Racial and ethnic disparities in the surgical management of tubal ectopic pregnancy

Alexandra Huttler, M.D.,[a] Christopher Hong, M.D.,[a,b] and Divya Kelath Shah, M.D., MME[c]

[a] Department of Obstetrics and Gynecology, Pennsylvania Hospital, Philadelphia, Pennsylvania; [b] Division of Gynecology, University of Michigan, Ann Arbor, Michigan; and [c] Division of Reproductive Endocrinology and Infertility, University of Pennsylvania, Philadelphia, Pennsylvania

Objective: To evaluate racial and ethnic disparities in the surgical management of ectopic pregnancy over time.
Design: Retrospective cohort study.
Setting: None.
Patient(s): Surgically-managed cases of patients with tubal ectopic pregnancy within the American College of Surgeons National Surgical Quality Improvement Program database between 2010 and 2019.
Intervention(s): None.
Main outcome measure(s): Surgical approach (laparoscopic compared with open) and procedure (salpingectomy compared with salpingostomy/other).
Result(s): Of 7791 patients undergoing surgical management of tubal ectopic pregnancy, 21.8% identified as Hispanic, 24.5% as Black, 9.4% as Asian/other, and 44.3% as White. Use of laparoscopy increased 1.3% per year from 81.4% in 2010 to 91.0% in 2019 (95% confidence interval [CI], 0.010–0.016). Odds of undergoing laparoscopic surgery were lower in Black (adjusted odds ratio [aOR] 0.52; 95% CI, 0.45–0.61) and Hispanic patients (aOR 0.52; 95% CI, 0.44–0.61) compared with White patients and remained similar over time. The use of salpingectomy increased by 1.1% per year from 80.6% in 2010 to 94.7% in 2019 (95% CI, 0.009–0.014). Odds of undergoing salpingectomy were higher among Black (aOR 1.78, 95% CI 1.43-2.23) and Hispanic patients (aOR 1.54; 95% CI, 1.24–1.93) and lower among Asian patients (aOR 0.73, 95% CI, 0.56–0.95) compared with White patients. These ratios remained similar for Black and Asian patients over time.
Conclusion(s): Despite the increased use of laparoscopy and salpingectomy in the surgical management of ectopic pregnancy over time, Black and Hispanic patients remain less likely to undergo minimally invasive surgery and more likely to undergo salpingectomy compared with White patients. (Fertil Steril Rep® 2022;3:311–6. ©2022 by American Society for Reproductive Medicine.)
Key Words: Racial disparity, ethnic disparity, gynecologic surgery, minimally invasive surgery, ectopic pregnancy

Ectopic pregnancy occurs in 1.5%–2% of all gestations, with the vast majority located within the fallopian tube (1, 2). Tubal ectopic pregnancy can be managed expectantly, medically, or surgically (1). When surgical management is elected, laparoscopy is preferred as it is associated with shorter operative time, less intraoperative blood loss, and lower cost (1, 2). Laparoscopy can be safely performed for ectopic pregnancy even in the setting of hemoperitoneum, reserving laparotomy for cases of inadequate visualization or hemodynamic instability (2, 3).

Surgical management of tubal ectopic pregnancy can involve salpingectomy or salpingostomy. The choice of procedure depends on multiple factors, including fertility preferences, condition of the fallopian tube, and ability to achieve hemostasis. Although there is no clear consensus on the comparative fertility outcomes after salpingectomy or salpingostomy, randomized controlled trials demonstrate similar rates of subsequent intrauterine versus ectopic pregnancy after either procedure (4).

Racial and ethnic disparities in gynecologic surgery have been previously identified, with Black and Hispanic patients less likely to undergo minimally invasive surgery than White patients (5–8). Black patients are also more likely to undergo salpingectomy and experience severe morbidity related to ectopic pregnancy than White patients (9–11). Previous studies examining disparities in the surgical management of ectopic pregnancy have been limited by small sample sizes, abstraction of data from claims-based databases, or analyses over short

Received April 11, 2022; revised August 25, 2022; accepted August 30, 2022.
A.H. has nothing to disclose. C.H. has nothing to disclose. D.K.S. has nothing to disclose.
Reprint requests: Alexandra Huttler, M.D., Department of Obstetrics and Gynecology, Pennsylvania Hospital, 2 Pine East 800 Spruce Street, Philadelphia, Pennsylvania 19107 (E-mail: alexandra.huttler@pennmedicine.upenn.edu).

