Journal of Gastrointestinal Surgery (2019) 23:1900–1910
https://doi.org/10.1007/s11605-018-4015-3

ORIGINAL ARTICLE

Combining Surgical Outcomes and Patient Experiences to Evaluate Hospital Gastrointestinal Cancer Surgery Quality

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Received: 20 June 2018 / Accepted: 12 October 2018 / Published online: 29 October 2018

Abstract

Background Assessments of surgical quality should consider both surgeon and patient perspectives simultaneously. Focusing on patients undergoing major gastrointestinal cancer surgery, we sought to characterize hospitals, and their patients, on both these axes of quality.

Methods Using the American College of Surgeons' National Surgical Quality Improvement Program registry, hospitals were profiled on a risk-adjusted composite measure of death or serious morbidity (DSM) generated from patients who underwent colectomy, esophagectomy, hepatectomy, pancreatectomy, or proctectomy for cancer between January 1, 2015 and December 31, 2016. These hospitals were also profiled using the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey. Highest-performing hospitals on both quality axes, and their respective patients, were compared to the lowest-performing hospitals.

Results Overall, 60,526 patients underwent their cancer operation at 530 hospitals. There were 38 highest- and 48 lowest-performing hospitals. The correlation between quality axes was poor ($\rho = 0.10$). Compared to the lowest-performing hospitals, the highest-performing hospitals were more often NCI-designated cancer centers (29.0% vs. 4.2%, $p = 0.002$) and cared for a lower proportion of Medicaid patients (0.14 vs. 0.23, $p < 0.001$). Patients who had their operations at the lowest- versus highest-performing hospitals were more often black (17.2% vs. 8.4%, $p < 0.001$), Hispanic (8.3% vs. 3.5%, $p < 0.001$), functionally dependent (3.8% vs. 0.9%, $p < 0.001$), and not admitted from home (4.4% vs. 2.4%, $p < 0.001$).

Conclusions Hospital performance varied when assessed by both risk-adjusted surgical outcomes and patient experiences. In this study, poor-performing hospitals appeared to be disproportionately serving disadvantaged and minority cancer patients.

Keywords NSQIP · Cancer surgery · Outcomes · Patient-reported experiences · Patient-reported outcomes · Quality

Prior Presentation: This work was presented at the 71st SSO Annual Cancer Symposium, March 21–24, 2018, Chicago, IL as an oral presentation.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s11605-018-4015-3) contains supplementary material, which is available to authorized users.

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Introduction

Measuring surgical outcomes, such as morbidity and mortality, is critical for quality improvement. However, these traditional metrics might overlook the patient's perspective.[1,2] One approach to improve patient-centered care is by measuring—and acting on—patients' experiences with their care. In the USA, the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey is the most frequently used tool to assess the patient experience.[3,4] More than 3.1 million patients completed HCAHPS surveys in 2017, and their responses are used to hold the healthcare system accountable through public reporting and pay-for-performance incentives.[5,6]

Patient-reported experiences (PREs) data are becoming increasingly recognized as important in surgical care, particularly to improve the patient-centeredness of care. Numerous studies have searched for a link between PREs as measured by the HCAHPS and surgical outcomes, hypothesizing that improvement in one axis might lead to improvement in the other, thereby legitimizing PREs data.[7–11] Although such a link might be important to delineate, PREs and surgical outcomes could represent two distinct axes of quality requiring simultaneous optimization.[12] Accepting that, hospital performance might be better assessed and more patient-centered if both risk-adjusted surgical outcomes and PREs data were used in tandem. Focusing on patients undergoing major gastrointestinal cancer surgery, the objective of this study was to understand whether hospital performance varied on both these axes of quality and, if so, to characterize the highest- and lowest-performing hospitals, and their patients. Specifically, this study aimed to answer the following questions: Can hospitals with both the lowest risk-adjusted surgical complications and the highest PREs scores be identified? And are these hospitals different than hospitals with both the highest risk-adjusted surgical complications and the lowest PREs scores in terms of their structural characteristics and patient populations? By combining PREs and surgical outcomes to evaluate hospital performance in this way, a more patient-centered approach might be possible.

Methods

Data Sources and Study Cohort

Two main data sources were merged for this cohort study: American College of Surgeons' National Surgical Quality Improvement Program (ACS NSQIP) registry and CMS Hospital Compare HCAHPS data.

Clinical data were obtained from the ACS NSQIP. Patients who underwent colectomy, esophagectomy, hepatectomy, pancreatectomy, or proctectomy for cancer between January 1, 2015 and December 31, 2016 at US hospitals participating in the ACS NSQIP were included. Because gastrointestinal cancer patients have long relationships with their surgeons and thus may have a differential impact on PREs, only these patients and operations were selected for study.

