

# Association Among Individual Race, Hospital Racial Composition, and Access to Minimally Invasive Hysterectomy for Patients With Uterine Leiomyomas

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**OBJECTIVE:** To assess the relative associations of individual race and hospital racial composition on the likelihood of undergoing minimally invasive hysterectomy for the treatment of uterine leiomyomas in New York State.

**METHODS:** We performed a retrospective cohort study that used the New York SPARCS (Statewide Planning and Research Cooperative System) database to identify women with uterine leiomyomas who underwent hysterectomy from 2000 to 2018. Hospitals were grouped by racial composition into quartiles based on the proportion of non-Hispanic Black (Black) patients, with quartile 1 corresponding to the lowest proportion of Black patients and quartile 4 corresponding to the greatest proportion of Black patients. Surgical route was characterized as minimally invasive (laparoscopic, vaginal, or

robot-assisted) or abdominal hysterectomy. The contributions of individual race and hospital racial composition on route of hysterectomy were assessed with a series of logistic regression models accounting for patient and hospital characteristics.

**RESULTS:** A total of 259,161 women with leiomyomas who underwent hysterectomies at 215 hospitals were identified. The rate of minimally invasive hysterectomy increased from 20.2% in 2000 to 65.7% in 2018. From 2000 to 2009, 29.6% of White patients underwent minimally invasive hysterectomy compared with 12.3% of Black women ( $P<.001$ ). Minimally invasive hysterectomy was performed in 34.4% of patients in hospitals that served the lowest percentage of Black patients, compared with 15.9% in centers serving the highest percentage of Black patients ( $P<.001$ ). Similar trends were noted for the 2010–2018 time period. In a series of models, both individual race (odds ratio [OR] 0.52; 95% CI, 0.48–0.56) and hospital racial quartile (OR 0.43; 95% CI, 0.32–0.58) remained associated with performance of minimally invasive hysterectomy.

**CONCLUSION:** Black women and women who receive care at hospitals that serve a greater proportion of Black patients are less likely to receive minimally invasive surgery when undergoing definitive surgical management for uterine leiomyomas. These disparities are worsening.

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Leiomyomas are benign tumors of the uterine smooth muscle that will affect most women before the end of their reproductive years. By age 50 years, the cumulative incidence of uterine leiomyomas for all women is estimated between 70% and 80%.<sup>1</sup> The dis-

tribution, however, is not equal. Compared with their non-Hispanic White (White) counterparts, non-Hispanic Black (Black) women are two to three times more likely to have uterine leiomyomas, develop them on average 5 years earlier, and are more likely to have a greater number and larger leiomyomas at the time of diagnosis, with continued high rates of growth until menopause.<sup>2</sup>

Despite an increasing number of nonsurgical management options, hysterectomy remains the most frequently performed major gynecologic surgery in the United States, with approximately 400,000 procedures performed per year and an estimated half of all hysterectomies performed for the treatment of leiomyomas.<sup>3,4</sup> Prior work has consistently shown that, compared with White women, Black women are more likely to undergo hysterectomy and are less likely to have a minimally invasive surgery (including laparoscopic, robot-assisted, and vaginal hysterectomy).<sup>2,3,5–7</sup> This has been shown to persist even after adjusting for uterine size, body mass index (BMI, calculated as weight in kilograms divided by height in meters squared), and prior abdominopelvic surgery.<sup>8</sup> Importantly, minimally invasive hysterectomy is recommended over abdominal (open) hysterectomy given its association with fewer complications, shorter hospital stays, quicker recovery, and decreased health care costs.<sup>3</sup>

There is a growing body of literature examining the effect of site of care on racial disparities and evidence that hospitals that predominately serve historically marginalized people are associated with a range of worse outcomes.<sup>9–14</sup> Treatment at hospitals that care for a larger proportion of underserved racial and ethnic minoritized groups is associated with higher rates of readmission after major surgery, increased length of stay and mortality in intensive care units, and lower odds of receiving palliative care on oncology floors.<sup>10,12,13</sup> However, the nuanced role of hospital characteristics in relation to the availability and utilization of minimally invasive surgery for uterine leiomyomas remains less understood. Our study aims to bridge this knowledge gap by examining a comprehensive 18-year span of inpatient and outpatient data to investigate the interplay between patient race and hospital racial composition in the context of minimally invasive hysterectomy. Specifically, using inpatient and outpatient data, we examined the importance of patient race and the racial composition of the hospital in which a patient was treated. We hypothesize that segregation of care—by geographic segregation, insurance practices, and referral patterns—contributes to the racial disparities observed

in the surgical management of uterine leiomyomas. The objective of our study was to further explore the Black–White disparity in rates of minimally invasive hysterectomy among women with uterine leiomyomas.

## METHODS

We performed a retrospective cohort study and selected women diagnosed with uterine leiomyomas who underwent hysterectomy between 2000 and 2018 and were included in the New York SPARCS (Statewide Planning and Research Cooperative System) database. The SPARCS database comprehensively captures hospital discharges, inpatient and ambulatory surgeries, and emergency department admissions in all facilities in New York State. Information related to patient characteristics, services, charges, diagnoses, as well as physician and facility characteristics are included in SPARCS.<sup>15</sup> All data were deidentified, and the study was determined to be non-human subjects research by the Columbia University IRB.