Fertil Steril Rep® Vol. 3, No. 4, December 2022 2666-3341

https://doi.org/10.1016/j.xfre.2022.08.009

TABLE 1

Demographic characteristics of all patients undergoing surgical management of tubal ectopic pregnancy (2010–2019).

Demographic	Total n = 7791 (%)	Laparoscopic n = 6667) (%)	Open n = 1124 (%)	*P* Value[a]	Salpingectomy n = 7074 (%)	Salpingostomy n = 717 (%)	*P* Value[b]
Race				<.001			<.001
White	3,451 (44.3)	3,081 (46.2)	370 (32.9)		3,081 (43.6)	370 (51.6)	
Black	1,905 (24.5)	1,548 (23.2)	357 (31.8)		1,782 (25.2)	123 (17.2)	
Hispanic	1,700 (21.8)	1,375 (20.6)	325 (28.9)		1,576 (22.3)	124 (17.3)	
Asian/other	735 (9.4)	663 (9.9)	72 (6.4)		635 (9.0)	100 (14.0)	
Age (y)	30 (26–34)	30 (26–34)	29 (26–34)	.42	30 (26–34)	29 (25–33)	<.001
BMI ≥ 30 kg/m^2	2,683 (33.5)	2,024 (33.9)	405 (38.1)	.007	2,248 (35.2)	181 (27.7)	<.001
Diabetes	116 (1.3)	91 (1.4)	10 (0.9)	.19	92 (1.3)	9 (1.3)	.92
Smoking	2,050 (22.4)	1,539 (23.1)	262 (23.3)	.87	1,636 (23.1)	165 (23.0)	.95
Hypertension	225 (2.5)	175 (2.6)	34 (3.0)	.44	187 (2.6)	22 (3.1)	.50
Bleeding disorder	33 (0.4)	27 (0.4)	3 (0.3)	.79	27 (0.4)	3 (0.4)	.75
ASA Class ≥ III	1,000 (10.9)	618 (9.3)	180 (16.0)	<.001	755 (10.7)	43 (6.0)	<.001
Transfusion	272 (3.0)	141 (2.1)	83 (7.4)	<.001	212 (3.0)	12 (1.7)	.043
Emergency case	6,925 (75.6)	4,841 (72.6)	896 (79.7)	<.001	5214 (73.7)	523 (72.9)	.66

Note: Data are median (interquartile range) or n (%) unless otherwise specified. BMI, body mass index; ASA Class, American Society of Anesthesiologists Physical Classification System.
[a] Comparison between laparoscopic and open groups.
[b] Comparison between salpingectomy and salpingostomy groups.

Huttler. ■■■. Fertil Steril Rep 2022.

timescales (11, 12). The objective of this study was to evaluate racial disparities in the surgical management of tubal ectopic pregnancy in a large, diverse, national cohort over a ten-year period. The primary outcome was the surgical approach (laparoscopic compared with open). Given previously identified disparities regarding the performance of tubal-sparing surgery in the management of ectopic pregnancy, a secondary outcome of procedure type (salpingectomy compared with salpingostomy) was also analyzed (11). It was hypothesized that racial and ethnic minority populations would be less likely to undergo minimally invasive surgery and salpingostomy than White patients, with potential dissipation of these disparities over time.

MATERIALS AND METHODS

The American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database is a prospectively-collected, validated national surgical database comprised of surgical cases from more than 700 community and participating academic hospitals. Data collection methods for the ACS NSQIP are publicly available and have been detailed in previous publications (13–16). Briefly, trained surgical reviewers at each participating site extract data from electronic medical records (15). The ACS NSQIP enforces annual quality audits to maintain accuracy, precision, and reproducibility among hospital participants, with results consistently showing reliable data and improvements in reliability each year (16). As subjects within the ACS NSQIP database are fully de-identified, the study protocol did not meet the criteria for human subjects research and was deemed exempt by the institutional review board at the University of Pennsylvania.