PREs data were obtained from the HCAHPS survey, publicly available on the Centers for Medicare and Medicaid Services (CMS) Hospital Compare website as hospital-level scores. Survey responses were from patients discharged between October 1, 2015 and September 30, 2016. Six HCAHPS subscales with potential for healthcare provider improvement were studied: subscale 1, communication with nurses; subscale 2, communication with physicians; subscale 3, responsiveness of hospital staff; subscale 4, pain management; subscale 5, discharge information; and subscale 6, care transition. Because the two global HCAHPS items were highly correlated ($\rho = 0.91$), only the Willingness to Recommend Hospital item was included. The linear score rather than the top-box score was used for each subscale because the linear score applies adjustments for the effects of patient mix, service line, survey mode, and quarterly weighting. Scores ranged from 0 to 100, where higher scores are better (i.e., patients reported better experiences with their care). Hospitals without HCAHPS data were necessarily excluded ($n = 6$).

Hospital characteristics, such as academic affiliation, nurse staffing, and availability of oncology-relevant support services, were obtained from the American Hospital Association (AHA) annual survey database and merged to the ACS NSQIP data.

The Advarra IRB deemed this study exempt as it used pre-existing, de-identified patient data, and publicly available hospital data.

Outcomes

The primary surgical outcome was a composite of death or at least one of the following serious morbidities (DSM) occurring within 30 days from the index operation regardless of discharge status: cardiac arrest requiring cardiopulmonary resuscitation, myocardial infarction, venous thrombosis or pulmonary embolism requiring therapy, sepsis, septic shock, deep incisional surgical site infection (SSI), organ space SSI, wound disruption, unplanned reintubation, pneumonia, progressive renal insufficiency, acute renal failure, urinary tract infection (UTI), or reoperation. Patients with SSI, pneumonia, sepsis, or UTI, who were intubated, or who required dialysis at the time of the operation were not treated as postoperative adverse events as they were present at time of surgery.

The primary patient experience outcome was a composite of the seven HCAHPS subscales, formed by taking the geometric mean of the linear scores.[13]

Statistical Analyses

Continuous variables were compared using Student's *t* test or Wilcoxon's rank sum test, where appropriate, and categorical variables were compared with χ^2 or Fisher's exact tests for association. Tests of significance were two-sided with $\alpha = 0.05$. SAS v9.4 (SAS Institute; Cary, NC) was used. The primary unit of analysis was hospitals.

To identify the highest- and lowest-performing hospitals, each hospital was assigned a performance quartile based on their risk-adjusted surgical outcomes from ACS NSQIP data and, separately, their HCAHPS survey results from CMS data.

To profile each hospital using surgical outcomes, a hierarchical logistic multivariable regression model was constructed predicting DSM with hospitals as random intercepts.[14] Hospital-level risk-adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were generated, comparing each hospital to the statistically estimated "average" hospital if it were treating the same types of patients. Variables included for risk adjustment were selected using a stepwise process from all available patient demographic, comorbidity, and perioperative data. Hospitals were then sorted into quartiles based on their ORs, such that an equal number of hospitals were in each quartile. Hospitals in the top quartile had better risk-adjusted outcomes than those in the bottom quartile.

To profile hospitals using PREs data, hospitals were sorted into quartiles based on the calculated composite of linear scores. Again, each hospital was assigned two performance quartiles: one based on its risk-adjusted DSM outcomes and one based on its HCAHPS scores. Hospitals in the top quartiles on both axes of quality were deemed the highest-performing hospitals, and those in the bottom quartiles on both axes were deemed the lowest-performing. Patient and hospital characteristics between the highest- and lowest-performing hospitals were compared.

As an exploratory analysis, hospitals performing the highest on surgical outcomes (i.e., DSM composite, ACS NSQIP data) and lowest on HCAHPS scores (i.e., HCAHPS composite, CMS Hospital Compare data) were compared to hospitals performing the lowest on surgical outcomes and highest on HCAHPS scores.

Sensitivity Analyses

Three sensitivity analyses were performed to test the robustness of results. First, because of methodological concerns when including mortality in studies of PREs,[15] analyses were repeated with 30-day mortality excluded from the primary surgical outcome. Second, because the "Willingness to Recommend Hospital" item could be considered a summary measure of the other six HCAHPS subscales or a measure of "satisfaction" as opposed to "experience,"[7] analyses were repeated with it excluded from the primary patient-experience composite. Last, because the majority of cases in this study were performed for colon cancer, all analyses were repeated on this subgroup of patients. None of these sensitivity analyses altered the results; thus, only the primary analysis is presented.

Results

Surgical Outcomes

Overall, 60,526 patients underwent their cancer operations at 530 ACS NSQIP hospitals. Table 1 reports patient characteristics. The unadjusted DSM rate was 16.8%. The median number of operations per hospital was 62 (interquartile range [IQR] 28–136), and the median DSM rate across hospitals was 16.7% (IQR 11.6–20.8%). After risk adjustment, there was statistically significant variation in DSM performance across the 530 hospitals studied ($p < 0.001$); Fig. 1 depicts risk-adjusted hospital performance on DSM. The lowest hospital OR was 0.63 and the highest 1.81 (mean 1.01, median 1.00), representing a nearly threefold difference in performance.

