

# Economic Disparities in Patients Undergoing Sigmoidectomy

Sean Neifert, BS, Nicole Ilonzo, MD, Jeanie L. Gribben, BS, I. Michael Leitman, MD, FACS

## ABSTRACT

**Background and Objectives:** Disparities in health care outcomes and resources utilized are present in the treatment of many conditions and represent an area for targeted improvement. This study analyzes the differences in outcomes and total hospital charges between the highest and lowest income quartiles of patients undergoing sigmoid colectomy.

**Methods:** This retrospective cohort study included patients undergoing sigmoid colectomy from 2013 to 2014 queried from the Agency for Healthcare Research and Quality National Inpatient Sample Database who were categorized as the lowest and highest income quartile based on average income of the patient's ZIP code. Patients were grouped into income quartiles, as defined by average income in the ZIP code of residence. In-hospital complications were the primary outcome of this study. We hypothesized that patients in the lowest income quartile would have poorer outcomes than those in the highest income quartile prior to data collection.

**Results:** The lowest ( $n = 40,995$ ) and highest ( $n = 40,940$ ) income quartiles are not significantly different based on age or gender. The lowest income quartile was sicker, with higher mean scores for the All Patient Refined Diagnosis Related Group Severity Index and All Patient Refined Diagnosis Related Group Risk of Mortality Index. The lowest income quartile cohort had higher rates of postoperative complications and higher total charges than those in the highest income quartile. Adjusted regression

analysis showed significantly lower total charges for the lowest income quartile but no significant differences in overall complications, mortality rates, or nonhome discharge.

**Conclusions:** Patients in the highest income quartile utilize more hospital resources than the lowest income quartile. Additional study is required to understand why these differences exist.

**Key Words:** Disparities, Hospital charges, Patient income, Sigmoidectomy, Socioeconomic status.

**Key Points:** 1. Significant differences in outcomes and hospital charges exist between socioeconomic groups undergoing sigmoidectomy. 2. There does not seem to be a difference in outcomes after sigmoidectomy among different socioeconomic groups. 3. Elective and laparoscopic sigmoid colectomy is more frequently applied to higher socioeconomic groups. 4. Hospital charges are also greater among patients of higher socioeconomic groups undergoing sigmoid colectomy.

**Question:** Does socioeconomic status affect outcomes and total charges in patients undergoing sigmoid colectomy?

**Findings:** Unadjusted analysis showed significant disparities between the highest and lowest income quartile in outcomes after sigmoid colon resection. Adjusted analysis showed no difference in outcomes, with patients in the highest income quartile having higher total charges.

**Meaning:** There is a value difference between high-income and low-income patients undergoing sigmoid colectomy.

Icahn School of Medicine at Mount Sinai, New York, New York (Mr. Neifert, Ms. Gribben, and Dr. Leitman).

Mount Sinai St. Luke's/West, New York, New York (Dr. Ilonzo).

Conflicts of Interest: All authors declare no conflict of interest regarding the publication of this article.

Informed consent: Dr. Leitman declares that written informed consent was obtained from the patient for publication of this study/report and any accompanying images.

Address correspondence to: I. Michael Leitman, MD, Icahn School of Medicine at Mount Sinai, One Gustave L. Levy Place, Box 1076, New York, NY 10029. E-mail: michael.leitman@mssm.edu

DOI: 10.4293/JSLS.2018.00066

© 2018 by JSLS, *Journal of the Society of Laparoendoscopic Surgeons*. Published by the Society of Laparoendoscopic Surgeons, Inc.