In this retrospective cohort study, data were abstracted on surgical approach and procedure for patients undergoing surgical management of ectopic pregnancy from January 1, 2010, to December 31, 2019, using the Current Procedural Terminology (CPT) codes 59120, 59121, 59150, and 59151. In addition, the International Classification of Disease (ICD) 9 (633.1, 633.11, 633.10) and 10 (000.101, 000.102, 000.111, 000.112, 000.1, 000.10, 000.11) codes were used to limit analyses to cases of tubal ectopic pregnancy. The cohort was restricted to patients between the ages of 18 and 50 years. Race and ethnicity were categorized as Hispanic, Black, White, or Asian/Other (including American Indian or Alaskan Native and Native American or Pacific Islander). Race and ethnicity were either self-assigned or assigned by trained clinical reviewers at the time of prospective data collection as directed by the ACS NSQIP guidelines. To assess associations between patient race/ethnicity and surgical approach, cases were categorized into those performed using laparoscopic techniques and those performed using an open abdominal approach. To assess associations between patient race/ethnicity and surgical procedure, cases were categorized into those involving salpingectomy and those not involving salpingectomy.

Data were abstracted on a selected subset of demographic and clinical variables within the ACS NSQIP database that could potentially confound the relationship between patient race and surgical management of tubal ectopic pregnancy. These included patient variables such as obesity (dichotomized as body mass index [BMI] < or ≥ 30 kg/m^2), diabetes, hypertension requiring medication, history of a bleeding disorder, current smoking status, and American Society of Anesthesiologists (ASA) Physical Status Classification (dichotomized as < or ≥ III [patient with a severe systemic disease]). Additional variables related to the surgical procedure, such as emergent status and blood transfusion before surgery, were also included.

Continuous variables were compared using Wilcoxon rank sum tests, and categorical variables were compared using $\chi^2$and Fisher's exact tests as appropriate. Logistic regression was performed to evaluate the proportion of cases performed laparoscopically and the proportion of procedures

involving salpingectomy within each operative year. Marginal analysis was then used to predict the marginal effect of operative year on surgical approach and procedure. Multivariable logistic regression analyses were used to calculate unadjusted and adjusted odds ratios (aOR) with 95% confidence intervals (CI) comparing Hispanic, Black, and Asian/other patients to White patients regarding the likelihood of undergoing laparoscopic surgery and the likelihood of undergoing salpingectomy. Multivariable models were adjusted for variables noted to be significantly different ($P<.1$) between the 2 relevant groups—ASA Class > III, preoperative blood transfusion, and emergency status when comparing laparoscopic with open surgery; age, obesity, ASA Class ≥ III, and preoperative blood transfusion when comparing cases of salpingectomy with those without salpingectomy. Interaction analyses evaluated the relationship between race/ethnicity and either surgical approach or surgical procedure between the 2 operative time cohorts, defined as 2010–2014 and 2015–2019. All statistical analyses were performed using Stata 16.1.