Patient-Reported Experiences

Figure 2 depicts the distributions of HCAHPS scores for each subscale separately. On average, across hospitals, patients reported their experiences with physician communication the highest (91.7 ± 1.6, mean ± SD), whereas patients reported their understanding of their care when they left the hospital the lowest (aka Care Transition; 81.9 ± 2.0). Patients rated their experiences with nurse communication an average 91.5 ± 1.7, hospital staff responsiveness 84.4 ± 3.1, pain management 87.4 ± 1.8, and discharge information 87.3 ± 2.5. Patients reported their willingness to recommend their hospital an average of 89.6 ± 3.1. When combined into a composite, the average score, across hospitals, was 87.6 ± 1.9.

Surgical Outcomes and Patient-Reported Experiences

Figure 3 depicts each hospital's performance based on their risk-adjusted DSM outcomes and HCAHPS composite score. There were 38 hospitals in the top quartiles (highest-performing) and 48 hospitals in the bottom (lowest-performing). In this study, the highest-performing hospitals had on average 9.5 ± 6.1% higher response rates on the HCAHPS as compared to lowest-performing hospitals ($p < 0.001$). The correlation between quality axes was poor ($\rho = 0.10$).

Table 1 Characteristics of patients who had their cancer operation at the 530 ACS NSQIP hospitals studied

Characteristics	Number (%)
Age (years), mean (SD)	64.6 (13.3)
Female	28,577 (47.2)
Race	
Asian	2673 (4.4)
Black or African-American	6131 (10.1)
Other/unknown	3382 (5.6)
White	48,340 (78.9)
Hispanic ethnicity	3650 (6.0)
Body mass index class	
Underweight	1520 (2.5)
Normal	18,488 (30.6)
Overweight	20,406 (33.7)
Class 1 obesity	11,913 (19.7)
Class 2 obesity	4954 (8.2)
Class 3 obesity	3245 (5.4)
ASA physical classification	
1–2	20,050 (33.1)
3	36,782 (60.8)
4–5	3694 (6.1)
Ventilator dependent	41 (0.1)
History of COPD	3121 (5.2)
Ascites	400 (0.7)
History of CHF	619 (1.0)
Dialysis dependent	285 (0.5)
Disseminated cancer	8514 (14.1)
Chronic steroids	1837 (3.0)
Recent weight loss	4244 (7.0)
Bleeding diathesis	2215 (3.7)
Smoking	9661 (16.0)
Hypertension requiring medications	31,499 (52.0)
Diabetes	
Insulin dependent	4445 (7.3)
Oral	7509 (12.4)
Dyspnea	4353 (7.2)
Dependent functional status	1228 (2.0)
Preoperative SIRS/sepsis or shock	1689 (2.8)
Emergency	1522 (2.5)
Not admitted from home	1878 (3.1)
Operation	
Colectomy	37,034 (61.1)
Esophagectomy	2126 (3.5)
Hepatectomy	6691 (11.1)
Pancreatectomy	9599 (15.9)
Proctectomy	5076 (8.4)
Cancer diagnosis	60,526 (100)

ASA American Society of Anesthesiologists, *COPD* chronic obstructive pulmonary disease, *CHF* congestive heart failure, *SIRS* systemic inflammatory response syndrome

In terms of structural characteristics, the highest-performing hospitals, as compared to the lowest-performing, were more often National Cancer Institute (NCI)-designated cancer centers (29.0% vs. 4.2%, $p = 0.002$; Table 2), had higher nurse staffing (5.12 vs. 4.48, $p = 0.01$), and served a lower proportion of Medicaid patients (0.14 vs. 0.23, $p < 0.001$). Highest-performing hospitals in this study were also more often American Nurses Credentialing Center (ANCC) Magnet recognized as compared to the lowest-performing hospitals. There were no differences in terms of hospital ownership, academic affiliation, location, oncology-relevant support services, size, or number of trainees (Table 2).

In terms of patient population characteristics, patients who had their cancer operation at the highest-performing hospitals were on average 1.4 years younger ($p < 0.001$) and were more frequently white (84.5% vs. 66.2%, $p < 0.001$) and non-Hispanic (3.5% vs. 8.3%, $p < 0.001$) as compared to those who had their cancer operation at the lowest-performing hospitals (Table 3). Although patients who had their cancer operation at the highest-performing hospitals more frequently had advanced stages of cancer (14.8% vs. 12.9%, $p = 0.002$), they less frequently had chronic conditions, such as hypertension (48.9% vs. 54.5%, $p < 0.001$), diabetes (17.9% vs. 22.6%, $p < 0.001$), or smoking (14.7% vs. 19.1%, $p < 0.001$) as compared to those who had their cancer operation at the lowest-performing hospitals. Furthermore, patients who went to the highest-performing hospitals were more functionally independent and more often admitted from home.