## INTRODUCTION

Sigmoid colon resection is commonly performed for diverticular disease and malignant neoplasms.<sup>1</sup> It may be performed with a primary anastomosis or as a Hartmann procedure, in which an end-colostomy is created with a closed anorectal stump.<sup>2</sup> The operation is more frequently being performed laparoscopically because of lower rates

of associated morbidity and mortality,<sup>3–5</sup> and conversion to an open laparotomy approach in the event of laparoscopic approach failure has been shown to increase morbidity and mortality.<sup>5</sup>

Socioeconomic disparities in morbidity and mortality following surgical procedures have been reported in the literature.<sup>6</sup> Low socioeconomic status (SES) has also been shown to correlate with length of stay and resource usage.<sup>7,8</sup> These differences have been widely attributed to characteristics of the hospitals treating those with low SES rather than patient characteristics.<sup>9,10</sup> However, SES disparities in care might be affected by disease progression, race, and insurance status, indicating that the root cause of these disparities might be more complex than originally considered.<sup>8,10</sup>

Much of the prior research into SES and its effect on colon resection morbidity and mortality is in the field of cancer. However, sigmoid colectomy is regularly performed for diverticulitis as well. The present study investigates the differences in outcomes between the lowest and highest income quartiles as defined by the average income of the patient's ZIP code as a proxy for the socioeconomic status of a patient group. We hypothesize that, based upon previous literature: the lowest-income-quartile patients will have higher rates of morbidity and mortality than those in the highest income quartile.

## METHODS

Data were queried from the National Inpatient Sample (NIS–Healthcare Cost and Utilization Project) calendar years 2013–2014.<sup>11,12</sup> The NIS is a weighted sample of 20% of discharges from all hospitals across the United States. The American Hospital Association Annual Survey of Hospitals is used to identify all hospitals in the sampling universe, and hospitals are then stratified by US Census division, urban or rural location, teaching status, ownership, and bed size. Discharges are then sampled in a systematic, random manner from all participating hospitals. Patient incomes in the NIS are codified by average income for the ZIP code of their residence, which was recently shown to be the preferred method for investigating health disparities based on income.<sup>13</sup>

Patients undergoing laparoscopic and open sigmoidectomy were identified by International Classification of Disease, ninth revision, codes 17.36 and 45.76, respectively. Demographic variables queried and analyzed included age, gender, race, primary insurance payer, and elective procedure. The All Patient Refined Diagnosis Re-

lated Group (APR-DRG) Severity of Illness and Risk of Mortality scores were also queried for each patient. Postoperative complications identified using Clinical Classification Software (CCS) codes included acute myocardial infarction (CCS 100), acute renal failure (CCS 157), and pneumonia (CCS 122). Postoperative complications identified using International Classification of Disease, ninth revision, codes included cardiac arrest (997.1 and 427.5), cerebrovascular accident (997.02), deep vein thrombosis (997.2 and 453.40), acute respiratory failure (518.81), failure to wean (997.3 and 997.39), ventilator-associated pneumonia (997.31), pulmonary embolism (415.11 and 415.19), postoperative anemia (285.1), procedural hemorrhage (998.1), accidental intraoperative laceration (998.2), wound dehiscence (998.32), wound infection (998.59), systemic inflammatory response syndrome or sepsis (995.91), severe sepsis (995.92), septic shock (998.02 and 785.52), urinary tract infection (599.0), peritonitis (567.567.0, 567.1, 567.2, 567.23, 567.8, and 567.9), ileus or bowel obstruction (560.9, 560.1, and 997.49), and peritoneal abscess (567.21). Patients who were discharged to anywhere other than home were grouped into a nonhome discharge group for analysis.

All statistical methods were performed on Statistical Analysis Software version 9.4 (SASv9.4, SAS Institute, Cary, NC). A value of  $P < .05$  was considered significant. Furthermore, specific statistical procedures were utilized to account for the stratification, clustering, and weighting of the discharges to create nationally representative results. For categorical variables,  $\chi^2$  and Fisher's exact test, when necessary, were utilized to compare differences between patients in the highest and lowest personal income quartiles. For continuous variables, means and linear regression models to calculate the significance of differences were calculated.