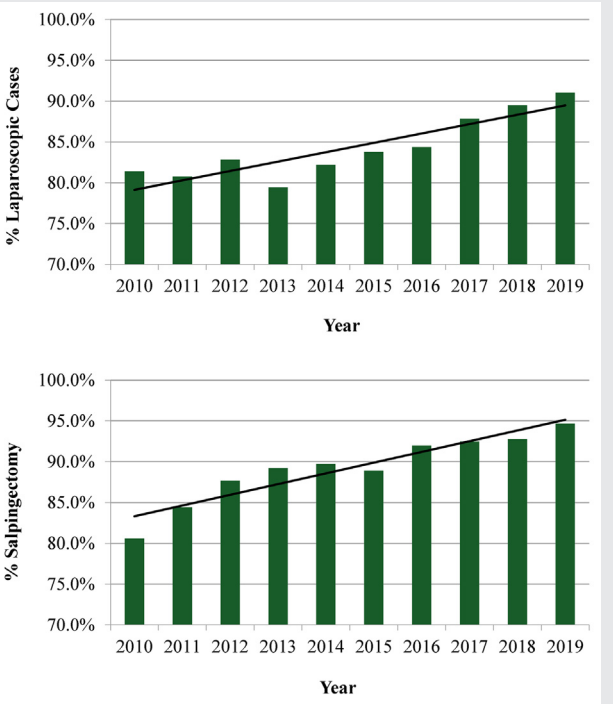
RESULTS

A total of 9164 reproductive-aged patients underwent surgical management of tubal ectopic pregnancy from 2010 to 2019. After excluding 1,189 with unreported race, 7,791 patients remained in the final cohort. Of these, 9.4% identified as Asian or other races (n = 735), 21.8% as Hispanic (n = 1,700), 24.5% as Black (n = 1,905), and 44.3% as White (n = 3,451). Most cases were performed laparoscopically (n = 6,667, 85.6%) as compared with open (n = 1,124, 14.4%). Compared with patients undergoing laparoscopic surgery, those undergoing open surgery were more likely to be obese, be ASA Class > III, have received a preoperative blood transfusion, and undergo emergency surgery. Salpingectomy was performed in most cases (n = 7,074, 90.8%). Compared with patients who did not undergo salpingectomy, those who underwent salpingectomy were more likely to be younger, obese, ASA Class > III, and have received a preoperative blood transfusion (Table 1).

The proportion of procedures performed laparoscopically increased from 81.4% in 2010 to 91.0% in 2019 (Fig. 1). On average, laparoscopic surgery increased by 1.3% per year, and this trend was found to be significant (95% CI, 0.010-0.016, $P<.01$). After adjusting for ASA Class > III, preoperative blood transfusion, and emergency status, Black and Hispanic patients were less likely to undergo laparoscopic surgery compared with White patients (Black aOR 0.52, 95% CI 0.45–0.61; Hispanic aOR 0.52, 95% CI 0.44–0.61) (Table 2). Obesity was no longer significant in the multivariable model. When this relationship between surgical approach and race/ethnicity was compared between the 2 operative time cohorts (2010–2014 and 2015–2019) using interaction analysis, there were no significant differences for all racial/ethnic groups (all $P>.05$, Table 2).

The proportion of salpingectomy procedures increased from 80.6% in 2010 to 94.7% in 2019 (Fig. 1). On average, salpingectomy increased by 1.1% per year, and this trend was found to be significant (95% CI 0.009–0.014, $P<.01$). After adjusting for age, obesity, ASA Class ≥ III, and preoperative blood transfusion, Black and Hispanic patients remained more likely to undergo salpingectomy than White patients (Black aOR 1.78, 95% CI 1.43–2.23; Hispanic aOR 1.54, 95% CI 1.24–1.93), and Asian patients less likely to undergo salpingectomy (aOR 0.73, 95% CI 0.56–0.95) (Table 3). When the relationship between surgical procedure and race/ethnicity was compared between the 2 operative time cohorts using interaction analysis, there were no significant differences for Black and Asian patients (both $P>.05$). In Hispanic patients, the increased odds of undergoing salpingectomy observed in the 2010-2014 cohort were significantly decreased in the 2015-2019 cohort ($P=.044$), at which point they were no longer significantly different compared with the referent group of White patients (Table 3).

FIGURE 1



Surgical approach and procedure for tubal ectopic pregnancy management over time. The percentage of cases performed laparoscopically (top) and the percentage of cases involving salpingectomy (bottom) by operative year. Logistic regression marginal analysis revealed a 1.3% increase in laparoscopic surgery (95% CI 0.010–0.016, $P<.01$) and a 1.1% increase in salpingectomy (95% CI 0.009–0.014, $P<.01$) per year, on average (trendline).

Huttler. ■■■. Fertil Steril Rep 2022.

DISCUSSION

Despite trends over the last decade toward greater use of laparoscopy and salpingectomy in the surgical management of tubal ectopic pregnancy, Black and Hispanic patients remain significantly less likely to receive minimally invasive surgery and more likely to undergo salpingectomy than their

TABLE 2

Odds ratios for laparoscopic surgery by patient race/ethnicity.