Supplemental Tables 1 and 2 depict the results of our exploratory analyses comparing hospitals with the highest risk-adjusted surgical outcomes and lowest HCAHPS scores to hospitals with the lowest risk-adjusted surgical outcomes and highest HCAHPS scores.

Discussion

Patient-reported experiences (PREs) have largely been neglected in the realm of surgical quality improvement due to assumptions that patient-reported data are less reliable and less valid than data obtained from medical record review and abstraction. However, well-developed and standardized PRE measures can complement traditional surgical outcomes by generating information about aspects of care quality for which patients are the best or only source, such as the degree to which care is respectful and responsive to their needs (i.e., patient-centered). When used in conjunction with surgical outcomes data to evaluate hospital performance, PREs could expand the traditional mindset of surgical quality measurement to one that is more patient-centered.

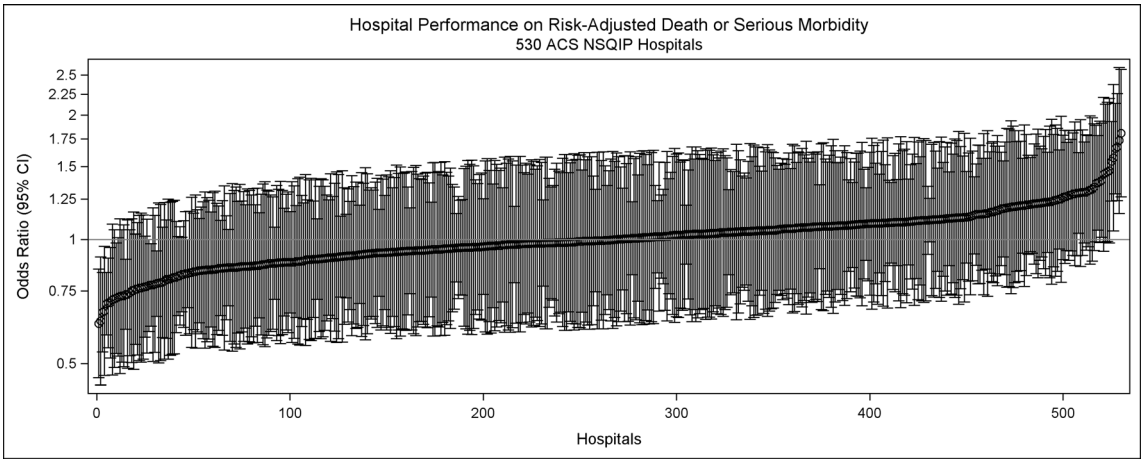

Fig. 1 Hospital performance based upon risk-adjusted death or serious morbidity (DSM) using ACS NSQIP data. Patients included were those who underwent their operation for a diagnosis of cancer (see text for details). Hospitals with better-than-average outcomes tend towards the left, whereas hospitals with worse-than-average outcomes tend towards the right

In this study, we first aimed to determine whether hospital performance could be assessed by both risk-adjusted surgical outcomes, as measured by the ACS NSQIP, and PREs, as measured by the HCAHPS survey. Using patients undergoing major gastrointestinal cancer surgery as an exploratory prototype, we detected significant hospital-level variation when these quality metrics were used together, reinforcing the idea that "quality" is multidimensional and both surgical outcomes and PREs could be used simultaneously to assess hospital cancer surgery quality.

Unlike the current study, others have examined the association between PREs, patient satisfaction, and surgical outcomes with the idea that demonstrating such a link would lend validity to patient-reported data. Most yielded heterogeneous findings.[3,7,8] For example, Tsai and colleagues studied more than 2900 hospitals and reported an inverse association between patient satisfaction and length of stay, readmission, and perioperative mortality.[9] However, other studies found little-to-no association.[10,11,16–18] A possible explanation for the mixed results in the literature may be a fundamental misunderstanding of patient experience and overall ratings of care.[1,3,7] An overall rating of care represents the gap between patient expectations and their actual experience. Patients tend to overrate an overall rating due to gratification bias, particularly in the treatment of cancer. Therefore, the validity and usefulness of overall ratings are limited, particularly for quality improvement purposes. In contrast, patient experience is defined as things that happen to patients and the extent that patients' needs are met.[3] Measures of the patient experience should inquire about specific care experiences, such as whether nurses and physicians listened carefully, rather than on rating aspects of care or treatment, so that the PREs data are meaningful to healthcare providers, policymakers, and patients.[12,19] Future studies would benefit from focusing on measures of the patient experience rather than simplistic summaries of overall ratings of care.

Another explanation for the heterogeneity of associations between PREs and surgical outcomes is that they represent two distinct axes of quality, each warranting individual attention. Under this premise, we assessed hospital performance using these two quality axes simultaneously and found that hospitals could indeed be assessed in a more multidimensional approach that incorporates the key quality pillar of patient-centeredness.

