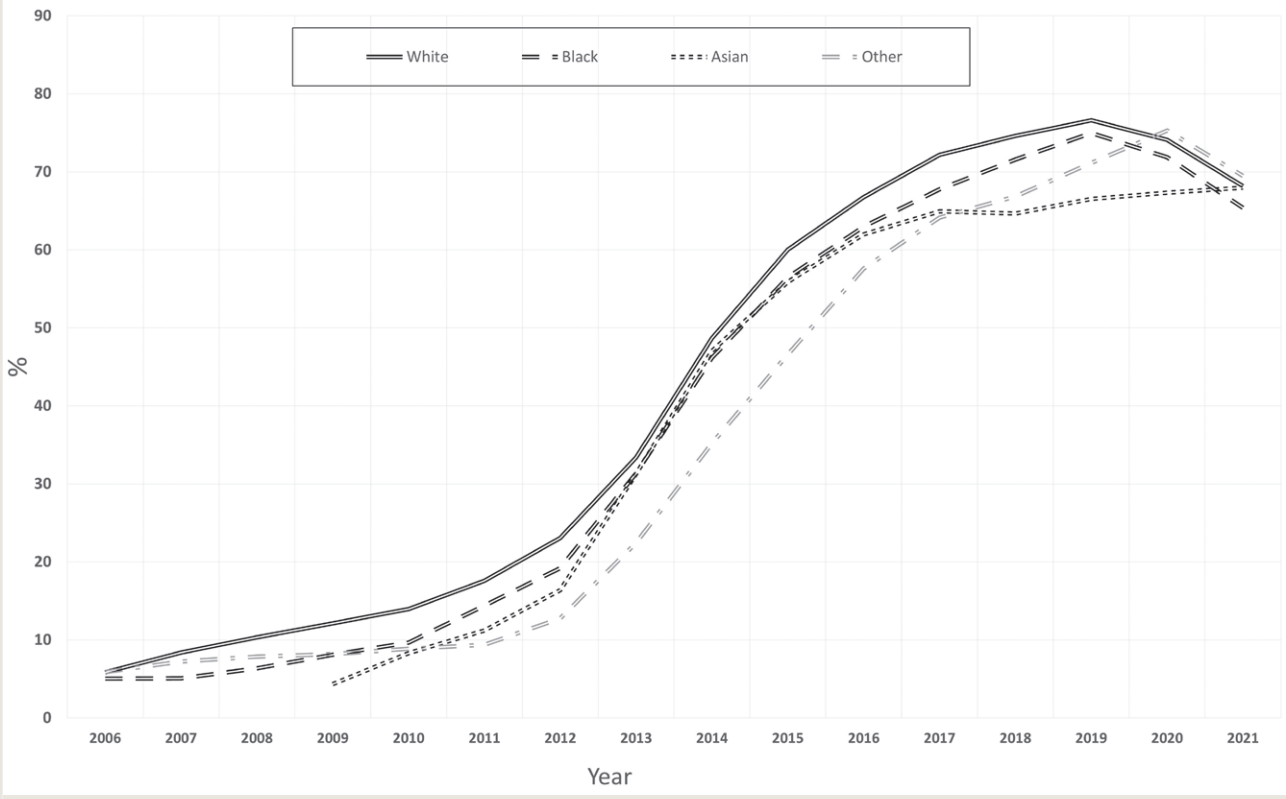

Fig. 1. Trend of high evidence-based perioperative practice component utilization over time by racial groups.

significance in the adjusted analysis (odds ratio, 1.01; 95% CI, 0.98 to 1.04). There were no differences between the Asian and White patients in regards to all studied outcomes, except for prolonged length of stay. However, such differences were erased after high evidence-based perioperative practice utilization (table 4).

Table 3. Racial Disparity Effect on Outcome with the Full Model and without Intersection

	Major Complication		Mortality		Prolonged Length of Stay	
	Odds Ratio (95% CI)	*P* Value	Odds Ratio (95% CI)	*P* Value	Odds Ratio (95% CI)	*P* Value
Asian	0.96 (0.90–1.04)	0.333	1.12 (0.73–1.71)	0.595	1.12 (1.08–1.16)	< 0.001
Black	1.50 (1.46–1.53)	< 0.001	1.39 (1.21–1.60)	< 0.001	1.41 (1.39–1.42)	< 0.001
Other	1.06 (1.04–1.09)	<0.001	1.19 (1.04–1.36)	0.013	1.13 (1.12–1.14)	< 0.001

All comparisons were against the White group of patients. The model included no intersection term and controlled for high evidence-based perioperative practice use. "Other" race included any patient that was not categorized as an Asian patient, Black patient, or White patient per Premier Healthcare (Premier Healthcare Solutions, Inc., USA).