Patients aged 18 years or older who underwent hysterectomy and had an International Classification of Diseases Ninth (ICD-9) or Tenth (ICD-10) Revision diagnostic code for uterine leiomyomas were included in the analysis (Appendix 1, available online at <http://links.lww.com/AOG/D735>). All routes of hysterectomy, including abdominal, laparoscopic, vaginal, and robot-assisted, were included. The procedures were further classified as either abdominal or minimally invasive (laparoscopic, vaginal, or robot-assisted) (Appendix 1, <http://links.lww.com/AOG/D735>). Women were excluded from the analytical cohort if they were not New York State residents, had concurrent gynecologic malignancy identified by ICD codes, had missing values for race or ethnicity variables, were younger than age 18 years, were treated at a facility with fewer than 10 patients, or had missing insurance status.

We measured individual patient race and the racial composition of the hospital in which a patient received care. The *hospital racial composition* was defined as the percentage of non-Hispanic Black patients who underwent hysterectomy for leiomyomas divided by the total number of patients who underwent hysterectomy for leiomyomas in a given center. Hospital racial composition was categorized into quartiles: 0–4.6%, 4.7–16.3%, 16.4–34.1%, 34.2–100% for 2000–2009 and 0–5.3%, 5.4–17.0%, 17.1–32.2%, 32.3–100% for 2010–2018.

Patient-level demographic characteristics were examined and included New York City residency

status, age at time of procedure (18–39, 40–49, 50–59, 60–69, 70 years or older), insurance status (commercial, Medicare, uninsured or Medicaid, other), year of surgery (2000–2018), race and ethnicity (Hispanic, non-Hispanic White, non-Hispanic Black, other), Elixhauser Comorbidity score (0, 1, 2, 3 or higher), and concurrent gynecologic diagnoses (endometrial hyperplasia, abnormal uterine bleeding, pelvic organ prolapse, other menstrual disorders). The *annualized hospital hysterectomy volume* was calculated as the total cases a hospital contributed divided by the years in which the hospital contributed at least one case. Annualized hospital volume was categorized into quartiles: 0–19.0; 19.1–45.8; 45.9–104.3; and 104.4–415.9 for 2000–2009 and 0–14.9; 15.0–43.6; 43.7–104.3; and 104.4–348.4 for 2010–2018.

Given the increased use of minimally invasive surgery in the later years of the study, we stratified the cohort into two periods: early (2000–2009) and late (2010–2018). The early time period encompasses the period in which minimally invasive hysterectomy was diffusing into clinical practice, and the late period represents the time period in which the procedure was more readily accepted. The rates of receiving minimally invasive surgery within the early and late period cohorts are reported descriptively for individual patient race and hospital racial composition quartile.

To evaluate the associations between the probability of receiving a minimally invasive hysterectomy and patients' individual race and hospital racial composition, three sets of logistic regression models were developed for the early (2000–2009) and late periods (2010–2018), respectively. The first set of models included individual patient race, but not hospital racial composition quartile; the second set included hospital racial composition quartile, but not individual patient race; the third set included both individual patient race and hospital racial composition quartile. All of the models additionally adjusted for New York City residency status, age at time of the procedure, patient insurance status, year of diagnosis, Elixhauser Comorbidity score, and presence of concurrent gynecologic diagnoses. The results are reported as odds ratios (ORs) with 95% CIs.

Within these models, the relative importance of each variable was assessed using the corrected Akaike information criterion. Single variable omissions were made from the logistic regression models that contained all other variables for both the early and late period groups, and the corrected Akaike information criterion was calculated for variance of each model. The variables were then ranked by corrected Akaike

information criterion score, with a higher score indicating a greater significance of the omitted variable.

The risk difference in receiving minimally invasive surgery by hospital racial quartile was analyzed in a restricted cohort of non-Hispanic White and Black patients using logistic regression models for the early and late periods that included individual patient race, New York City residency status, age at time of procedure, patient insurance status, year of diagnosis, Elixhauser Comorbidity score, and presence of concurrent gynecologic diagnoses. The adjusted risk differences in receiving minimally invasive surgery between non-Hispanic White patients and non-Hispanic Black patients were calculated and reported by hospital racial quartile.<sup>16</sup>

