


Access to High-Volume Hospitals for High-Risk Cancer Surgery for Racial and Ethnic Minoritized Groups

Michelle C. Salazar, MD, MHS ^{1,2,*} Maureen E. Canavan, PhD,^{3,4} Louisa W. Holaday, MD, MHS,^{2,5} Kevin G. Billingsley, MD, MBA,⁶ Joseph Ross, MD,^{2,7} Daniel J. Boffa, MD,⁴ Cary P. Gross, MD^{2,3,7}

¹Department of Surgery, Yale University School of Medicine, New Haven, CT, USA; ²National Clinician Scholars Program, Yale University School of Medicine, New Haven, CT, USA; ³Cancer Outcomes Public Policy and Effectiveness Research (COPPER) Center, Department of Internal Medicine, Yale University School of Medicine, New Haven, CT, USA; ⁴Section of Thoracic Surgery, Department of Surgery, Yale University School of Medicine, New Haven, CT, USA; ⁵West Haven VA Medical Center, West Haven, CT, USA; ⁶Section of Surgical Oncology, Department of Surgery, Yale University School of Medicine, New Haven, CT, USA; and ⁷Department of Internal Medicine, Yale University School of Medicine, New Haven, CT, USA

*Correspondence to: Michelle C. Salazar, MD, MHS, Department of Surgery, Yale University School of Medicine, PO Box 208088, New Haven, CT 06510-8088, USA (e-mail: michelle.salazar@yale.edu).

Abstract

High-volume hospitals have been associated with better outcomes for high-risk cancer surgeries, although concerns exist concerning inequitable access to these high-volume hospitals. We assessed tendencies in access to high-volume hospitals for 4 (lung, pancreatic, rectal, esophageal) high-risk cancer surgeries for Black and Hispanic patients in the National Cancer Database. Hospitals were classified as high volume according to Leapfrog Group volume thresholds. Odds of accessing high-volume hospitals increased over time for Black and Hispanic patients for 3 surgeries, but Black patients had lower probabilities of undergoing a pancreatectomy, proctectomy, or esophagectomy at high-volume hospitals than non-Black patients (eg, 2016 pancreatectomy rate: 49.0% [95% confidence interval (CI) = 45.4% to 52.5%] vs 62.3% [95% CI = 61.1% to 63.5%]). Although for Hispanics the gap narrowed for lung resection and pancreatectomy, these populations continued to have lower probabilities of accessing high-volume hospitals than non-Hispanic patients (eg, 2016 pancreatectomy: 48.8% [95% CI = 44.1% to 53.5%] vs 61.6% [95% CI = 60.5% to 62.8%]). Despite increased access to high-volume hospitals for high-risk cancer surgeries, ongoing efforts to improve equity in access are needed.

Receiving care at high-volume hospitals has been associated with better outcomes for patients undergoing certain high-risk cancer surgeries (1,2). Accordingly, the Leapfrog Group and other stakeholders have long advocated for hospitals to meet minimum-volume standards (3,4). Geographic and financial barriers prevent patients' access to high-volume hospitals, however, raising concerns that minimum-volume standards may exacerbate racial and ethnic disparities (5,6). We evaluated trends in access to high-volume hospitals for high-risk cancer surgeries in the overall population and for Black and Hispanic patients in the National Cancer Database (NCDB).

We conducted an observational study using the NCDB 2017 participant user file, identifying patients diagnosed from 2005 to 2016 who underwent lung resection, pancreatectomy, proctectomy, or esophagectomy for cancer. Hospitals were defined as high volume if they met the Leapfrog Group yearly threshold (lung = 40, pancreatic = 20, rectal = 16, and esophageal = 20). Each hospital's cancer-specific volume was calculated as a rolling 2-year average. Hospitals were defined as reporting to the NCDB

if they had reported any care (diagnosis or treatment) for any of 6 cancers (lung, pancreas, rectal, esophageal, breast, and colon) during that year. Therefore, if a hospital was reporting but had no surgeries recorded for that year, the hospital was defined as having had zero surgeries for that year. To diminish the risk of bias from hospitals reporting intermittently to the NCDB, we included only those hospitals that reported for the entirety of the study period. We also conducted a sensitivity analysis of all hospitals that had reported to the NCDB at some point during the study period and found no meaningful change in the results.