Propensity matching was based on the type of procedure (open vs. laparoscopic), age, length of stay, elective or emergent procedure, and both APR-DRG scores as indicators of patient comorbidity burden. The propensity matching was then applied to mortality rates, overall complication rates, rates of nonhome discharge, and total charges. Sequential modeling was performed to investigate confounding or causative variables for any disparities in outcomes between the two cohorts. In sequence, 5 models were conducted for each of the previously specified outcomes in the following order: univariate analysis, propensity matched, previous plus race and payer, previous plus number of diagnoses and number of procedures, and previous plus controlling for the facility at which the procedure was performed. Modeling for complication

rates, mortality rates, and rates of nonhome discharge were performed using logistic regression, and modeling for total charges was performed using linear regression.

**RESULTS**

The lowest and highest income quartiles are not significantly different, based on age (60.39 vs. 60.51,  $P = .62$ ) or gender (53.48% female vs. 52.67% female,  $P = .30$ ) (**Table 1**). However, the groups exhibit significant differences in the ethnic races of the patients ( $P < .0001$ ), with the highest income quartile cohort having a higher proportion of Caucasian patients (84.87% vs. 70.50%) and lower proportions of black (3.73% vs. 14.50%) and Hispanic (5.37% vs. 11.42%) patients than the lowest income quartile cohort (**Table 1**). Furthermore, the highest income quartile group had a significantly higher proportion of patients with private insur-

ance (52.58% vs. 33.15%) and lower proportions of patients with Medicaid (4.25% vs. 11.93%) and patients listed as self-pay (1.91% vs. 5.58%) than the lowest income quartile (**Table 1**). The highest income quartile had a higher degree of elective sigmoidectomy (63.10% vs. 51.42%,  $P < .0001$ ) and laparoscopic sigmoidectomy (45.26% vs. 29.58%,  $P < .0001$ ) than the lowest income quartile (**Table 1**). The lowest income quartile had more chronic disease, with higher mean scores for the APR-DRG Severity Index (1.95 vs. 1.76,  $P < .0001$ ) and APR-DRG Risk of Mortality Index (2.37 vs. 2.16,  $P < .0001$ ) (**Table 1**).

The lowest income quartile cohort had higher rates of acute postoperative myocardial infarction (1.07% vs. 0.68%,  $P = .007$ ), acute renal failure (11.54% vs. 8.89%,  $P < .0001$ ), pneumonia (5.39% vs. 3.05%,  $P < .0001$ ), respiratory failure (5.72% vs. 4.04%,  $P < .0001$ ), failure to

**Table 1.**

Characteristics of the Lowest and Highest Income Quartiles of Patients Undergoing Sigmoidectomy in the United States From 2013 to 2014

Variables	Lowest Income Quartile (n = 40,995)	Highest Income Quartile (n = 40,940)	P Value
Age <sup>a</sup>	60.39 (0.18)	60.51 (0.17)	.62
Sex (female)	21,925 (53.48%)	21,565 (52.67%)	.3
Race			<.0001
White	27,800 (70.50%)	32,950 (84.87%)	
Black	5720 (14.50%)	1450 (3.73%)	
Hispanic	4505 (11.42%)	2085 (5.37%)	
Asian/Pacific Islander	350 (0.89%)	1175 (3.02%)	
Native American	265 (0.67%)	60 (0.15%)	
Other	795 (2.02%)	1105 (2.85%)	
Primary payer			<.0001
Medicare	18,645 (45.57%)	15,860 (38.76%)	
Medicaid	4880 (11.93%)	1740 (4.25%)	
Private insurance	13,565 (33.15%)	21,515 (52.58%)	
Self-pay	2285 (5.58%)	780 (1.91%)	
No charge	340 (0.83%)	150 (0.37%)	
Other	1205 (2.94%)	870 (2.13%)	
Elective procedure	21,080 (51.42%)	25,835 (63.10%)	<.0001
Type of procedure			<.0001
Open	28,870 (70.42%)	22,410 (54.74%)	
Laparoscopic	12,125 (29.58%)	18,530 (45.26%)	
APR-DRG Mortality Index <sup>a</sup>	1.95 (0.01)	1.76 (0.01)	<.0001
APR-DRG Severity Index <sup>a</sup>	2.37 (0.01)	2.16 (0.01)	<.0001