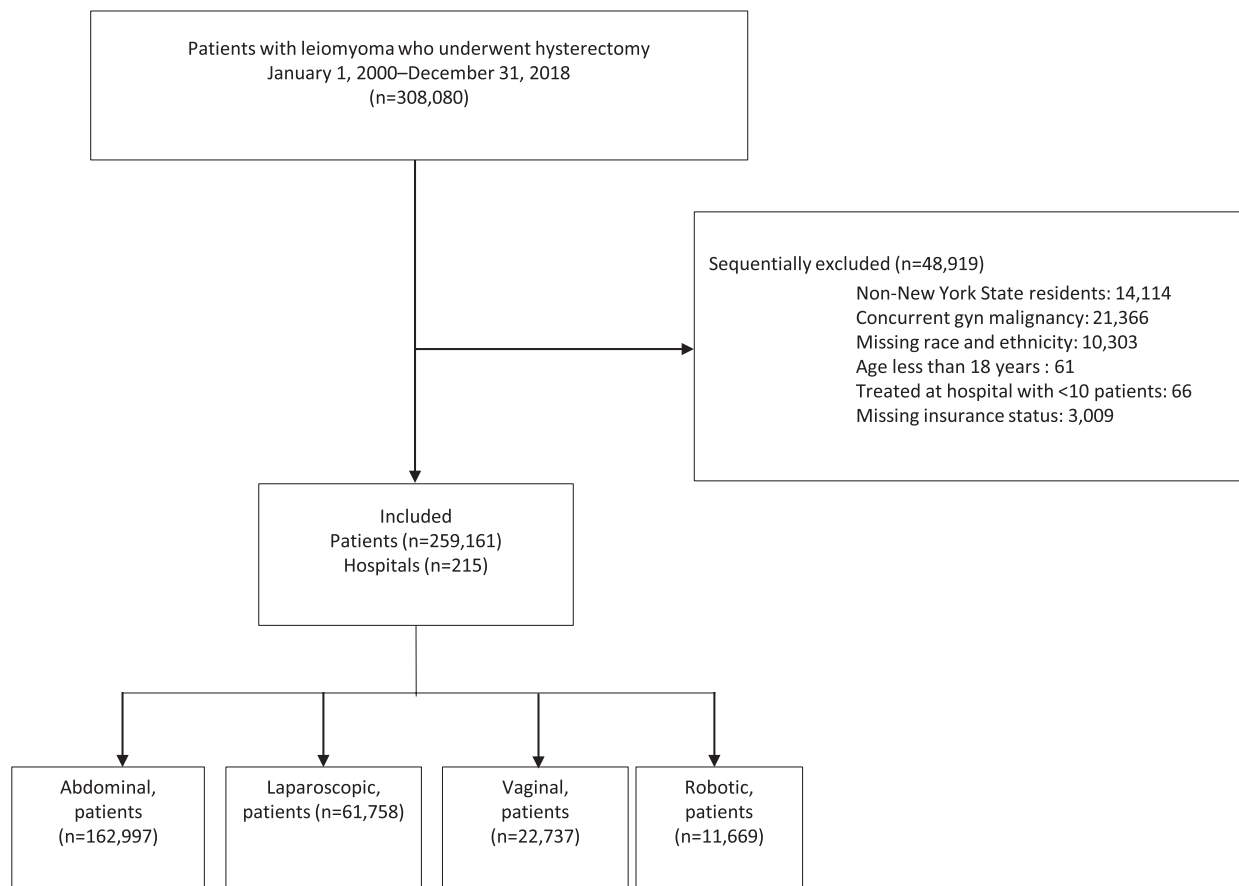
All statistical tests were two sided.  $P < .05$  was considered statistically significant. All analyses were performed with R 4.2.2.

## RESULTS

A total of 259,161 patients cared for at 215 unique hospitals in New York State were identified (Fig. 1). The rate of minimally invasive hysterectomy increased over the study period, from 20.2% in 2000 to 65.7% in 2018 (Fig. 2). The rate of laparoscopic hysterectomy increased from 13.1% in 2000 to 37.8% in 2018; the use of robot-assisted hysterectomy rose from 0.3% to 9.9% during the same time period. In contrast, the rate of vaginal hysterectomy declined from 10.4% in 2000 to 6.7% in 2018. The use of minimally invasive surgery increased over time for all racial subgroups (Fig. 3).

During the 2000–2009 timeframe, minimally invasive hysterectomy was more common among older women, Medicare recipients, those without comorbidities, patients with concomitant pelvic organ prolapse, and residents outside of New York City ( $P < .001$  for all) (Table 1). The highest volume hospitals performed minimally invasive hysterectomy in 24.9% of the procedures, compared with 23.7% in the lowest volume hospitals. Among White patients, 29.6% underwent minimally invasive hysterectomy compared with 12.3% of Black women ( $P < .001$ ). Minimally invasive hysterectomy was performed in 34.4% of patients in hospitals that served the lowest percent of Black patients compared with 15.9% in those centers serving the highest percentage of Black patients ( $P < .001$ ).

These trends were largely similar in those treated from 2010 to 2018. During this period, 67.4% of White patients underwent minimally invasive hysterectomy compared with 35.7% of Black patients



**Fig. 1.** Cohort selection: patients who underwent hysterectomy for treatment of uterine leiomyomas in New York State between 2000 and 2018, captured by the New York SPARCS (Statewide Planning and Research Cooperative System) database.