Table 4. Racial Disparity Effect on Outcomes of the Black Patient Group, Asian Patient Group, and Other Patient Group Compared to the White Patient Group

	Race	Odds Ratio	Lower	Upper	Pr > |t|
Major complication					
EBPOP, Yes	Asian	1.01	0.90	1.13	0.844
EBPOP, Yes	Black	1.61	1.55	1.67	< 0.001
EBPOP, Yes	Other	1.15	1.09	1.20	< 0.001
EBPOP, No	Asian	0.93	0.84	1.03	0.149
EBPOP, No	Black	1.43	1.39	1.48	< 0.001
EBPOP, No	Other	1.03	1.00	1.07	0.056
Mortality					
EBPOP, Yes	Asian	0.89	0.35	2.24	0.804
EBPOP, Yes	Black	1.70	1.29	2.25	< 0.001
EBPOP, Yes	Other	1.34	0.94	1.92	0.103
EBPOP, No	Asian	1.19	0.74	1.90	0.475
EBPOP, No	Black	1.29	1.10	1.51	0.002
EBPOP, No	Other	1.16	1.00	1.34	0.051
Prolonged length of stay					
EBPOP, Yes	Asian	0.98	0.93	1.03	0.361
EBPOP, Yes	Black	1.45	1.42	1.48	< 0.001
EBPOP, Yes	Other	1.14	1.11	1.16	< 0.001
EBPOP, No	Asian	1.23	1.18	1.29	< 0.001
EBPOP, No	Black	1.38	1.37	1.40	< 0.001
EBPOP, No	Other	1.13	1.12	1.14	< 0.001

"Other" race included any patient that was not categorized as an Asian patient, Black patient, or White patient per Premier Healthcare (Premier Healthcare Solutions, Inc., USA).
EBPOP, evidence-based perioperative practice, Pr > |t|, probability of observing any value equal or larger than t.

Discussion

Our study of more than 3 million lower extremity joint arthroplasty patients indicated evidence-based perioperative practice utilization increased during the last decade across all racial groups. However, racial disparities still exist, with Black patients consistently receiving evidence-based perioperative practice less commonly than White patients. The Black patients exhibited higher odds of composite major complications, mortality, and prolonged length of stay compared to White patients, independent of whether they received evidence-based perioperative practice. Sensitivity analysis on the primary and secondary outcomes by sequentially dropping several components of the evidence-based perioperative practice drew the same conclusions.

Our study confirmed that racial disparities in low extremity total joint arthroplasty exist, with Black patients less commonly receiving interventions like evidence-based perioperative practice that might reduce them. Although the difference in implementation significantly improved during the last decade, there is still room to close the gap. Our finding is consistent with existing literature reporting that racial disparities do exist and that Black patients have a higher risk of morbidity and mortality across many surgical specialties. Historically, Black patients experienced worse outcome related to longer length of stay, higher readmission, and higher mortality after colorectal surgery,[1,13] cardiac surgery,[14] and oncologic surgery,[15] among others.

Evidence-based perioperative practice pathways focus on hastening recovery without compromising on surgical outcomes. Their main focus is on reducing stress and organ

dysfunction postoperatively by implementing evidence-based standardized care protocols. Evidence-based perioperative practice has been consistently shown to reduce lengths of stay and perioperative complications, while most of the literature is derived from colorectal surgery.[12,16,17] Our results also showed that evidence-based perioperative practice adherence after low extremity total joint arthroplasty was associated with significantly lower odds of composite major complications and mortality, and less prolonged length of stay across all Asian, Black, and White patient subgroups.