<sup>a</sup>Data are presented as mean (SE).

wean (1.23% vs. 0.82%,  $P = .007$ ), postoperative anemia (13.84% vs. 9.64%,  $P < .0001$ ), accidental intraoperative laceration (3.09% vs. 2.42%  $P = .01$ ), surgical site infection (4.31% vs. 3.36%,  $P = .002$ ), systemic inflammatory response syndrome /sepsis (4.88% vs. 3.59%,  $P < .0001$ ), severe sepsis (6.77% vs. 4.82%,  $P < .0001$ ), septic shock (5.32% vs. 3.77%,  $P < .0001$ ), urinary tract infection (8.39% vs. 5.15%,  $P < .0001$ ), peritonitis (7.93% vs. 6.58%,  $P = .001$ ), and ileus or bowel obstruction (22.51% vs. 19.70%) than those in the highest income quartile (**Table 2**). Patients in the highest income quartile had higher rates of

cerebrovascular accident (0.11% vs. 0.02%,  $P = .03$ ) than those in the lowest income quartile (**Table 2**).

The overall rates of postoperative complication are higher in the lowest income quartile (50.84% vs. 41.24%,  $P < .0001$ ) (**Table 2**). More patients died in the lowest income quartile (3.07% vs. 2.11%  $P = .0001$ ). Patients in the highest income cohort also had a significantly shorter length of stay (8.04 vs. 9.88,  $P < .0001$ ) and lower rates of nonhome discharge (15.21% vs. 20.28%,  $P < .0001$ ) than the lowest income quartile (**Table 2**). In addition, the

**Table 2.**  
Outcomes of Lowest and Highest Income Quartiles Undergoing Sigmoidectomy in the United States From 2013 to 2014

Variables	Lowest Income Quartile (n = 40,995)	Highest Income Quartile (n = 40,940)	P Value
Acute MI	440 (1.07%)	280 (0.68%)	.007
Cardiac arrest	495 (1.21%)	475 (1.16%)	.78
Acute renal failure	4730 (11.54%)	3640 (8.89%)	<.0001
Pneumonia	2210 (5.39%)	1250 (3.05%)	<.0001
Cerebrovascular accident	10 (0.02%)	45 (0.11%)	.03
Deep vein thrombosis	180 (0.44%)	115 (0.28%)	.09
Respiratory failure	2345 (5.72%)	1655 (4.04%)	<.0001
Failure to wean	505 (1.23%)	335 (0.82%)	.007
ventilator-associated pneumonia	45 (0.11%)	20 (0.05%)	.21
Pulmonary embolism	260 (0.63%)	200 (0.49%)	.21
Postoperative anemia	5675 (13.84%)	3945 (9.64%)	<.0001
Accidental intraoperative laceration	1265 (3.09%)	990 (2.42%)	.01
Wound dehiscence	320 (0.78%)	265 (0.65%)	.33
Wound infection	1765 (4.31%)	1375 (3.36%)	.002
SIRS/sepsis	2000 (4.88%)	1470 (3.59%)	<.0001
Severe sepsis	2775 (6.77%)	1970 (4.82%)	<.0001
Septic shock	2180 (5.32%)	1545 (3.77%)	<.0001
UTI	3440 (8.39%)	2110 (5.15%)	<.0001
Peritonitis	3250 (7.93%)	2695 (6.58%)	.001
Ileus/bowel obstruction	9230 (22.51%)	8065 (19.70%)	<.0001
Peritoneal abscess	1090 (2.66%)	1210 (2.96%)	.25
Any complication	20,840 (50.84%)	16,885 (41.24%)	<.0001
Death	1260 (3.07%)	865 (2.11%)	.0001
Non-home discharge	8315 (20.28%)	6225 (15.21%)	<.0001
Length of stay <sup>a</sup>	9.88 (0.11)	8.04 (0.09)	<.0001
Total hospital charges <sup>a</sup>	\$100,219 (1805)	\$93,123 (1656)	.003

MI, myocardial infarction; UTI, urinary tract infection; SIRS, systemic inflammatory response syndrome.