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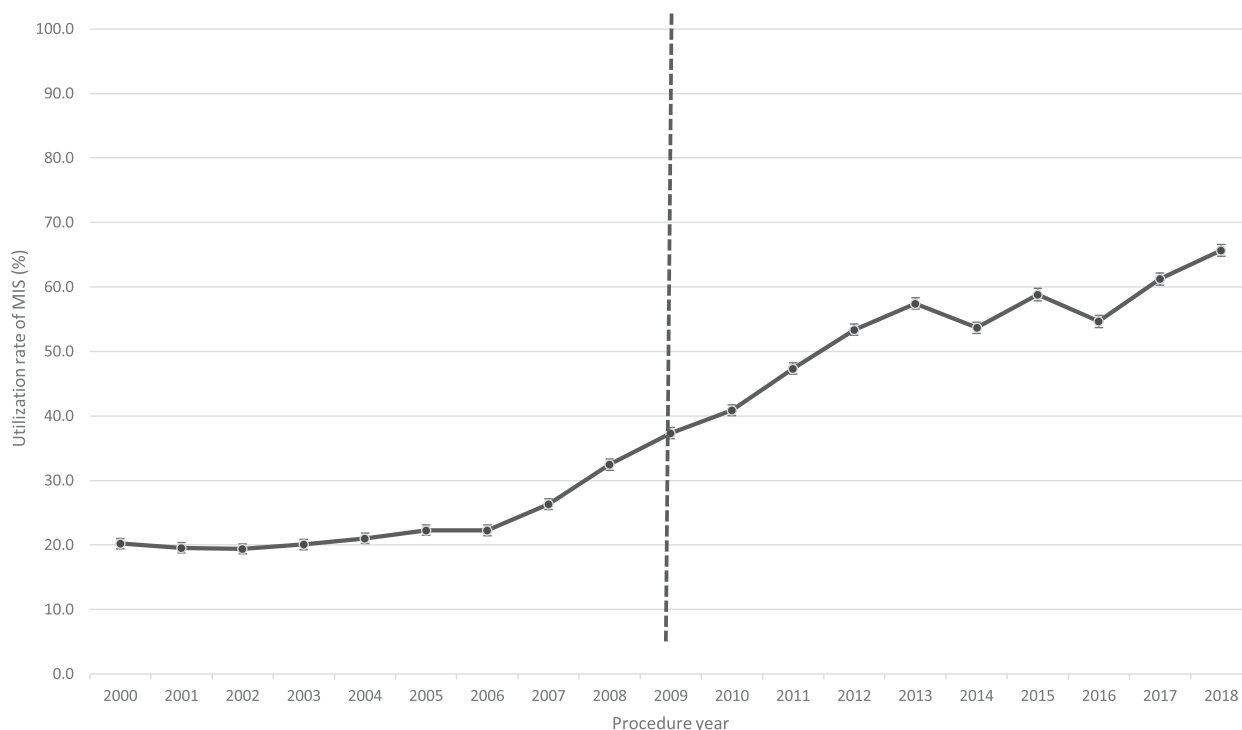
( $P<.001$ ). Hospitals that cared for the lowest percentage of Black patients performed minimally invasive hysterectomy in 68.0% of cases, compared with 34.9% of procedures in hospitals that served the highest percentage of Black patients ( $P<.001$ ).

In a multivariable model that included patient race and other clinical and demographic characteristics for patients treated in 2000 to 2009, Black women were 57% less likely to undergo minimally invasive hysterectomy than White patients (OR 0.43; 95% CI, 0.39–0.48) (Appendix 1 [<http://links.lww.com/AOG/D735>] and Table 2). When the hospital racial quartile was included instead of individual race, patients at hospitals that served the highest concentration of Black women were 69% less likely to undergo minimally invasive hysterectomy than those at hospitals that served the lowest percentage of Black patients (OR 0.31; 95% CI, 0.23–0.42). When both individual race and hospital racial quartile were included in the model, the effect size was attenuated,

but both individual race (OR 0.52; 95% CI, 0.48–0.56) and the hospital racial quartile (OR 0.43; 95% CI, 0.32–0.58) remained associated with performance of minimally invasive hysterectomy. These trends were similar in the cohort treated from 2010 to 2018.

Accounting for all of the clinical and demographic variables, a concurrent diagnosis of pelvic organ prolapse and year of surgery were the first and second most important predictors of performance of minimally invasive surgery for both the early and late time periods (Table 3). In the 2000–2009 cohort, hospital racial quartile followed by individual patient race were the third- and fourth-most important predictors of minimally invasive hysterectomy. In the 2010–2018 cohort, individual patient race was slightly more important than the hospital racial quartile.

Within each hospital racial quartile, there was a difference in the rates of minimally invasive hysterectomy between White and Black patients; however, the magnitude of this difference decreased with



**Fig. 2.** Rate of minimally invasive surgery (MIS) for all patients undergoing hysterectomy as treatment for uterine leiomyomas in New York State from 2000 to 2018.