Racial disparities are attributable to multiple factors, and are associated with variations at the patient, provider, and healthcare system level. Evidence-based perioperative practice pathways are designed to reduce unwanted variations *via* standardization, and therefore have been proposed as a platform to minimize potential disparities in surgery. Encouragingly, Buchanan reported that racial disparities in perioperative management and outcomes in 606 elective congenital cardiac surgical patients under the Enhanced Recovery after Surgery pathway did not exist.[18] Wahl *et al.* also reported that an Enhanced Recovery after Surgery pathway was effective in eliminating racial disparity in postoperative length of stay after colorectal surgery without increase of complications and mortality.[19] Our study showed that evidence-based perioperative practice compliance improved length of stay without increasing complications among Asian patients.

However, this is not the case for Black patients. Our analysis showed that Black patients exhibited worse outcomes compared to the White patients, independent of whether they received evidence-based perioperative practice or not. While the former finding is not new, the latter indicates that more work is needed on effective strategies to reduce racial disparities. Indeed, Singh *et al.* studied Medicare data for the years 1991 to 2008 and reported persistent racial disparities in joint arthroplasty usage and readmission rates.[20] Likewise, Rudisill *et al.* conducted a systemic review and meta-analysis on racial and ethnic disparities of 63 published studies and concluded that Black patients exhibited higher incidences of mortality, complications, prolonged length of stay, and readmission.[5] However, none of these studies focused on strategies to decrease disparities and improve outcomes. Although both Black and White patients exhibited lower odds for composite major complication, mortality, and prolonged length of stay after receiving evidence-based perioperative practice protocols, the more standardized evidence-based perioperative practice model did not reduce all studied complications when comparing Black and White patients. More research is needed to determine the impact of these pathways on specific populations as why Black patients and White patients respond to evidence-based perioperative practice standardized intervention differently. More research is also indicated to identify any barriers to implementation that may disproportionately affect certain racial or ethnic groups.

It is worth noting that while race and ethnicity can play a role in healthcare disparities, the situation is complex and often involves many other factors, including socioeconomic status, access to health care, and so forth. Addressing racial disparities in health care therefore requires a multifaceted approach that takes into account the unique needs and experiences of each population, and it is important to have robust data and research to inform these efforts.

Our study has several limitations. First, this is a retrospective cohort study. Our study is limited by the quality of existing database and by the available details. Socioeconomic and geographic information could not be extracted for further analysis. Second, we defined evidence-based perioperative practice based on our group's previous publication.[10] Evidence-based perioperative practice pathways vary across different institutions at different times, and our approach is unlikely to appreciate these differences. Third, we defined high evidence-based perioperative practice use as above 80% with equal weight on each component. However, the benefits from different components on the outcome are likely unequal. Fourth, the component used in our definition of evidence-based perioperative practice is similar to that used in many Enhanced Recovery after Surgery pathways. Even though our study includes a period of time before many Enhanced Recovery after Surgery pathways were implemented in the United States, our definition of evidence-based perioperative practice includes many of the same categories (*e.g.*, multimodal analgesia, use of antiemetics, avoidance of drains) in many contemporary Enhanced Recovery after Surgery pathways. Last, there have been some changes in the Premier Healthcare dataset regarding how race and ethnicity were recorded during these years. "Asian" was not recorded as a separate race category before 2008, and Hispanic ethnicity was (erroneously) recorded as a race category in the dataset up until 2011, after which a separate ethnicity variable was created. Therefore, Hispanic ethnicity is to some extent represented in our "Other" race category. We do not believe this will significantly affect our main findings as it is likely to represent a bias toward the null (given the inclusion of patients in the "Other" group for which we expect a potential disparity in terms of evidence-based perioperative practice use and outcomes). Future studies are indicated. Furthermore, although Premier Healthcare does not perform additional external validation process on race, the fact that the Premier Healthcare dataset missed only 0.80% (27,561 of 3,449,941 patients) of race information is a positive indication of the quality of data registry from contributing hospitals.

Conclusions

Evidence-based perioperative practice utilization in lower extremity joint arthroplasty has been increasing during the last decade. However, racial disparities still exist, with Black patients consistently receiving lower evidence-based perioperative practice compliance than the White patients. The Black patients exhibited higher odds of composite major complications, mortality, and prolonged length of stay compared to the White patients, independent of whether they were receiving evidence-based perioperative practice or not.

Research Support

Support was provided solely from institutional and/or departmental sources.