<sup>a</sup>Data are presented as mean (SE).

highest income quartile group had lower average total charges (\$93,123 vs. \$100,219,  $P = .003$ ) than the lowest income quartile cohort (**Table 2**).

When patients were propensity matched, the difference between the 2 cohorts was preserved for overall complications (95% confidence interval [CI]: 1.02–1.18;  $P = .02$ ) but not for rates of mortality (95% CI: 0.89–1.35;  $P = .38$ ) or nonhome discharge (95% CI: 0.96–1.15;  $P = .29$ ) (**Table 3**). Furthermore, propensity matching produced a reversal of the hospital charge differences, with total hospital charges \$10,432 less (95% CI: \$6,100–\$14,764;  $P < .0001$ ) than the highest income cohort (**Table 3**). When race and payer were controlled for, the differences in complication rates were eliminated (95% CI: 0.97–1.13;  $P = .27$ ), whereas differences in total hospital charges remained statistically significant, with hospital charges for the lowest income quartile \$13,245 less (95% CI: \$10,839–\$15,651;  $P < .0001$ ) than the highest income cohort (**Table 3**). When number of procedures and diagnoses during the hospital stay were controlled for, differences between the 2 income quartiles were preserved for total charges (95% CI: \$6,184–\$10,522;  $P = .0001$ ) (**Table 3**). The full model that incorporated all previous variables and hospital characteristics showed significantly lower total charges for the lowest income quartile (\$6,937, 95% CI: \$4,772–\$9,102;  $P < .0001$ ), whereas there were no significant differences in overall complications (95% CI: 0.95–1.14;  $P = .37$ ), mortality rates (95% CI: 0.89–1.39;  $P = .36$ ), or nonhome discharge (95% CI: 0.97–1.23;  $P = .14$ ) (**Table 3** and **Figure 1**).

## DISCUSSION

The present study is the first to demonstrate disparities in outcomes and total hospital charges between patients in the lowest income quartile and highest income quartile in a nationally representative sample of patients undergoing sigmoid colectomy for any primary diagnosis. Univariate analysis demonstrates that the lowest income quartile group has significantly higher total charges, longer lengths of stay, and increased rates of in-hospital complications, death, and nonhome discharge compared with those patients in the highest income quartile. Multivariable modeling based on previous significant factors in the literature<sup>7–10</sup> eliminated these differences in complications, mortality rates, and nonhome discharge while indicating that low-income patients incurred fewer total charges during their hospital stay.

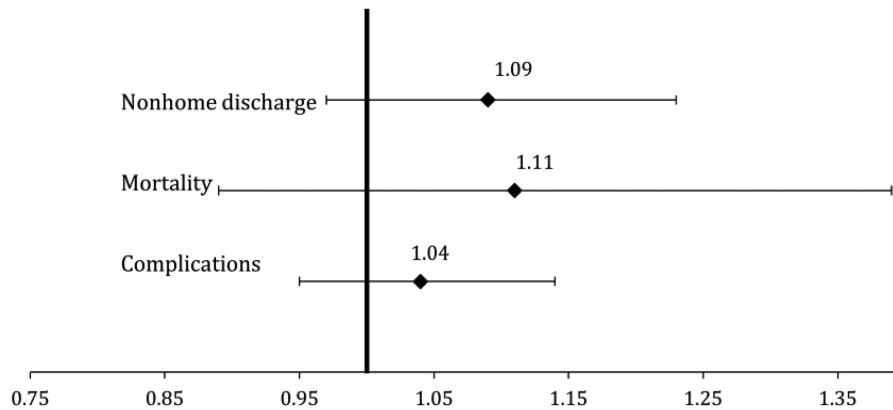
Previously published studies postulated that disparities based on income in complication rates, failure to rescue, or