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increasing hospital concentration of Black patients (Table 4). For example, from 2000 to 2009, the adjusted risk difference in rate of minimally invasive hysterectomy between White and Black patients was 10.7% (95% CI, 9.3–12.1%) for hospitals with the lowest concentration of Black patients, compared with 4.6% (95% CI, 2.3–6.9%) at hospitals with the highest concentration of Black patients. The trends were similar in the 2010–2018 timeframe, although the magnitude of the differential was greater across all four hospital racial quartiles. The adjusted risk difference in hospitals with the lowest concentration of Black patients was 28.8% (95% CI, 27.3–30.3%); the differential was 11.0% (95% CI, 8.4–13.6%) at hospitals with the highest concentration of Black patients.

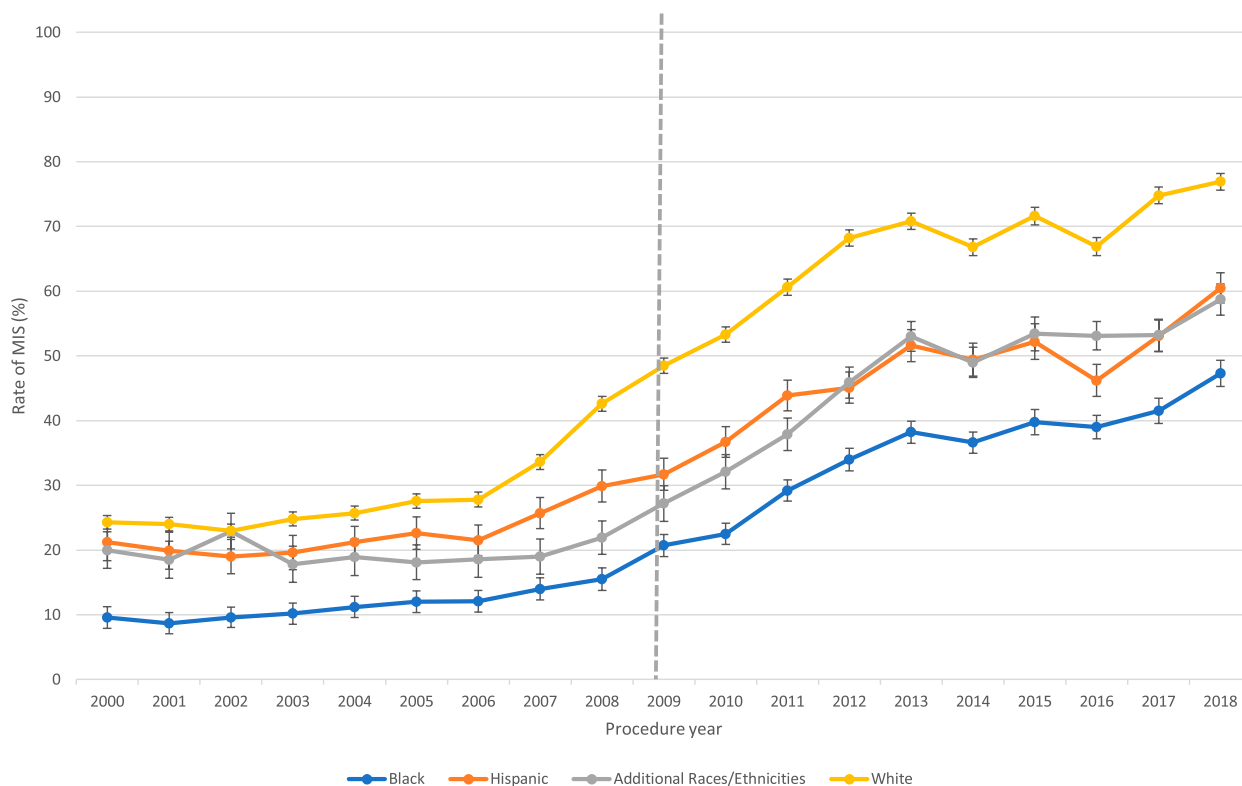
## DISCUSSION

Our study demonstrates the well-described Black–White disparity in the surgical approach to hysterectomy for the treatment of uterine leiomyomas. Our data show that not only are Black women less likely than their White counterparts to undergo minimally invasive hysterectomy, but also that the rate of minimally invasive hysterectomy decreases in hospitals with a higher concentration of Black patients. Importantly, we show that these dis-

parities have increased over time and are more pronounced at hospitals that serve a larger concentration of White patients.

Our data suggest that both individual race and the racial composition of the treating hospital are associated with the likelihood of performance of minimally invasive hysterectomy. This is in accord with a multistate retrospective study of a similar patient population, which found that hospitals that served a higher proportion of Black patients perform more abdominal hysterectomies and fewer vaginal hysterectomies across all races, and that Black patients are more likely to undergo minimally invasive surgery at hospitals serving almost exclusively non-Black patients as compared with at hospitals that disproportionately care for Black patients.<sup>17</sup> In our analysis, the disparity in minimally invasive hysterectomy for Black women, compared with White, women was two to three times more pronounced at hospitals that served mostly non-Black patients, compared with hospitals that care for a more racially diverse population.