Competing Interests

Dr. Memtsoudis has a U.S. patent application for a Multicatheter Infusion System (US-2017-0361063) and is the owner of SGM Consulting, LLC (Rumson, New Jersey). He is a partner in Parvizi Surgical Innovations, LLC (Philadelphia, Pennsylvania), and investor in HATH (New York, New York). None of the aforementioned relations influenced the conduct of the current study. The other authors declare no competing interests.

Correspondence

Address correspondence to Dr. Liu: Department of Anesthesiology, Hospital for Special Surgery, 535 East 70th Street, New York, New York 10021. liuji@hss.edu. This article may be accessed for personal use at no charge through the Journal Web site, www.anesthesiology.org.

Supplemental Digital Content

Analysis plan of racial disparity, https://links.lww.com/ALN/D298

References

1. Schneider EB, Haider A, Sheer AJ, Hambridge HL, Chang DC, Segal JB, Wu AW, Lidor AO: Differential association of race with treatment and outcomes in Medicare patients undergoing diverticulitis surgery. Arch Surg 2011; 146:1272–6
2. Cooper WA, Thourani VH, Guyton RA, Kilgo P, Lattouf OM, Chen EP, Morris CD, Vega JD, Vassiliades TA Jr, Puskas JD: Racial disparity persists after on-pump and off-pump coronary artery bypass grafting. Circulation 2009; 120:S59–64
3. Marques IC, Wahl TS, Chu DI: Enhanced Recovery after Surgery and surgical disparities. Surg Clin North Am 2018; 98:1223–32
4. Varadhan KK, Neal KR, Dejong CH, Fearon KC, Ljungqvist O, Lobo DN: The Enhanced Recovery after Surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: A meta-analysis of randomized controlled trials. Clin Nutr 2010; 29:434–40
5. Rudisill SS, Varady NH, Birir A, Goodman SM, Parks ML, Amen TB: Racial and ethnic disparities in total joint arthroplasty care: A contemporary systematic review and meta-analysis. J Arthroplasty 2023; 38:171–187.e18
6. Riepen DW, Gelvez D, Collett GA, Nakonezny P, Estrera KA, Huo MH: Standardized total knee arthroplasty pathway improves outcomes in minority patients. Am J Manag Care 2021; 27:e152–6
7. Zhong H, Poeran J, Liu J, Illescas A, Cozowicz C, Memtsoudis SG: Tranexamic acid and perioperative myocardial infarction: A retrospective database analysis. Br J Anaesth 2022; 129:e132–4
8. Flanagin A, Frey T, Christiansen SL; AMA Manual of Style Committee: Updated guidance on the reporting of race and ethnicity in medical and science journals. JAMA 2021; 326:621–7
9. Fiasconaro M, Wilson LA, Bekeris J, Liu J, Poeran J, Soffin EM, Memtsoudis SG: Enhanced recovery implementation and perioperative outcomes in posterior fusion patients. Spine (Phila Pa 1976) 2020; 45:E1039–46
10. Memtsoudis SG, Fiasconaro M, Soffin EM, Liu J, Wilson LA, Poeran J, Bekeris J, Kehlet H: Enhanced recovery after surgery components and perioperative outcomes: A nationwide observational study. Br J Anaesth 2020; 124:638–47
11. Cheng GHM, Tan GKY, Kamarudin MFB, Lee BWW, Mei YY, Tan KG: Steroids significantly decrease postoperative postural hypotension in total knee replacement. J Knee Surg 2023; 36:208–15
12. Ljungqvist O, Scott M, Fearon KC: Enhanced Recovery after Surgery: A review. JAMA Surg 2017; 152:292–8
13. Schneider EB, Haider AH, Hyder O, Efron JE, Lidor AO, Pawlik TM: Assessing short- and long-term outcomes among black vs white Medicare patients undergoing resection of colorectal cancer. Am J Surg 2013; 205:402–8
14. Singh TP, Almond C, Givertz MM, Piercey G, Gauvreau K: Improved survival in heart transplant recipients in the United States: Racial differences in era effect. Circ Heart Fail 2011; 4:153–60
15. Artinyan A, Mailey B, Sanchez-Luege N, Khalili J, Sun CL, Bhatia S, Wagman LD, Nissen N, Colquhoun SD, Kim J: Race, ethnicity, and socioeconomic status influence the survival of patients with hepatocellular carcinoma in the United States. Cancer 2010; 116:1367–77
16. Kehlet H: Fast-track colorectal surgery. Lancet 2008; 371:791–3
17. Lassen K, Soop M, Nygren J, Cox PB, Hendry PO, Spies C, von Meyenfeldt MF, Fearon KC, Revhaug A, Norderval S, Ljungqvist O, Lobo DN, Dejong CH; Enhanced Recovery after Surgery (ERAS) Group: Consensus review of optimal perioperative care in colorectal surgery: Enhanced Recovery after Surgery (ERAS) Group recommendations. Arch Surg 2009; 144:961–9
18. Buchanan R, Roy N, Parra MF, Staffa SJ, Brown ML, Nasr VG: Race and outcomes in patients with