The second aim of this study was to identify the structural characteristics and the patient population of the highest- as compared to the lowest-performing hospitals. We identified several hospital structural metrics of quality that differed between them, including NCI cancer center designation, nurse staffing levels, and proportion of Medicaid patients. It is not surprising that NCI-designated cancer centers have more structural characteristics of quality as accreditation has historically been based on the availability of these resources.[20,21] Nevertheless, this suggests that regionalization of care into centers of excellence would naturally follow, which carries downstream implications (e.g., disparities in access). For example, using a "mystery shopper" approach, Hamlyn et al.[22] studied the difficulty for patients to obtain a consultation at NCI-designated cancer centers and suggested that Medicaid patients were more likely to have to wait a week or more for an appointment than privately insured patients. This worrisome pattern is paralleled in our finding of the highest-performing hospitals more frequently caring for a lower proportion of Medicaid patients.

Previous studies have reported a positive association between nurse staffing levels and improved patient experiences as measured with the HCAHPS survey.[23,24] Similarly, studies

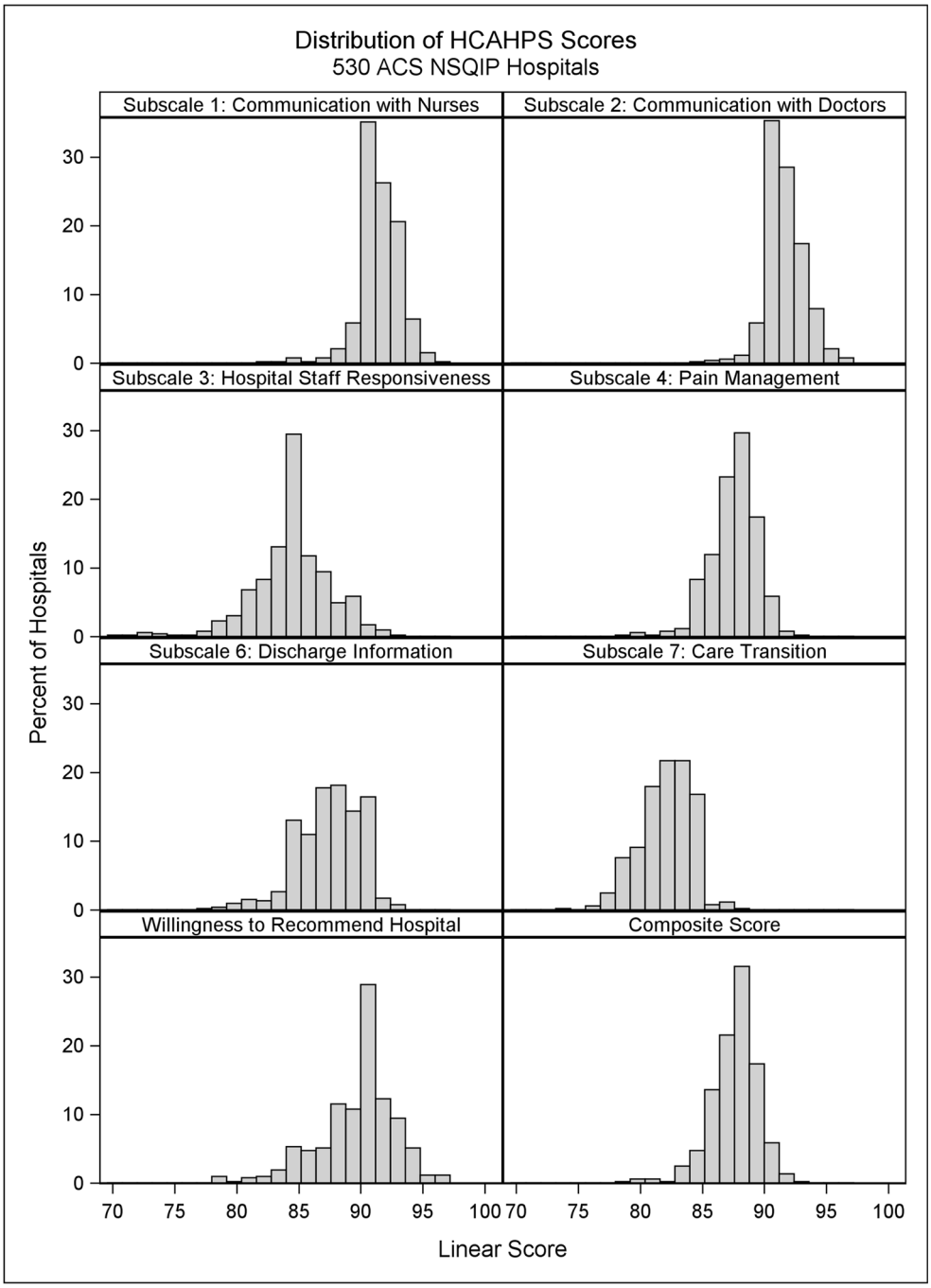

Fig. 2 Distribution of individual HCAHPS measure linear scores and composite score. Linear scores ranged from 0 to 100, where higher is better. The composite score was obtained by taking the geometric mean of the other seven HCAHPS measures

have reported a positive association between nurse staffing levels and clinical outcomes.[25–28] Our results highlight the findings of these studies that have examined PREs and clinical outcomes separately. The implications of our findings, however, are challenging to resolve because of limited resources and rising healthcare costs. Although California and Massachusetts have legislation regarding minimum nurse-to-patient ratios, other states do not, and further research and policymaking are needed to address this structural metric.[29,30] Magnet recognition by the American Nurses' Credentialing Center (ANCC) may be one avenue for improvement, but creating a culture of safety and trust is likely to be most ideal independent of accreditation.