Concerningly, we demonstrated that disparities in access to minimally invasive hysterectomy widened over time. In 2009, the American College of Obstetricians and Gynecologists suggested that minimally invasive hysterectomy was appropriate “whenever



**Fig. 3.** Rate of minimally invasive surgery (MIS) by patient race for women undergoing hysterectomy as treatment for uterine leiomyomas in New York State from 2000 to 2018.

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feasible” for patients undergoing surgery for benign indications.<sup>18</sup> In kind, over the past two decades an abundance of data have emerged documenting the benefits of minimally invasive hysterectomy when feasible.<sup>19–21</sup> A smaller study of an integrated health care system performed in the years surrounding the American College of Obstetricians and Gynecologists’ recommendation (2008–2015) found a higher annual relative rate increase in minimally invasive hysterectomy for racial and ethnic minority patients in comparison with their White counterparts, effectively eliminating the racial disparity in likelihood of minimally invasive surgery by the end of the study period; this was not seen in our larger and more diverse study population.<sup>22</sup> Rather, from 2009 to 2013, we show that the rate of minimally invasive surgery increased more steeply for White patients, compared with both Black and Hispanic patients. Further, our data end after the 2014 U.S. Food and Drug Administration warning against the use of laparoscopic power morcellation for surgical removal of leiomyomas, given the potential for spread of unsuspected cancer. Correspondingly, we show a relative decrease in the rate of minimally invasive surgery for

all races beginning in 2014. The shift away from morcellation may have disproportionately affected Black women undergoing hysterectomy for leiomyomas.<sup>23</sup>

As a result of systemic racism, hospitals that care for a larger proportion of underserved racial and ethnic minoritized groups face challenges that include limited resource allocation, workforce recruitment difficulties, and lower reimbursement rates, which can restrict their ability to offer advanced surgical options such as minimally invasive hysterectomy. Prior work has shown that hospitals with high hysterectomy volumes are less likely to be hospitals that serve the highest proportion of Black patients.<sup>17</sup> A second issue is that even within a given institution, referral patterns may differ by race. In a single-institution retrospective study of the association of race and ethnicity on the use of minimally invasive hysterectomy for the treatment of leiomyomas, Schneyer et al<sup>24</sup> found that Black and Hispanic patients were significantly less likely to undergo surgery with fellowship-trained minimally invasive gynecologic surgery subspecialists. Similarly, we previously demonstrated that within hospitals that perform a high volume of hysterectomies, Black

**Table 1. Patient and Hospital Characteristics, Stratified by Surgical Approach**

Characteristic	2000–2009 (n=146,679)			2010–2018 (n=112,482)		
	Abdominal	MIS	P	Abdominal	MIS	P
Approach						
Laparoscopic		19,230 (13.1)			42,528 (37.8)	
Robot-assisted		508 (0.3)			11,161 (9.9)	
Vaginal		15,256 (10.4)			7,481 (6.7)	
Year of diagnosis			<.0001			<.001
2000	12,097 (79.8)	3,067 (20.2)				
2001	12,198 (80.4)	2,967 (19.6)				
2002	13,116 (80.6)	3,153 (19.4)				
2003	11,946 (79.9)	3,001 (20.1)				
2004	11,915 (79.0)	3,172 (21.0)				
2005	11,373 (77.7)	3,264 (22.3)				
2006	10,955 (77.8)	3,135 (22.2)				
2007	10,152 (73.7)	3,627 (26.3)				
2008	9,363 (67.5)	4,500 (32.5)				
2009	8,570 (62.7)	5,108 (37.3)				
2010				8,209 (59.1)	5,678 (40.9)	
2011				7,124 (52.6)	6,409 (47.4)	
2012				6,106 (46.6)	6,987 (53.4)	
2013				5,502 (42.6)	7,426 (57.4)	
2014				5,948 (46.3)	6,892 (53.7)	
2015				4,373 (41.2)	6,243 (58.8)	
2016				5,422 (45.3)	6,534 (54.7)	
2017				4,514 (38.8)	7,133 (61.2)	
2018				4,114 (34.3)	7,868 (65.7)	
Age (y)			<.001			<.001
18–39	13,913 (76.8)	4,201 (23.2)		5,003 (42.7)	6,704 (57.3)	
40–49	67,894 (79.1)	17,918 (20.9)		30,370 (48.6)	32,077 (51.4)	
50–59	23,979 (75.5)	7,774 (24.5)		12,984 (46.7)	14,839 (53.3)	
60–69	4,023 (56.8)	3,055 (43.2)		2,172 (29.3)	5,231 (70.7)	
70 or older	1,876 (47.8)	2,046 (52.2)		783 (25.2)	2,319 (74.8)	
Race			<.001			<.001
Hispanic	11,679 (76.5)	3,581 (23.5)		7,695 (51.4)	7,274 (48.6)	
Non-Hispanic Black	31,628 (87.7)	4,430 (12.3)		18,172 (64.3)	10,071 (35.7)	
Non-Hispanic White	57,882 (70.4)	24,303 (29.6)		17,582 (32.6)	36,281 (67.4)	
None of the above	10,496 (79.7)	2,680 (20.3)		7,863 (51.0)	7,544 (49.0)	
Insurance status			<.001			<.001
Commercial	93,735 (76.7)	28,413 (23.3)		39,336 (45.0)	48,141 (55.0)	
Medicare	4,908 (61.2)	3,115 (38.8)		2,450 (34.4)	4,681 (65.6)	
Uninsured or Medicaid	12,635 (79.3)	3,289 (20.7)		9,207 (53.9)	7,888 (46.1)	
Other	407 (69.7)	177 (30.3)		319 (40.9)	460 (59.1)	
New York City resident			<.001			<.001
No	66,950 (73.3)	24,439 (26.7)		25,328 (37.8)	41,680 (62.2)	
Yes	44,735 (80.9)	10,555 (19.1)		25,984 (57.1)	19,490 (42.9)	
Elixhauser Comorbidity score			<.001			<.001
0	61,371 (75.3)	20,123 (24.7)		22,246 (41.7)	31,139 (58.3)	
1	36,185 (77.2)	10,710 (22.8)		18,134 (49.3)	18,670 (50.7)	
2	11,593 (77.3)	3,403 (22.7)		7,898 (49.8)	7,958 (50.2)	
3 or higher	2,536 (77.0)	758 (23.0)		3,034 (47.1)	3,403 (52.9)	
Concurrent gynecologic diagnosis						
Endometrial hyperplasia	1,529 (64.2)	852 (35.8)	<.001	680 (22.0)	2,406 (78.0)	<.001
Abnormal uterine bleeding	4,067 (75.4)	15,058 (24.6)	<.001	16,853 (46.6)	19,328 (53.4)	<.001
Pelvic organ prolapse	2,400 (18.4)	10,674 (81.6)	<.001	850 (11.4)	6,608 (88.6)	<.001
Other menstrual disorders	3,632 (64.0)	2,039 (36.0)	<.001	1,436 (43.7)	1,853 (56.3)	<.001
Hospital racial demographic (quartiles)			<.001			<.001