congenital cardiac disease in an enhanced recovery program. J Cardiothorac Vasc Anesth 2022; 36:3603–9
19. Wahl TS, Goss LE, Morris MS, Gullick AA, Richman JS, Kennedy GD, Cannon JA, Vickers SM, Knight SJ, Simmons JW, Chu DI: Enhanced Recovery after Surgery (ERAS) eliminates racial disparities in postoperative length of stay after colorectal surgery. Ann Surg 2018; 268:1026–35
20. Singh JA, Lu X, Rosenthal GE, Ibrahim S, Cram P: Racial disparities in knee and hip total joint arthroplasty: An 18-year analysis of national Medicare data. Ann Rheum Dis 2014; 73:2107–15

Appendix 1. Identification of Evidence-based Perioperative Practice Components Using Billing Data and the Current Procedural Terminology

Component	Billing Code	Current Procedural Terminology Code
Multimodal Anesthesia		
Acetaminophen	Acetaminophen, Ofirmev	
Non-Steroidal Anti-Inflammatory	Diclofenac,	
	Diflunisal,	
	Etodolac,	
	Fenoprofen,	
	Flurbiprofen,	
	Ibuprofen,	
	Indomethacin,	
	Ketoprofen,	
	Ketorolac,	
	Meclofenamate,	
	Meloxicam,	
	Nabumetone,	
	Naproxen,	
	Oxaprozin,	
	Piroxicam,	
	Salicylate,	
	Salsalat,	
	Sulindac,	
	Sumatriptan/Naproxen,	
	Tolmetin	
Cyclooxygenase-2 Inhibitors	Celecoxib,	
	Rofecoxib,	
	Valdecoxib	
Gabapentin/Pregabalin	Gabapentin,	
	Pregabalin	
Ketamine	Ketamine	
Peripheral Nerve Block	Anes Crna Regional Flat Rate,	64415,
	Anes For Nerve Block/Inj Not Prone,	64416,
	Anes For Nerve Block/Inj Prone Pos,	64445,
	Anes Regional 1 Hr,	64446,
	Anes Regional 1 Hr 30 Min,	64447,
	Anes Regional 1st Hr,	64448,
	Anes Regional 2 Hr,	64449,
	Anes Regional 2 Hr 30 Min,	64450
	Anes Regional 3 Hr,	
	Anes Regional 3 Hr 30 Min,	
	Anes Regional 4 Hr,	
	Anes Regional Addl 30 Min,	
	Anes Regional Flat Rate,	
	Anes Regional Setup,	
	Er Inj Anes Paravertebral Multi,	
	Er Inj Anes Paravertebral Single,	
	Er Inj Anes Sciatic Single,	
	Inj Anes Femoral Nerve Cont Infusion By Catheter,	
	Inj Anes Femoral Nerve Single,	
	Inj Anes Ilioinguinal/Iliohypogastric Op,	
	Inj Anes Lumbar Or Thoracic Paravert Sympathetic),	
	Inj Anes Lumbar Plexus Cont Infusion By Catheter,	
	Inj Anes Paravertebr Multi,	
	Inj Anes Paravertebral Multi,	
	Inj Anes Paravertebral Multi Op,	
	Inj Anes Paravertebral Sing,	
	Inj Anes Paravertebral Single,	
	Inj Anes Paravertebral Single Op,	
	Inj Anes Sciatic Sing,	
	Inj Anes Sciatic Single,	
	Inj Anes Sciatic Single Op,	

(*Continued*)

Appendix 1. (Continued)