We performed multivariable logistic regression by diagnosis year to evaluate time trends while adjusting for region, age, sex, insurance coverage, area-level income, area of residence, Charlson-Deyo Comorbidity Index score, and pathologic stage. Definitions of variables and methodological details on race and ethnicity can be found in the Supplementary "Methods" section (available online). We evaluated differences in temporal trends in access to high-volume hospitals for Black and Hispanic patients using year x race and year x ethnicity interaction

Received: October 11, 2021; Revised: January 22, 2022; Accepted: January 24, 2022

© The Author(s) 2022. Published by Oxford University Press.

This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<https://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited. For commercial re-use, please contact journals.permissions@oup.com

Table 1. Proportions and adjusted odds ratios of access to high-volume hospitals for high-risk surgeries, 2005-2016^a

High-risk surgery	2005	2006	2011	2012	2015	2016	Overall findings
Lung resection							
All patients							Overall trend: Increased HVH use
Treated at HVH, %	43.3	48.0	47.8	48.1	51.3	53.0	
OR (95% CI)	1	1.21 (1.17 to 1.26)	1.21 (1.16 to 1.25)	1.22 (1.17 to 1.27)	1.40 (1.35 to 1.46)	1.51 (1.45 to 1.56)	
Black							No racial disparity
Treated at HVH, %	42.4	47.4	45.9	46.6	52.2	52.8	
OR (95% CI)	1	1.23 (1.07 to 1.42)	1.16 (1.02 to 1.34)	1.19 (1.04 to 1.37)	1.49 (1.30 to 1.70)	1.53 (1.33 to 1.75)	
Non-Black							
Treated at HVH, %	43.4	47.9	47.9	48.2	51.0	52.8	
OR (95% CI)	1	1.21 (1.16 to 1.26)	1.21 (1.17 to 1.26)	1.23 (1.18 to 1.28)	1.40 (1.34 to 1.45)	1.51 (1.45 to 1.57)	
Hispanic							Ethnic disparity: Decreased over time
Treated at HVH, %	27.6	32.0	39.9	40.8	53.7	48.2	
OR (95% CI)	1	1.24 (0.92 to 1.66)	1.79 (1.37 to 2.35) ^b	1.93 (1.47 to 2.54) ^b	3.19 (2.46 to 4.14) ^b	2.65 (2.05 to 3.43) ^b	
Non-Hispanic							
Treated at HVH, %	43.9	48.0	48.5	48.6	51.5	53.5	
OR (95% CI)	1	1.19 (1.14 to 1.24)	1.21 (1.16 to 1.26) ^b	1.21 (1.16 to 1.26) ^b	1.38 (1.33 to 1.44) ^b	1.50 (1.44 to 1.56) ^b	
Pancreatectomy							
All patients							Overall trend: Increased HVH use
Treated at HVH, %	37.0	41.4	54.2	57.3	59.3	60.5	
OR (95% CI)	1	1.23 (1.12 to 1.35)	2.12 (1.94 to 2.32)	2.45 (2.25 to 2.67)	2.65 (2.44 to 2.89)	2.84 (2.61 to 3.09)	
Black							Racial disparity: Same over time
Treated at HVH, %	24.5	30.3	43.3	49.6	48.5	49.3	
OR (95% CI)	1	1.42 (1.01 to 2.00)	2.52 (1.85 to 3.42)	3.29 (2.44 to 4.44) ^b	3.09 (2.30 to 4.15)	3.19 (2.37 to 4.29)	
Non-Black							
Treated at HVH, %	38.1	42.5	55.4	58.0	60.7	61.8	