*(continued)*

**Table 1. Patient and Hospital Characteristics, Stratified by Surgical Approach (continued)**

Characteristic	2000–2009 (n=146,679)			2010–2018 (n=112,482)		
	Abdominal	MIS	P	Abdominal	MIS	P
Lowest % Black	13,370 (65.6)	7,010 (34.4)	<.001	3,270 (32.0)	6,935 (68.0)	<.001
Low % Black	25,523 (69.9)	10,968 (30.1)		10,290 (36.9)	17,584 (63.1)	
High % Black	44,850 (79.3)	11,733 (20.7)		19,323 (41.9)	26,769 (58.1)	
Highest % Black	27,942 (84.1)	5,283 (15.9)		18,429 (65.1)	9,882 (34.9)	
Hospital volume (quartiles)						
Lowest annual volume	3,073 (76.3)	952 (23.7)		1,259 (59.3)	864 (40.7)	
Low annual volume	13,437 (80.0)	3,358 (20.0)		5,287 (49.0)	5,502 (51.0)	
High annual volume	28,046 (77.0)	8,377 (23.0)		13,805 (52.3)	12,604 (47.7)	
Highest annual volume	67,129 (75.1)	22,307 (24.9)		30,961 (42.3)	42,200 (57.7)	

MIS, minimally invasive surgery.

Data are n (%) unless otherwise specified.

patients are more likely than White patients to receive care from a low-volume surgeon.<sup>25</sup> Reducing institutional barriers to access to minimally invasive hysterectomy clearly warrants further investigation and may be leveraged to reduce disparities in access to care.

Although some prior work has demonstrated that commercial insurance is associated with higher likelihood of minimally invasive hysterectomy, large studies adjusted for various characteristics have found that insurance status is less important than

race.<sup>7,17,26</sup> This is consistent with our finding that insurance status had a minimal association with the likelihood of performance of minimally invasive hysterectomy. It is, however, of note that our particular population of interest, Black women of reproductive age, face the largest disparity in health insurance coverage and are less likely to have a personal physician and receive routine check-ups when compared with White women and women with health insurance coverage.<sup>27</sup>

**Table 2. Effect of Patient Race and Hospital Racial Demographic on the Odds of Minimally Invasive Hysterectomy\***

	2000–2009			2010–2018		
	Patient Race	Hospital Racial Composition	Patient+Hospital	Patient Race	Hospital Racial Composition	Patient+Hospital
Patient race						
Black	0.43 (0.40–0.48)		0.52 (0.48–0.56)	0.37 (0.35, 0.40)		0.45 (0.43–0.48)
White	Ref		Ref	Ref		Ref
Hospital racial quartile						
Lowest % Black		Ref	Ref		Ref	Ref
Low % Black		0.75 (0.59–0.94)	0.79 (0.63–1.00)		0.80 (0.65–0.98)	0.88 (0.71–1.08)
High % Black		0.45 (0.35–0.57)	0.50 (0.39–0.64)		0.62 (0.51–0.76)	0.77 (0.63–0.93)
Highest % Black		0.31 (0.23–0.42)	0.43 (0.32–0.58)		0.25 (0.21–0.31)	0.38 (0.31–0.46)

Ref, referent.