Component	Billing Code	Current Procedural Terminology Code
	Pf Anes For Nerve Block/Inj Not Prone,	
	Pf Anes For Nerve Block/Inj Prone Pos,	
	Pf Anes Knee/Popliteal Skin,	
	Pf Anes Regional Limb,	
	Pf Inj Anes Femoral Nerve Single,	
	Pf Inj Anes Paravertebral Multi,	
	Pf Inj Anes Paravertebral Single,	
	Pf Inj Anes Sciatic Single,	
	Tray Anes Nerve Block,	
	Tray Region/Block Anes,	
	Er Inj Anes Lumbar Plexus Cont Infusion By Cath,	
	Inj Anes Sciatic Cont Infusion By Catheter,	
	Pf Inj Anes Femoral Nerve Cont Infusion By Cath,	
	Pf Inj Anes Lumbar Plexus Cont Infusion By Cath	
	Pf Inj Anes Sciatic Cont Infusion By Catheter	
Duramorph	Morphine, Duramorph	
Tranexamic Acid	Tranexamic Acid	
Antiemetics	Aprepitant,	
	Dexameth,	
	Dolasetron,	
	Droperidol,	
	Ephedrine,	
	Granisetron,	
	Haloperidol,	
	Methylpred,	
	Ondansetron,	
	Palonosetron,	
	Perphenazine,	
	Promethazine	
Steroids	Betameth,	
	Budesoni,	
	Cortison,	
	Dexameth,	
	Hydrocor,	
	Methylpr,	
	Predniso,	
	Triamcin	
Physical Therapy	Pt Per Day	97110,
	Pt Exercise Therapeutic 15 Min	97112,
	Pt Exercise Back 15 Min	97113,
	Pt Exercise Therapeutic 30 Min	97116,
	Pt Exercise Therapeutic 20 Min	97124,
	Pt Exercise Isokinetic 30 Min	97140,
	Pt Exercise Kinetic 30 Min	97150,
	Pt Exercise Isokinetic 15 Min	97530,
	Pt Exercise Range Of Motion 15 Min	97140
	Pt Exercise Kinetic 15 Min	
	Pt Exercise Cardiac 15 Min	
	Pt Mobility Training 15 Min	
	Pt Aquatic Therapy/Exercise 15 Min	
	Pt Aquatic Therapy/Exercise 30 Min	
	Pt Gait Training 15 Min	
	Pt Gait Training Addl Person 15 Min	
	Pt Gait Training 20 Min	
	Pt Gait Training 30 Min	
	Pt Orthotic Managment/Training Init 15 Min 97760	
	*Pt Orthotic Training 15 Min 97760	
	Pt Orthotic Management/Training Init 30 Min 97760	
	Pt Prosthetic Training Init 15 Min 97761	
	Pt Prosthetic Training 30 Min 97761	
	Pt Therapeutic Activity Direct Funct Perf 15 Min	
	Pt Wheelchair Training 15 Min	
	Pt Transfer Training 15 Min 97139	
	Pt Transfer Training 30 Min 97139	
	Pt Orthotic/Prosthetic Manage/Training Subs 15min	
	Pt Cognitive Training 15 Min 97532	
	Pt/Ot Exercise Group Pool 15 Min	
	*Pt Orthotic Fitting 15 Min 97760	
	Pt/Ot Therapy Group 15 Min	
	Pt/Ot Therapy Group 30 Min	
	Pt/Ot Therapy Group 1 Hr	

(*Continued*)

Appendix 1. (Continued)