Race/Ethnicity	Unadjusted OR 2010–2019 (95% CI)	Adjusted OR[a] 2010–2019 (95% CI)	Adjusted OR[a] 2010–2014 (95% CI)	Adjusted OR[a] 2015–2019 (95% CI)	Interaction *P* Value
White	Ref	Ref	Ref	Ref	Ref
Black	0.52 (0.44–0.61)	0.52 (0.45–0.61)	0.51 (0.40–0.65)	0.53 (0.43–0.65)	.83
Hispanic	0.51 (0.43–0.60)	0.52 (0.44–0.61)	0.47 (0.36–0.62)	0.52 (0.42–0.63)	.61
Asian/other	1.10 (0.84–1.44)	1.18 (0.90–1.55)	1.38 (0.89–2.14)	1.06 (0.76–1.50)	.37

OR, odds ratio; Ref, referent.
[a] Adjusted for American Society of Anesthesiologists Class ≥ III, preoperative blood transfusion, and emergency status

Huttler. ■■■. Fertil Steril Rep 2022.

White counterparts. Asian patients are also less likely to undergo salpingectomy.

These findings are consistent with previous studies evaluating racial disparities in gynecologic surgery (5–8, 11, 12), though the underlying etiologies remain unclear. In the present study, the decreased use of laparoscopy in minority patients was not accounted for by ASA classification, preoperative blood transfusion, or emergency status of surgery. It remains possible that clinical variables not captured in the ACS NSQIP database—such as beta human chorionic gonadotropin level or estimated gestational age at the presentation—may confound this relationship. The increased use of salpingectomy among minority patients was similarly not accounted for by age, obesity, ASA classification, or preoperative blood transfusion. Again, patient factors, including parity, fertility desires, coverage for assisted reproduction, gynecologic history and condition of the fallopian tube, and presence of a contralateral fallopian tube, are not captured by the ACS NSQIP; if these differ among racial and ethnic groups they may contribute to observed disparities.

It is perhaps equally plausible that these disparities result from racism within the American health care system. Although the precise impact of a racial bias on medical decision-making remains challenging to quantify, physician prejudice has been identified as a significant contributor to racial disparities in health care (17, 18). For example, erroneous beliefs about intrinsic biologic differences in pain perception between Black and White individuals held by White medical trainees have resulted in inappropriate and inadequate treatment recommendations for Black patients (19). However, perhaps even more significant than individual biases is the impact of structural racism on differential access to care for minority patients (20, 21). In nongynecologic surgery and internal medicine literature, studies have suggested that Black, Hispanic, and Asian patients are more likely to undergo surgery at low-volume hospitals and seek care with low-volume or nonboard certified physicians who lack consistent access to high-quality resources (22–26). Moreover, claims-based analyses have demonstrated associations between surgical management of ectopic pregnancy, hospital characteristics, and patient insurance status, with Medicaid and uninsured patients found to be 60%–70% less likely to undergo salpingostomy compared with commercially insured patients (11). These factors may contribute to the present study's findings if Black and Hispanic patients disproportionally lacked commercial health insurance or were presented to lower-resourced hospitals. Although the ACS NSQIP database does not capture geographic, hospital, insurance, and provider level data—thus limiting the ability to account for these factors—differences in insurance status or access to care between racial and ethnic groups may represent central manifestations of systemic racism, with disparities in the surgical management of ectopic pregnancy signifying downstream effects.

The strengths of this study include its large sample size, the racial and ethnic diversity of the study population, and the use of a highly-validated clinical database. An additional

TABLE 3

Odds ratios for salpingectomy by patient race/ethnicity.

Race/Ethnicity	Unadjusted OR 2010–2019 (95% CI)	Adjusted OR[a] 2010–2019 (95% CI)	Adjusted OR[a] 2010–2014 (95% CI)	Adjusted OR[a] 2015–2019 (95% CI)	Interaction *P* Value
White	Ref	Ref	Ref	Ref	Ref
Black	1.73 (1.41–2.15)	1.78 (1.43–2.23)	1.89 (1.35–2.66)	1.73 (1.29–2.33)	.69
Hispanic	1.53 (1.23–1.89)	1.54 (1.24–1.93)	2.09 (1.41–3.10)	1.28 (0.97–1.68)	.044
Asian/other	0.76 (0.60–0.97)	0.73 (0.56–0.95)	0.65 (0.44–0.98)	0.78 (0.55–1.12)	.49