OR (95% CI)	1	1.22 (1.10 to 1.35)	2.09 (1.91 to 2.29)	2.36 (2.16 to 2.59) ^b	2.63 (2.41 to 2.88)	2.82 (2.58 to 3.09)	
Hispanic							Ethnic disparity: Decreased over time
Treated at HVH, %	12.5	18.0	41.4	38.7	47.3	48.4	
OR (95% CI)	1	1.68 (0.89 to 3.18) ^b	5.34 (3.11 to 9.16) ^b	4.92 (2.89 to 8.37) ^b	6.65 (3.94 to 11.22) ^b	7.20 (4.30 to 12.03) ^b	
Non-Hispanic							
Treated at HVH, %	39.1	43.6	55.7	58.5	60.1	61.5	
OR (95% CI)	1	1.24 (1.12 to 1.37) ^b	2.05 (1.87 to 2.25) ^b	2.33 (2.12 to 2.55) ^b	2.48 (2.27 to 2.71) ^b	2.65 (2.42 to 2.90) ^b	
Proctectomy							
All patients							Overall trend: Increased HVH use
Treated at HVH, %	43.4	47.1	50.3	50.2	56.8	57.8	
OR (95% CI)	1	1.16 (1.10 to 1.23)	1.32 (1.24 to 1.39)	1.31 (1.23 to 1.38)	1.68 (1.59 to 1.78)	1.74 (1.65 to 1.85)	
Black							Racial disparity: Same over time
Treated at HVH, %	39.9	48.4	48.5	52.3	52.2	52.9	
OR (95% CI)	1	1.37 (1.12 to 1.68)	1.44 (1.17 to 1.77)	1.70 (1.38 to 2.09) ^b	1.63 (1.33 to 1.99)	1.69 (1.38 to 2.07)	
Non-Black							
Treated at HVH, %	43.4	46.8	50.4	50.1	57.2	58.2	
OR (95% CI)	1	1.15 (1.08 to 1.21)	1.32 (1.24 to 1.40)	1.29 (1.22 to 1.37) ^b	1.71 (1.61 to 1.82)	1.77 (1.67 to 1.88)	
Hispanic							Ethnic disparity: Increased over time
Treated at HVH, %	46.0	48.3	43.5	42.6	53.1	53.7	
OR (95% CI)	1	1.06 (0.82 to 1.38)	0.87 (0.67 to 1.13) ^b	0.85 (0.66 to 1.10) ^b	1.31 (1.03 to 1.67) ^b	1.32 (1.03 to 1.69) ^b	
Non-Hispanic							
Treated at HVH, %	43.1	45.9	51.2	51.1	57.4	58.3	
OR (95% CI)	1	1.12 (1.05 to 1.19)	1.37 (1.29 to 1.46) ^b	1.36 (1.28 to 1.44) ^b	1.73 (1.63 to 1.84) ^b	1.78 (1.68 to 1.89) ^b	
Esophagectomy							
All patients							Overall trend: Same HVH use
Treated at HVH, %	21.1	24.0	25.3	28.5	22.2	19.3	
OR (95% CI)	1	1.25 (1.09 to 1.44)	1.26 (1.09 to 1.46)	1.49 (1.29 to 1.72)	1.05 (0.91 to 1.22)	0.88 (0.76 to 1.02)	

(continued)

Table 1. (continued)

High-risk surgery	2005	2006	2011	2012	2015	2016	Overall findings
Black ^c							Racial disparity: Same over time
Treated at HVH, % 10.0		10.1	14.3	17.9	5.9	7.8	
OR (95% CI)		1	1.58 (0.88 to 2.84)		0.53 (0.25 to 1.10)		
Non-Black ^c							
Treated at HVH, % 21.3		24.3	25.9	29.0	22.9	19.9	
OR (95% CI)		1	1.24 (1.12 to 1.38)		0.89 (0.80 to 0.99)		
Hispanic ^c							Ethnic disparity: Same over time
Treated at HVH, % 15.4		14.3	17.2	17.7	5.7	8.3	
OR (95% CI)		1	1.34 (0.61 to 2.91)		0.38 (0.15 to 0.94)		
Non-Hispanic ^c							
Treated at HVH, % 21.5		24.9	25.8	29.1	22.8	20.0	
OR (95% CI)		1	1.16 (1.05 to 1.29)		0.82 (0.73 to 0.91)		

^aFor brevity, not all years included in the analyses are displayed. Full models are available upon request. CI = confidence interval; HVH = high-volume hospital; OR = odds ratio.