Component	Billing Code	Current Procedural Terminology Code
Urinary Catheters	Catheter Foley	
Patient-Controlled Analgesia	Fentanyl, Sublimaze PCA, Hydromorphone, Dilaudid PCA, Meperidine, Demerol PCA, Morphine PCA	
Wound Drains	*Drain Hemovac Evacuator Only	
	Adapter Drain Hemovac	
	Bag Drain Hemovac	
	Bag Wound Drainage	
	Connector Drain Hemovac	
	Connector Y Drain Hemovac	
	Drain Blake	
	Drain Blake Flat 10m	
	Drain Blake Flat 7mm	
	Drain Blake Fluted	
	Drain Davol Round Suction	
	Drain Hemovac Autotransfusion	
	Drain Hemovac Evacuator	
	Drain Hemovac Tubing	
	Drain Hemovac Tubing 1/4	
	Drain Hemovac Tubing Lg	
	Drain Hemovac Tubing Med	
	Drain Hemovac Tubing Sm	
	Drain Hemovac Wound	
	Drain Jackson Pratt 10mm	
	Drain Jackson Pratt 10mm 3/4	
	Drain Jackson Pratt 10mm 3/4 Perf	
	Drain Jackson Pratt 10mm Flat	
	Drain Jackson Pratt 7mm	
	Drain Jackson Pratt 7mm 3/4	
	Drain Jackson Pratt 7mm 3/4 Perf	
	Drain Jackson Pratt 7mm Flat	
	Drain Jackson Pratt Flat	
	Drain Jackson Pratt Reservoir	
	Drain Jackson Pratt Round	
	Drain Jackson Pratt Snyder	
	Drain Jvac Flat	
	Drain Jvac Reservoir	
	Drain Jvac Round	
	Drain Ortho Flat	
	Drain Ortho Round	
	Drain Wound Lg Soft	
	Drain Wound-Evac 400ml Kit	
	Drain Wound-Evac 800ml Kit	
	Drain Wound-Evac Evacuator	
	Drain Zimmer	
	Kit Drain Hemovac	
	Kit Drain Hemovac Lg	
	Kit Drain Hemovac Med	
	Kit Drain Jackson Pratt	
	Kit Sump Drainage	
	Kit Wound Drain	
	Kit Wound Drain 1/8	
	Needle Hemovac Drain	
	Set Drain Wound	
	Set Drainage	
	Suction Drain Wound	
	Wound Drainage System Constavac	

Appendix 2. Evidence-based Perioperative Practice Components Use by Race

	Race								
	Asian		Black		Other		White		*P* value
	N	(%)	N	(%)	N	(%)	N	(%)	
Used multimodal analgesia	28,832	93.7	235,974	87.9	266,459	82.3	2,430,200	88.9	< 0.001
Peripheral nerve block	6,477	21.1	49,185	18.3	45,648	14.1	498,832	18.2	< 0.001
Duramorph	2,317	7.5	15,566	5.8	27,595	8.5	204,442	7.5	< 0.001
Gabapentin/pregabalin	12,134	39.4	97,382	36.3	83,130	25.7	927,797	33.9	< 0.001
Ketamine	2,763	9.0	24,145	9.0	22,609	7.0	208,476	7.6	< 0.001
Nsaid	17,337	56.4	141,267	52.6	146,807	45.4	1,485,032	54.3	< 0.001
Cox2	13,331	43.3	113,636	42.3	115,988	35.8	1,152,929	42.2	< 0.001
Acetaminophen	23,124	75.2	160,806	59.9	168,543	52.1	1,634,061	59.8	< 0.001
Tranexamic acid	18,067	58.7	128,062	47.7	86,745	26.8	1,293,668	47.3	< 0.001
Antiemetics	26,762	87.0	221,872	82.6	256,710	79.3	2,329,855	85.2	< 0.001
Steroids	15,620	50.8	111,216	41.4	106,295	32.8	1,253,715	45.9	< 0.001
Physical therapy	26,844	87.3	237,033	88.2	257,629	79.6	2,472,421	90.4	< 0.001
No patient controlled analgesia	28,762	93.5	244,204	90.9	274,601	84.9	2,459,911	90.0	< 0.001
No of urinary catheters	29,770	96.8	258,265	96.2	297,283	91.9	2,625,441	96.0	< 0.001
No wound drains	22,919	74.5	222,812	83.0	248,096	76.7	2,283,110	83.5	< 0.001

"Other" race included any patient who was not categorized as an Asian patient, Black patient, or White patient per Premier Healthcare (Premier Healthcare Solutions, Inc., USA).

Appendix 3. Identify Complications with International Classification of Diseases, Ninth and Tenth Revisions

	International Classification of Diseases, Ninth	International Classification of Diseases, Tenth
Respiratory failure	518.5, 518.52, 518.51, 518.53, 518.82, 786.09, 799.02, 799.01, 518.81, 518.84	J95.2, J80, R09.02, R09.01, J95.821, J96.00, J96.01, J96.02, J96.90, J96.91, J96.92, J96.20, J96.21, J96.22, J95.822
Acute renal failure	584, N17	E879.1, V45.11, Z99.2
Delirium	293.0,293.1, 292.81, 293.9, 780.09, 780.97	R40.4, R40.1, F05, F06, R41.82, F19.921, F13.121, F13.921
Myocardial infarction	410.XX	I21.XX
Pulmonary embolism	415.1X	I26.9, T81.718A, T81.72XA, T82.818A
Stroke	433.01, 433.11, 433.21, 433.31, 433.81, 433.91, 434.01, 434.11, 434.91, 997.02	I97.8, I63.XX