**Table 3.** Sequential Multivariable Modeling for Income Quartile (Lowest vs. Highest) and Outcomes Disparities

Variables	Univariate Analysis	Propensity Matched	Add Race and Payer	Add Number of Procedures and Number of Diagnoses	Add Hospital Characteristics
Any complication <sup>a</sup>	$P < .0001$ 1.47 (1.38–1.57) $P = .0001$	$P = .02$ 1.09 (1.02–1.18) $P = .38$	$P = .27$ 1.05 (0.97–1.13) $P = .46$	$P = .16$ 1.07 (0.98–1.16) $P = .08$	$P = .37$ 1.04 (0.95–1.14) $P = .36$
Death <sup>a</sup>	1.47 (1.21–1.79) $P < .0001$	1.10 (0.89–1.35) $P = .29$	1.08 (0.88–1.34) $P = .69$	1.23 (0.98–1.54) $P = .04$	1.11 (0.89–1.39) $P = .14$
Non-home discharge <sup>a</sup>	1.42 (1.31–1.54) $P = .003$	1.05 (0.96–1.15) $P < .0001$	1.02 (0.92–1.13) $P < .0001$	1.13 (1.01–1.27) $P < .0001$	1.09 (0.97–1.23) $P < .0001$
Total hospital charges <sup>b</sup>	\$7,096 (\$2,439–11,753)	–\$10,432 (–14,764 to –\$6,100)	–\$13,245 (–\$15,651 to –\$10,839)	–\$8,353 (–\$10,522 to –\$6,184)	–\$6,937 (–\$9,102 to –\$4,772)

<sup>a</sup>Logistic regression modeling used odds ratios and their 95% confidence intervals presented; <sup>b</sup>linear regression modeling used regression coefficients and their 95% confidence intervals presented.





**Figure 1.** Adjusted odds ratios of lowest vs. highest income quartiles for complications, mortality, and nonhome discharge with 95% confidence intervals.

death can generally be eliminated by adjusting for hospital characteristics.<sup>9,10</sup> The present study suggests that complication and mortality rate disparities for sigmoidectomy can be eliminated when propensity-matched patients are compared controlling for race and primary insurance payer. Dimick et al.<sup>14</sup> suggest that racial disparities in care are partially caused by segregation, leading to a propensity for minority patients to undergo surgery at low-quality hospitals. The present results suggest that race might be a proxy for disparities based on income, specifically in the United States and, at the very least, a necessary confounding variable for which to control. Dik et al.<sup>6</sup> in The Netherlands, who did not control for race, found no significant differences between patients of high SES and low SES for surgical outcomes. Furthermore, they found that adding hospital characteristics did not significantly affect their results. National differences in sociodemographic factors between the 2 countries could play an important role in these different conclusions.

The significant difference between income cohorts in the surgical approach (open vs. laparoscopic) is well documented in the literature, specifically in the realm of colectomy for cancer resection.<sup>15,16</sup> Furthermore, because laparoscopic sigmoidectomy has been shown to provide better short-term outcomes, reduced length of stay, and lower costs, differences in procedural approach can be isolated to surgeon skill level or available resources that could limit surgeon decision making.<sup>3,17</sup> Specifically, access to care and receiving treatment at high-quality medical centers, which are generally less accessible for those of low SES or those living in rural areas, are of importance in distinguishing patients who undergo laparoscopic or open procedures, whereby patients of a lower SES undergo a higher proportion of open surgery.<sup>16,18</sup> Some of

our results concur with these conclusions. Upon propensity matching, which included procedural approach, we suggest that the major charge reversal from univariate analysis is due to the fact that we controlled for open vs. laparoscopic approach in the propensity score.