We also identified several differences in the patients who had their cancer operations at the highest- and lowest-performing hospitals. The lowest-performing hospitals tended to care for minority patients, have patients with more chronic conditions, such as diabetes and hypertension, and poorer functional status. Quality improvement initiatives aimed at preparing patients for surgery (e.g., "prehabilitation") are

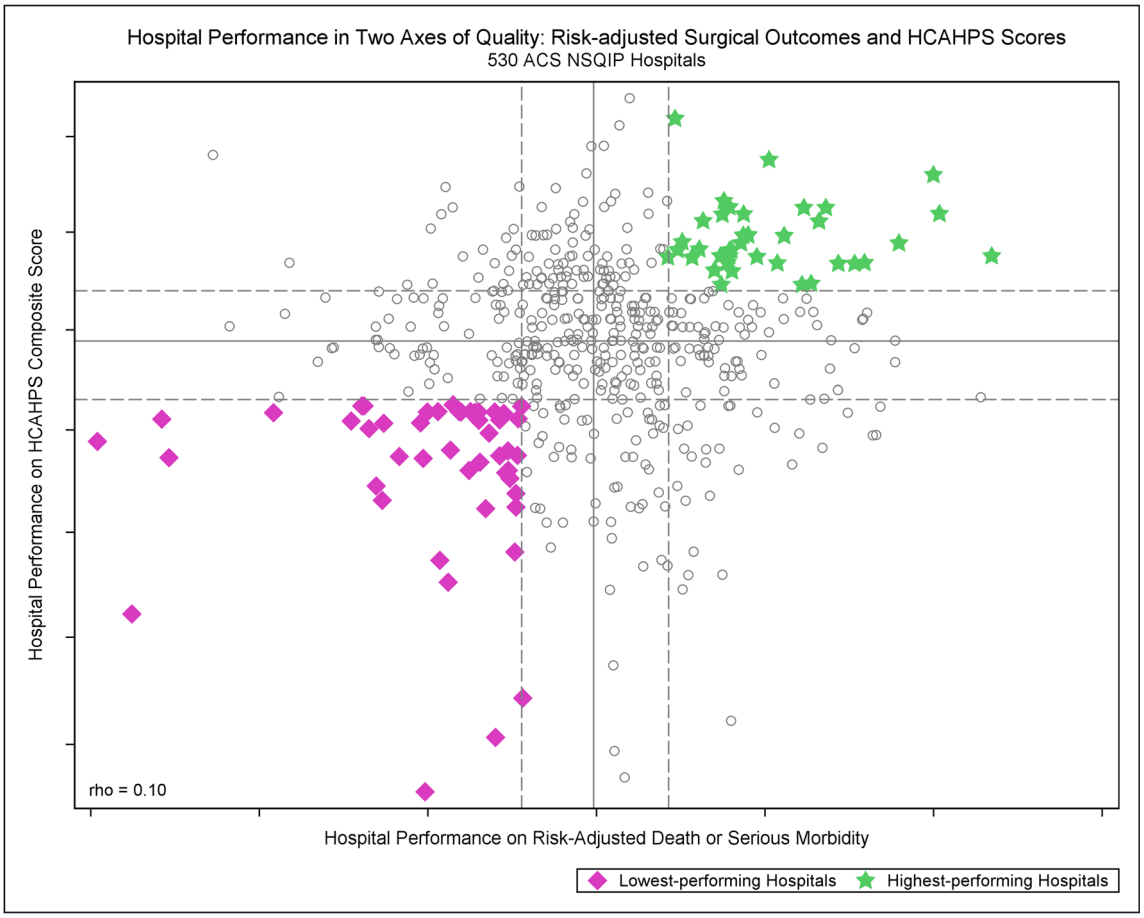

Fig. 3 Hospital performance along two quality axes: death or serious morbidity (DSM, *x*-axis) and HCAHPS composite score (*y*-axis). Solid lines represent medians in each dimension, and dashed lines represent the 25th and 75th percentiles. In this study, the highest-performing hospitals were those in the top quartiles for both DSM and HCAHPS performance (i.e., star markers, top-right, $n = 38$), whereas the lowest-performing hospitals were those in the bottom quartiles (i.e., diamond markers, bottom-left, $n = 48$). Correlation between the two dimensions was poor ($\rho = 0.10$)

likely to benefit the patients at these hospitals. Perioperative communication, including evidence-based risk reduction strategies and coordination with multidisciplinary providers (e.g., anesthesiologists, geriatricians), could potentially improve both surgical outcomes and PREs.[31,32] Moreover, initiatives aimed at streamlining care processes across all phases of surgical care, such as enhanced recovery protocols, hold promise.[33–35]