OR, odds ratio; Ref, referent.
[a] Adjusted for age, body mass index ≥ 30 kg/m^2, American Society of Anesthesiologists Class ≥ III, and preoperative blood transfusion

Huttler. ■■■. Fertil Steril Rep 2022.

strength is the longitudinal analysis over a ten-year interval which enabled the assessment of previously unevaluated trends over time. This study also has limitations related to its use of retrospective aggregate data. As previously described, the ACS NSQIP database does not capture certain patient, geographic, hospital, and provider level data that may confound the relationship between patient race/ethnicity and surgical management of tubal ectopic pregnancy. Secondly, CPT coding does not distinguish between salpingectomy and oophorectomy for ectopic pregnancy, and there is no CPT code that specifies salpingostomy. Although most surgical cases for tubal ectopic pregnancy that do not involve salpingectomy are likely to represent salpingostomy procedures, some cases of tubal abortions may also be included in this group. As this study uses both ICD-9 and ICD-10 codes, there may also be disruptions in observed rates of tubal pregnancy related to the coding transition, though this should be equally distributed among all patients. Additionally, the cohort of Asian patients included approximately 3% of patients who identified as other races, and the categorical definition of race precluded the assessment of patients who identified as multiple races. Finally, 13.0% of patients were excluded because of missing or unknown race and ethnicity, which may result in inclusion bias.

Additional analyses are necessary to clarify and correct the underlying factors that result in disparate surgical management between racial and ethnic groups. Implementing universal protocols for the management of ectopic pregnancy—akin to those that have demonstrated efficacy in reducing disparities within obstetric care—represents potential interventions to mitigate these inequalities (27).

CONCLUSION

In conclusion, most disparities regarding the surgical approach and procedure type in the surgical management of ectopic pregnancy among minority patients have persisted over the last decade. Many minority patients remain not only disproportionally affected by ectopic pregnancy but also less likely to receive care concordant with established standards. The increased likelihood to undergo salpingectomy seen among Hispanic patients from 2010 to 2014 was the only disparity that did not persist in the 2015–2019 cohort. Although the clinical significance of this finding is unclear given the ambiguity surrounding the most beneficial surgical procedure for tubal ectopic pregnancy, it is reassuring that this disparity dissipated over time. Identifying racial and ethnic disparities in reproductive health care is a requisite first step in establishing interventions to equalize care across all individuals.