^bDesignates variables of race and ethnicity that had a significant interaction term with the year of diagnosis.

^cVolume reported as 2 consecutive years given that yearly frequency fell below 100.

terms. The non-Black and non-Hispanic groups included any patients who were not identified as Black or Hispanic, respectively. Missing variables were imputed using multiple imputation, except for region, which was left as “unknown” because it is suppressed by the NCDB for patients aged from birth to 39 years. A 95% confidence interval (CI) that did not cross the null value of 1.00 was considered statistically significant. The Yale institutional review board deemed this study exempt. We used SAS statistical software, version 9.4 (SAS Institute Inc), and Stata, release 16 (StataCorp LP). We followed the Strengthening the Reporting of Observational Studies in Epidemiology reporting guidelines for observational studies (<http://www.equator-network.org/reporting-guidelines/strobe/>).

The final study sample included 1099 hospitals and 483 212 patients; 272 671 of these patients underwent lung resection, 65 161 pancreatotomy, 117 795 proctectomy, and 27 585 esophagectomy. The median age was 66 years (interquartile range = 58–73). The proportion of Black and Hispanic patients in the overall population increased from 2005 to 2016 by 1.4% and 1.5%, respectively. The proportion of hospitals that became high volume increased from 2005 to 2016 across all cancers, except for esophageal (lung, 13.5% to 16.3%; pancreatic, 3.5% to 9.3%; rectal, 15.1% to 18.6%; esophageal, 1.2% to 1.2%). The proportion of patients receiving surgery at high-volume hospitals increased between 2005 and 2016 for all surgeries, except esophagectomies (lung resection, 43.3% in 2005 to 53.0% in 2016; pancreatotomy, 37.0% to 60.5%; proctectomy, 43.4% to 57.8%; esophagectomy, 21.1% to 19.3%). At the beginning of the study period, a lower percentage of Black patients compared with non-Black patients underwent pancreatotomy, proctectomy, and esophagectomy at high-volume hospitals. The percentage of Hispanic patients undergoing lung resection, pancreatotomy, or esophagectomy at high-volume hospitals in 2005 was also lower than that of non-Hispanic patients. The odds of accessing high-volume hospitals for lung resection, pancreatotomy, or proctectomy statistically significantly increased over time for the overall population as well as for the subgroups of Black and Hispanic patients (Table 1).

After adjusting for sociodemographic and clinical characteristics, the increase in odds of accessing high-volume hospitals over time was similar for Black and non-Black patients (Table 1),

but racial disparities persisted. Black patients continued to have lower predicted probabilities of accessing high-volume hospitals for pancreatotomy, proctectomy, and esophagectomy than non-Black patients (eg, 2016 pancreatotomy: 49.0% [95% CI = 45.4% to 52.5%] vs 62.3% [95% CI = 61.1% to 63.5%]) (Figure 1). For lung resection and pancreatotomy, the increase in access to high-volume hospitals was more rapid for Hispanic compared with non-Hispanic patients (Table 1). For all surgeries, however, Hispanic patients continued to have lower predicted probabilities of accessing high-volume hospitals than non-Hispanic patients (eg, 2016 pancreatotomy: 48.8% [95% CI = 44.1% to 53.5%] vs 61.6% [95% CI = 60.5% to 62.8%]) (Figure 1).

In our study, we found an increase in rates of access to high-volume hospitals over time for all patients who require high-risk cancer surgery, including Black and Hispanic patients, but racial disparities persisted without a change in the gap between Black and non-Black patients over time for 3 of the 4 cancers. Although disparities between Hispanic and non-Hispanic patients also remained, the gap narrowed for 2 of the 4 cancers. Our study adds to previous literature by assessing access to high-volume hospitals for minoritized populations for more than a decade, using data from all 50 states (6,7).