Although the potential quality improvement targets that we identified have been reported, our study findings serve two purposes. First, these structural and disparities in care further underscores the importance of these aspects of healthcare. Using two quality axes allows us to triangulate the most critical needs, namely social disparities, prevalence of chronic conditions, and nurse staffing levels. Second, the ability to detect previously identified patterns of quality gaps using this novel approach, which combines both PREs and surgical outcomes not only surgical outcomes, suggests the validity and feasibility of this two-pronged approach. Were these previously identified patterns not present, this dual approach to hospital quality assessment might not be as useful.

We posit that considering and interpreting hospital performance using both surgical outcomes and PREs simultaneously is an approach that could improve the patient-centeredness of surgical care. Though complications and mortality are critical to measure and to improve surgical care, they fundamentally do not consider the patient's perspective and are thus insufficient when considered alone. Failing to include the patient's voice when evaluating surgical quality represents a major gap that when addressed could significantly improve surgical quality. For example, a patient who did not experience any complications may be dissatisfied with the surgery she received because she was not able to return to her usual activities of daily living as she had hoped or because her postoperative pain did not resolve as she might have expected and compromised her quality of life. Therefore,

Table 2 Characteristics of the highest- versus lowest-performing hospitals

	Highest-performing hospitals ($n = 38$)	Lowest-performing hospitals ($n = 48$)	p
NCI-designated cancer center, *n* (%)	11 (29.0)	2 (4.2)	0.002
Commission on cancer accredited, *n* (%)	27 (71.1)	38 (79.2)	0.45
Rural location, *n* (%)	0 (0.0)	2 (4.2)	0.50
Hospital ownership, *n* (%)			0.17
Public	6 (15.8)	10 (20.8)	
For-profit	0 (0.0)	4 (8.3)	
Not-for-profit	32 (84.2)	34 (70.8)	
Teaching affiliation, *n* (%)			0.47
Major	17 (44.7)	27 (56.3)	
Minor	13 (34.2)	11 (22.9)	
Non-teaching	8 (21.1)	10 (20.8)	
Census region, *n* (%)			0.28
Midwest	12 (31.6)	9 (18.8)	
Northeast	7 (18.4)	17 (35.4)	
South	12 (31.6)	15 (31.3)	
West	7 (18.4)	7 (14.6)	
Patient representative services,[a] *n* (%)	36 (97.3)	44 (95.7)	1.00
Pain management program,[a] *n* (%)	30 (81.1)	40 (87.0)	0.55
ANCC Magnet Recognized Organization, *n* (%)	24 (63.2)	14 (29.2)	0.002
Palliative care program,[a] *n* (%)	34 (91.9)	40 (87.0)	0.72
Hospital beds, median (IQR)	336.5 (198–660)	425.5 (248.5–613.5)	0.55
Physicians, median (IQR)	22.5 (0–158)	19 (1.5–90.5)	0.94
Total personnel, median (IQR)	2340.5 (1466–6933)	2613 (1676–4252)	0.87
Total trainees, median (IQR)	11 (0–521)	42.5 (8–382)	0.24
Average daily census, median (IQR)	185 (121–496)	293 (176–460)	0.38
Nurse-to-bed ratio, median (IQR)	2.37 (1.94–3.47)	2.06 (1.66–2.30)	0.009
Nurse staffing level,[b] median (IQR)	5.12 (4.07–5.87)	4.48 (3.60–5.11)	0.01
Proportion inpatient Medicare days, median (IQR)	0.47 (0.41–0.59)	0.46 (0.38–0.51)	0.28
Proportion inpatient Medicaid days, median (IQR)	0.14 (0.10–0.22)	0.23 (0.19–0.32)	< 0.001

The highest-performing hospitals were those in the top quartiles for risk-adjusted death or serious morbidity outcomes and HCAHPS composite score, and the lowest-performing hospitals were those in the bottom (see text for details)

ANCC American Nurses Credentialing Center, *NCI* National Cancer Institute

[a] Effective sample size is 83 for these variables due to missing data

[b] Number of full-time nurses per 1000 patient days

complementing current surgical quality metrics with the patient's voice using PREs represents an opportunity to greatly improve the patient-centeredness of surgical care and healthcare quality overall. In the near future, the measurement of patient-reported outcomes (PROs) in addition to PREs will expand our ability to improve surgical care from the patient's perspective.[2]