REFERENCES

1. Hajenius PJ, Mol F, Mol BW, Bossuyt PM, Ankum WM, van der Veen F. Interventions for tubal ectopic pregnancy. Cochrane Database Syst Rev 2007;2007:CD000324.
2. Barnhart KT. Clinical practice. Ectopic pregnancy. N Engl J Med 2009;361:379–87.
3. Cohen A, Almog B, Satel A, Lessing JB, Tsafrir Z, Levin I. Laparoscopy versus laparotomy in the management of ectopic pregnancy with massive hemoperitoneum. Int J Gynaecol Obstet 2013;123:139–41.
4. Cheng X, Tian X, Yan Z, Jia M, Deng J, Wang Y, et al. Comparison of the fertility outcome of salpingotomy and salpingectomy in women with tubal pregnancy: a systematic review and meta-analysis. PLoS One 2016;11:e0152343.
5. Ko JS, Suh CH, Huang H, Zhuo H, Harmanli O, Zhang Y. Association of race/ethnicity with surgical route and perioperative outcomes of hysterectomy for leiomyomas. J Minim Invasive Gynecol 2021;28:1403–14010.e2.
6. Esselen KM, Vitonis A, Einarsson J, Muto MG, Cohen S. Health care disparities in hysterectomy for gynecologic cancers: data from the 2012 National Inpatient Sample. Obstet Gynecol 2015;126:1029–39.
7. Alexander AL, Strohl AE, Rieder S, Holl J, Barber EL. Examining disparities in route of surgery and postoperative complications in black race and hysterectomy. Obstet Gynecol 2019;133:6–12.
8. Stentz NC, Cooney LG, Sammel MD, Shah DK. Association of patient race with surgical practice and perioperative morbidity after myomectomy. Obstet Gynecol 2018;132:291–7.
9. Stulberg DB, Cain LR, Dahlquist I, Lauderdale DS. Ectopic pregnancy rates and racial disparities in the Medicaid population, 2004-2008. Fertil Steril 2014;102:1671–6.
10. Creanga AA, Shapiro-Mendoza CK, Bish CL, Zane S, Berg CJ, Callaghan WM. Trends in ectopic pregnancy mortality in the United States: 1980-2007. Obstet Gynecol 2011;117:837–43.
11. Hsu JY, Chen L, Gumer AR, Tergas AI, Hou JY, Burke WM, et al. Disparities in the management of ectopic pregnancy. Am J Obstet Gynecol 2017;217:49.e1–10.
12. Ranjit A, Chaudhary MA, Jiang W, Zhan T, Schneider EB, Cohen SL, et al. Disparities in receipt of a laparoscopic operation for ectopic pregnancy among TRICARE beneficiaries. Surgery 2017;161:1341–7.
13. [dataset] American College of Surgeons. American College of Surgeons National Surgical Quality Improvement Program user guide. Chicago (IL): American College of Surgeons; 2019.
14. Ingraham AM, Richards KE, Hall BL, Ko CY. Quality improvement in surgery: the American College of Surgeons National Surgical Quality Improvement Program approach. Adv Surg 2010;44:251–67.
15. Birkmeyer JD, Shahian DM, Dimick JB, Finlayson SR, Flum DR, Ko CY, et al. Blueprint for a new American College of Surgeons: National Surgical Quality Improvement Program. J Am Coll Surg 2008;207:777–82.
16. Shiloach M, Frencher SK Jr, Steeger JE, Rowell KS, Bartzokis K, Tomeh MG, et al. Toward robust information: data quality and inter-rater reliability in the American College of Surgeons National Surgical Quality Improvement Program. J Am Coll Surg 2010;210:6–16.
17. Smedley BD, Stith AY, Nelson AR, editors. Institute of Medicine. Unequal treatment: confronting racial and ethnic disparities in health care. Washington, DC: The National Academies Press, 2003.
18. Chapman EN, Kaatz A, Carnes M. Physicians and implicit bias: how doctors may unwittingly perpetuate health care disparities. J Gen Intern Med 2013;28:1504–10.
19. Hoffman KM, Trawalter S, Axt JR, Oliver MN. Racial bias in pain assessment and treatment recommendations, and false beliefs about biological differences between blacks and whites. Proc Natl Acad Sci U S A 2016;113:4296–301.
20. Bailey ZD, Krieger N, Agénor M, Graves J, Linos N, Bassett MT. Structural racism and health inequities in the USA: evidence and interventions. Lancet 2017;389:1453–63.
21. Bailey ZD, Feldman JM, Bassett MT. How structural racism works—racist policies as a root cause of U.S. racial health inequities. N Engl J Med 2021;384:768–73.
22. Dimick J, Ruhter J, Sarrazin MV, Birkmeyer JD. Black patients more likely than whites to undergo surgery at low-quality hospitals in segregated regions. Health Aff (Millwood) 2013;32:1046–53.
23. Huang LC, Tran TB, Ma Y, Ngo JV, Rhoads KF. Factors that influence minority use of high-volume hospitals for colorectal cancer care. Dis Colon Rectum 2015;58:526–32.

24. Liu JH, Zingmond DS, McGory ML, SooHoo NF, Ettner SL, Brook RH, et al. Disparities in the utilization of high-volume hospitals for complex surgery. JAMA 2006;25:1973–80, 296.
25. Epstein AJ, Gray BH, Schlesinger M. Racial and ethnic differences in the use of high-volume hospitals and surgeons. Arch Surg 2010;145:179–86.
26. Bach PB, Pham HH, Schrag D, Tate RC, Hargraves JL. Primary care physicians who treat blacks and whites. N Engl J Med 2004;351:575–84.
27. Hamm RF, Srinivas SK, Levine LD. A standardized labor induction protocol: impact on racial disparities in obstetrical outcomes. Am J Obstet Gynecol MFM 2020;2:100148.