The fact that racial disparities—and some ethnic disparities—were observed after adjusting for sociodemographic characteristics suggests that structural racism plays a role. This finding is in line with prior reports in the cancer population in which Black patients have been shown to have higher rates of postoperative mortality and complications, even after accounting for social characteristics (8). Ultimately, these findings raise the concern that initiatives such as regionalization of high-risk cancer surgeries might be resulting in the unintended consequence of worsening access to high-quality care for minoritized populations (9).

Although the NCDB captures 70% of new cancer diagnoses, our findings might not reflect access to Commission on Cancer nonaccredited hospitals, which tend to be smaller and more rural (10). Furthermore, the NCDB does not capture other underlying patient-specific factors that can lead to lack of access to high-volume hospitals (eg, access to transportation, social support); therefore, we could not include them in our analysis. It is also important to note that our study focuses on patients who received surgery which represents a single point on the cancer

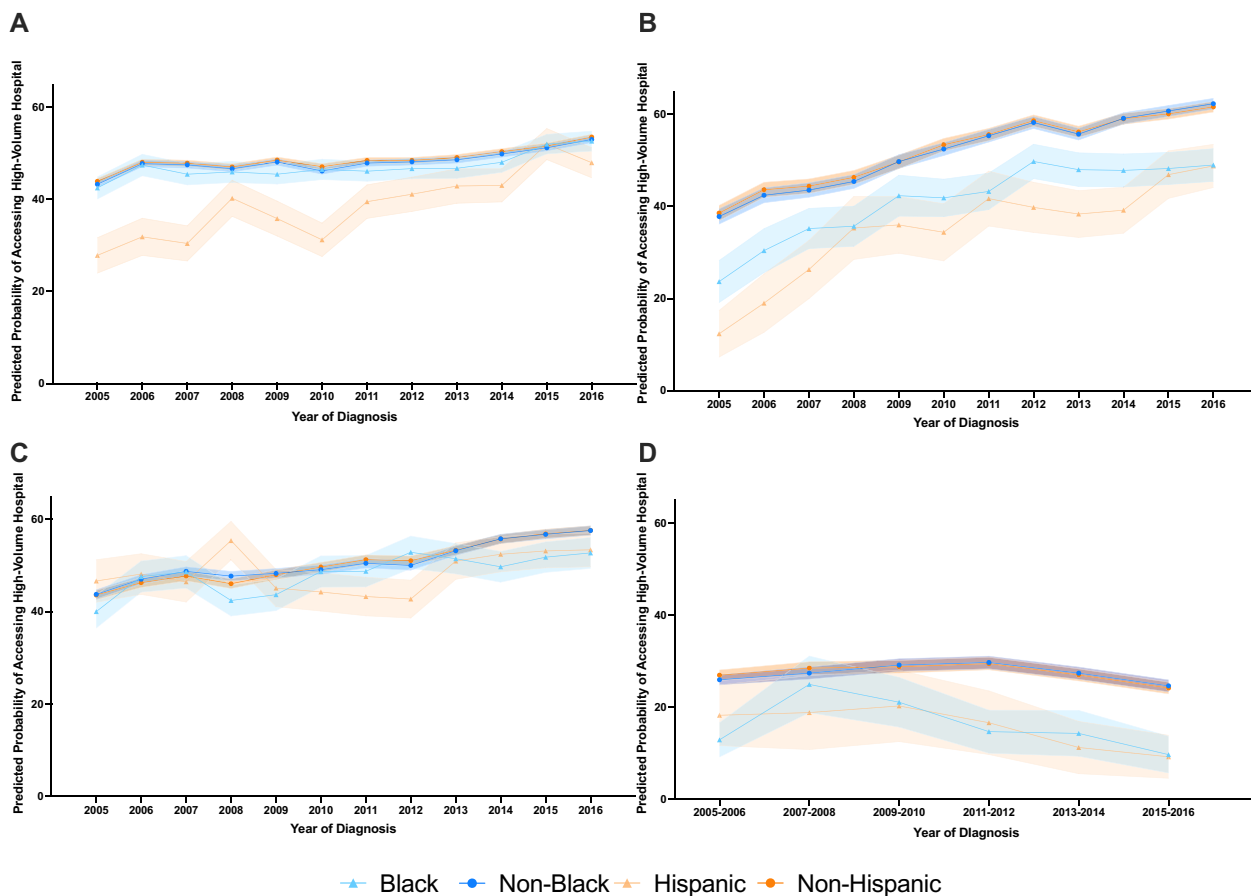


Figure 1. Predicted probabilities of accessing high-volume hospitals for high-risk cancer surgeries by race and ethnicity. A) Lung resection; B) pancreatectomy; C) proctectomy; D) esophagectomy. Shaded areas of the curves indicate 95% confidence intervals.

care continuum. Nevertheless, our study underscores that even though regionalization of high-risk cancer surgeries appears to be happening, ongoing efforts are needed to guarantee equitable access to high-volume hospitals.

Funding

This work was supported by the Yale National Clinician Scholars Program and by CTSA Grant Number TL1 TR001864 from the National Center for Advancing Translational Science, a component of the National Institutes of Health.

Notes

Role of the funder: The funder had no role in any portion of the study. The funder supported author MCS with a stipend throughout the period of academic development during which this study was completed.

Disclosures: The authors have no potential conflict of interest related to this study.