Data are odds ratio (95% CI).

\* All models adjusted for New York City residency status, age at time of procedure, patient insurance status, year of diagnosis, Elixhauser Comorbidity score, and presence of concurrent gynecologic diagnoses.



**Table 3. Contribution of Each Variable Used in the Logistic Regression Model**

Year 2000–2009			Year 2010–2018		
Model (Omitted Variable)	Rank	AICc	Model (Omitted Variable)	Rank	AICc
Null model		131,137	Null model		112,453
Full model		103,540	Full model		95,863
Pelvic organ prolapse	1	119,861	Pelvic organ prolapse	1	98,805
Year	2	106,269	Year	2	97,734
Hospital racial composition	3	104,558	Patient race	3	97,524
Patient race	4	104,362	Hospital racial composition	4	96,995
Hospital volume	5	104,228	Hospital volume	5	96,751
Abnormal uterine bleeding	6	104,083	Elixhauser Comorbidity score	6	96,277
Elixhauser Comorbidity score	7	103,718	Endometrial hyperplasia	7	96,268
Patient age	8	103,715	Patient age	8	96,160
Other menstrual disorders	9	103,660	New York City resident	9	96,159
Endometrial hyperplasia	10	103,578	Abnormal uterine bleeding	10	95,979
Patient insurance	11	103,541	Patient insurance	11	95,905
New York City resident	12	103,538	Other menstrual disorders	12	95,861

AICc, corrected Akaike information criterion.

Although our study is strengthened by its large and diverse cohort that spans all insurance payers and captures inpatient and outpatient hysterectomies across 19 years in a racially diverse state, we recognize a number of important limitations. First, our data set lacked a number of important missing patient-, surgeon-, and hospital-level covariates including BMI, uterine size, leiomyoma characteristics, abdominopelvic surgical history, and surgeon volume, years of experience, and fellowship training, which likely influenced the choice of route of hysterectomy. We were further unable to account for patient preference, as well as the potential for unmeasured bias on both individual and systemic levels. Other limitations include the potential for incorrectly reported data on race, the wide range of hospital demographics described by each racial quartile (particularly the

fourth quartile), the combined analysis of patients who are uninsured and those receiving Medicaid insurance, and the transition from ICD-9 to ICD-10 codes and associated risk of change in reporting over the study period.

In sum, we noted that there is a significant disparity in access to minimally invasive hysterectomy between Black and White women. This disparity appears to be widening and is associated both with individual race and the racial composition in which a patient is treated. Addressing these disparities necessitates comprehensive policy reforms aimed at improving funding and enhancing surgical recruitment. Efforts to enhance cultural competency and patient engagement in these hospitals are also essential to improve care outcomes and patient trust.

**Table 4. Raw and Adjusted Risk Difference in Probability of Minimally Invasive Hysterectomy for White Patients Compared With Black Patients, Stratified by Racial Composition of Treating Hospital\***

2000–2009 (n=146,679)					2010–2018 (n=112,482)				
Quartile (%)	Rate of MIS [% (n)]		RD (95% CI)	aRD (95% CI)	Quartile (%)	Rate of MIS [% (n)]		RD (95% CI)	aRD (95% CI)
	Non-Hispanic White	Non-Hispanic Black				Non-Hispanic White	Non-Hispanic Black		
1 (0–4.6)	35.1 (6,678)	20.8 (96)	14.3 (12.8–15.9)	10.7 (9.3–12.1)	1 (0–5.3)	68.9 (6,240)	47.5 (104)	21.4 (18.6–24.2)	28.8 (27.3–30.3)
2 (4.7–16.3)	33.6 (9,047)	16.7 (651)	16.9 (15.9–17.9)	8.5 (5.7–11.3)	2 (5.4–17.0)	70.6 (13,228)	46.2 (1,480)	24.4 (22.8–26.0)	25.2 (21.3–29.2)
3 (16.4–34.1)	24.2 (7,330)	12.5 (1,607)	11.7 (11.0–12.4)	5.3 (3.1–7.6)	3 (17.1–32.2)	68.1 (14,888)	44.7 (4,841)	23.4 (22.1–24.7)	22.1 (18.5–25.8)
4 (34.2–100)	21.4 (1,248)	11.0 (2,076)	10.4 (9.6–11.2)	4.6 (2.3–6.9)	4 (32.3–100)	45.4 (1,925)	26.1 (3,646)	19.3 (18.0–20.6)	11.0 (8.4–13.6)

MIS, minimally invasive surgery; RD, risk difference; aRD, adjusted risk difference.

\* All models adjusted for New York City residency status, age at time of procedure, patient insurance status, year of diagnosis, Elixhauser Comorbidity score, and presence of concurrent gynecologic diagnoses.

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## PEER REVIEW HISTORY

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