Appendix 4. Sensitivity Analysis on Outcomes

Primary outcome: Black patients have lower odds of complying to evidence-based perioperative practice

Dropped Tranexamic acid as a component			
Outcome = high evidence-based perioperative practice			
Ref = White patients	Estimate	95% Confidence Limits	P value
Black patients	0.910	0.900 0.919	< 0.001
Dropped Steroid as a component			
Outcome = high evidence-based perioperative practice			
Ref = White patients	Estimate	95% Confidence Limits	P value
Black patients	0.936	0.925 0.947	< 0.001
Dropped PCA as a component			
Outcome = high evidence-based perioperative practice			
Ref = White patients	Estimate	95% Confidence Limits	P value
Black patients	0.910	0.900 0.920	< 0.001

Secondary outcome: Despite evidence-based perioperative practice use, racial disparities in outcomes persist, especially when comparing Black patients to White patients

Dropped Tranexamic acid as a component

Major Complications

Simple Effect Level	RACER	_RACER	Odds Ratio	Lower Odds Ratio	Upper Odds Ratio	Pr > |t|
count1_bi 1	Black	White	1.555	1.509	1.603	< 0.0001
count1_bi 0	Black	White	1.428	1.379	1.479	< 0.0001

Mortality

Simple Effect Level	RACER	_RACER	Odds Ratio	Lower Odds Ratio	Upper Odds Ratio	Pr > |t|
count1_bi 1	Black	White	1.51	1.207	1.89	0.0003
count1_bi 0	Black	White	1.248	1.048	1.486	0.0128

Prolonged LOS

Simple Effect Level	RACER	_RACER	Odds Ratio	Lower Odds Ratio	Upper Odds Ratio	Pr > |t|
count1_bi 1	Black	White	1.429	1.408	1.451	< 0.0001
count1_bi 0	Black	White	1.37	1.348	1.392	< 0.0001

Dropped Steroid as a component

Major Complications

Simple Effect Level	RACER	_RACER	Odds Ratio	Lower Odds Ratio	Upper Odds Ratio	Pr > |t|
count2_bi 1	Black	White	1.556	1.51	1.603	< 0.0001
count2_bi 0	Black	White	1.426	1.375	1.478	< 0.0001

Mortality

Simple Effect Level	RACER	_RACER	Odds Ratio	Lower Odds Ratio	Upper Odds Ratio	Pr > |t|
count2_bi 1	Black	White	1.589	1.278	1.977	< 0.0001
count2_bi 0	Black	White	1.23	1.03	1.469	0.0221

Prolonged LOS

Simple Effect Level	RACER	_RACER	Odds Ratio	Lower Odds Ratio	Upper Odds Ratio	Pr > |t|
count2_bi 1	Black	White	1.443	1.421	1.465	< 0.0001
count2_bi 0	Black	White	1.366	1.345	1.389	< 0.0001

Dropped PCA as a component

Major Complications

Simple Effect Level	RACER	_RACER	Odds Ratio	Lower Odds Ratio	Upper Odds Ratio	Pr > |t|
count3_bi 1	Black	White	1.60	1.55	1.66	< 0.0001
count3_bi 0	Black	White	1.43	1.39	1.47	< 0.0001

Mortality

Simple Effect Level	RACER	_RACER	Odds Ratio	Lower Odds Ratio	Upper Odds Ratio	Pr > |t|
count3_bi 1	Black	White	1.72	1.31	2.25	< 0.0001
count3_bi 0	Black	White	1.27	1.08	1.49	0.003

Prolonged LOS

Simple Effect Level	RACER	_RACER	Odds Ratio	Lower Odds Ratio	Upper Odds Ratio	Pr > |t|
count3_bi 1	Black	White	1.44	1.41	1.47	< 0.0001
count3_bi 0	Black	White	1.39	1.37	1.41	< 0.0001

Pr > |t|, probability of observing any value equal or larger than t.