Author contributions: Conceptualization: MCS, MEC, LWH, KGB, JR, DJB, CPG. Data curation: MCS, MEC, CPG. Formal analysis: MCS, MEC. Methodology: MCS, MEC, LWH, KGB, JR, DJB, CPG. Project administration: MCS. Supervision: KGB, JR, DJB, CPG. Writing—original draft: MCS, MEC, LWH, CPG. Writing—review and editing: MCS, MEC, LWH, KGB, JR, DJB, CPG.

Disclaimers: This manuscript and its contents are solely the responsibility of the authors and do not necessarily represent the official view of the National Institutes of Health.

Data Availability

The data used for this study are available upon request.

References

- Finks JF, Osborne NH, Birkmeyer JD. Trends in hospital volume and operative mortality for high-risk surgery. *N Engl J Med*. 2011;364(22):2128–2137.
- Birkmeyer JD, Siewers AE, Finlayson EVA, et al. Hospital volume and surgical mortality in the United States. *N Engl J Med*. 2002;346(15):1128–1137.
- Leapfrog ratings: complex adult and pediatric surgery. Group TL Web site. <https://ratings.leapfroggroup.org/measure/hospital/complex-adult-surgery>. Accessed December 27, 2021.
- Birkmeyer JD, Dimick JB. Potential benefits of the new Leapfrog standards: effect of process and outcomes measures. *Surgery*. 2004;135(6):569–575.
- Stitzenberg KB, Sigurdson ER, Egleston BL, Starkey RB, Meropol NJ. Centralization of cancer surgery: implications for patient access to optimal care. *J Clin Oncol*. 2009;27(28):4671–4678.
- Liu JH, Zingmond DS, McGory ML, et al. Disparities in the utilization of high-volume hospitals for complex surgery. *JAMA*. 2006;296(16):1973–1980.
- Sheetz KH, Chhabra KR, Smith ME, Dimick JB, Nathan H. Association of discretionary hospital volume standards for high-risk cancer surgery with patient outcomes and access, 2005–2016. *JAMA Surg*. 2019;154(11):1005–1012.
- Lam MB, Raphael K, Mehtsun WT, et al. Changes in racial disparities in mortality after cancer surgery in the US, 2007–2016. *JAMA Netw Open*. 2020;3(12):e2027415.
- Schwartz DM, Fong ZV, Warshaw AL, Zinner MJ, Chang DC. The hidden consequences of the volume pledge: “No Patient Left Behind”? *Ann Surg*. 2017;265(2):273–274.
- National Cancer Database. American College of Surgeons Web site. <https://www.facs.org/Quality-Programs/Cancer/NCDB>. Accessed December 5, 2021.