This study should be interpreted considering several limitations. First, the ACS NSQIP represents a convenience sample of hospitals that chose to participate, and thus our findings might not be generalizable. Nevertheless, most ACS NSQIP hospitals are large, academic hospitals caring for most of complex gastrointestinal cancer patients, and all hospitals, regardless of ACS NSQIP participation, submit HCAHPS data to CMS. Second, as an observational study, confounding may be present. For instance, we did not have patient data on household income or insurance status (e.g., dually enrolled Medicare and Medicaid patients). Lastly, HCAHPS respondents include patients from service lines beyond surgery and not only those of surgical patients or cancer surgery patients. Therefore, the relationship between HCAHPS survey scores and the complications of patients in this study may not be generalizable to cancer surgery patients *en toto*. However, we analyzed the linear score, a patient mix-adjusted score, rather than the top-box score to account for this heterogeneity to the extent possible. How other diagnoses and indications

Table 3 Characteristics of patients who underwent their cancer operation at the highest- versus lowest-performing hospitals

	Patients at the highest-performing hospitals ($n = 9906$)	Patients at the lowest-performing hospitals ($n = 4920$)	p
Age (years) mean (SD)	63.5 (13.3)	64.9 (13.2)	< 0.001
Female	4642 (46.9)	2316 (47.1)	0.81
Race			< 0.001
Asian	347 (3.5)	404 (8.2)	
Black or African-American	835 (8.4)	847 (17.2)	
Other/unknown	350 (3.5)	411 (8.4)	
White	8374 (84.5)	3258 (66.2)	
Hispanic ethnicity	349 (3.5)	406 (8.3)	< 0.001
Body mass index class			< 0.001
Underweight	228 (2.3)	161 (3.3)	
Normal	3009 (30.4)	1556 (31.6)	
Overweight	3383 (34.2)	1621 (32.9)	
Class 1 obesity	2012 (20.3)	924 (18.8)	
Class 2 obesity	790 (8.0)	384 (7.8)	
Class 3 obesity	484 (4.9)	274 (5.6)	
ASA physical classification			< 0.001
1–2	3190 (32.2)	1700 (34.6)	
3	6191 (62.5)	2888 (58.7)	
4–5	525 (5.3)	332 (6.7)	
Ventilator dependent	7 (0.1)	5 (0.1)	0.55
History of COPD	455 (4.6)	231 (4.7)	0.80
Ascites	55 (0.6)	33 (0.7)	0.43
History of CHF	85 (0.9)	46 (0.9)	0.64
Dialysis dependent	38 (0.4)	21 (0.4)	0.68
Disseminated cancer	1466 (14.8)	634 (12.9)	0.002
Chronic steroids	357 (3.6)	135 (2.7)	0.006
Recent weight loss	637 (6.4)	407 (8.3)	< 0.001
Bleeding diathesis	357 (3.6)	166 (3.4)	0.51
Smoking	1455 (14.7)	940 (19.1)	< 0.001
Hypertension requiring medications	4847 (48.9)	2683 (54.5)	< 0.001
Diabetes			< 0.001
Insulin dependent	637 (6.4)	396 (8.0)	
Oral	1141 (11.5)	716 (14.6)	
Dyspnea	664 (6.7)	318 (6.5)	0.60
Dependent functional status	93 (0.9)	186 (3.8)	< 0.001
Preoperative SIRS/sepsis or shock	174 (1.8)	151 (3.1)	< 0.001
Emergency	149 (1.5)	173 (3.5)	< 0.001
Not admitted from home	233 (2.4)	217 (4.4)	< 0.001
Cancer operation			< 0.001
Colectomy	4669 (47.1)	3095 (62.9)	
Esophagectomy	636 (6.4)	139 (2.8)	
Hepatectomy	1522 (15.4)	514 (10.4)	
Pancreatectomy	1991 (20.1)	816 (16.6)	
Proctectomy	1088 (11.0)	356 (7.2)	

Values represent n (%), unless otherwise noted. The highest-performing hospitals were those in the top quartiles for risk-adjusted death or serious morbidity outcomes and HCAHPS composite score, and the lowest-performing hospitals were those in the bottom (see text for details)

ASA American Society of Anesthesiologists, *COPD* chronic obstructive pulmonary disease, *CHF* congestive heart failure, *SIRS* systemic inflammatory response syndrome

for surgery impact both hospital performance and HCAHPS scores deserves further study. Furthermore, the experiences measured using the HCAHPS might not be reflective of the unique surgical patient experience. Unless the CAHPS Surgical Care (S-CAHPS) survey becomes more widely adopted,[36] researchers will remain restricted to currently available data to generate insights.

In conclusion, the patient-centeredness of traditional quality metrics that use surgical outcomes to assess hospital performance could be improved by simultaneously considering patient-reported experiences. A broader perspective of surgical quality measurement that considers the patient perspective should be considered moving forward.

Author Contributions All authors contributed significantly to the study and meet all four criteria set forth by the ICMJE.

Funding There was no specific funding for this research. JBL is supported by the American College of Surgeons Clinical Scholars in Residence Program.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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