In controlling for the APR-DRG Severity and Risk of Mortality measures along with whether the procedure was elective, we tried to eliminate confounding based on stage of presentation. Similar to income-based disparities in outcomes, income-based disparities in stage of presentation have been previously reported and appear to be linked to hospital factors and race.<sup>10,19,20</sup> Even screening recommendations for cancer appear to be affected by SES and insurance payer factors, such as deductible.<sup>21</sup> If procedural designation as elective and the APR-DRG Severity index can be taken as measures of disease stage at presentation for sigmoidectomy, then our data indicate that there are significant differences in stage of presentation between those in the lowest and highest income quartiles.

Our significant difference in total charges, even after sequential modeling, is novel, both in the context of sigmoid colectomies and surgery in general. Previous studies have shown that most charge differences based on SES to be due to case mix and hospital factors, rather than SES itself.<sup>22</sup> Our differences persisted despite controlling for number of procedures, number of diagnoses, severity of the illness, and hospital factors. These data raise important questions about what contributes to the difference in total hospital charges, if it cannot be attributed to anything controlled for in our models. There is precedent that socioeconomic status is significantly associated with treatment selection and the decision to operate in specific patient populations.<sup>23</sup> However, the present data, espe-

cially when controlled for procedures and diagnoses, still demonstrate a significant difference in charges. The drivers of this difference are unclear, and the issue warrants further investigation.

The present study has several limitations. First, we were limited to the data contained in the NIS database, which allows for calculation only of in-hospital complications and mortality, provides no index for level of patient connection with the health care system, and did not allow us to control for individual surgeon characteristics in our analysis. Furthermore, only 11% of the patients in our lowest income quartile had their primary insurance payer designated as Medicaid, indicating some level of error in our income data, possibly because of the effects of quantifying income based on ZIP code Census estimates. Because these geographic estimates have been shown to provide conservative estimates of income-based health disparities, this study probably underestimates the size of the real disparities in care based on income.<sup>24</sup> The lack of itemized costs prevents us from specifically identifying more details about the hospital charge differences.

Because of the lack of differences in complications and significant differences in total charges between the low-income and high-income patients, there exists a significant value gap between the 2 cohorts, with the low-income patients getting more value than higher-income patients. However, as mentioned previously, without itemized charge details, it is not possible to evaluate these charge differences on patient-specific levels. Whereas there is both incentive for and an established practice of patients shopping for care to maximize value, the practice can be complicated by the lack of information regarding cost and by differential access to care on racial or insurance-based lines. Furthermore, in the era of Centers of Excellence and consolidation of surgical procedures to improve outcomes across health systems,<sup>25</sup> the question of geographical segregation raising access to care issues becomes apparent, especially when it is tied directly to outcomes in univariate analysis and value upon multivariable analysis, as our results suggest.

Taking a meaningful approach to alleviating income-based disparities and maximize value will require multiple steps. There is no standardized measure of income for health studies that incorporates geographical, insurance-based, racial, and other types of confounding variables. There is a precedent in the literature of using a combination of race, primary payer, and geographically calculated income to determine a more precise income measure, but the values assigned to these demographical categoriza-

tions are inconsistent and arbitrary.<sup>19</sup> A standardized measure would allow for comparisons across different disciplines and geographical locations. Changes in national and state-level health policy have been shown to have a disproportionately positive impact on patients with lower SES, suggesting that targeted policy is an effective solution for alleviating these disparities.<sup>26</sup> However, more information is needed on whether policy should target income-based, racial, insurance-based, hospital-based, or other types of disparities to alleviate the disparities seen based on income. Better understanding nationally representative cohorts of patients hospitalized for common conditions and procedures could drive policy solutions with specific targets to alleviate disparities.

## CONCLUSIONS

Significant differences in demographics, clinical outcomes, and total hospital charges are present between the lowest income quartile when compared with the highest income quartile of patients undergoing sigmoidectomy. When controlling for various factors, the differences in outcomes become insignificant, whereas the difference in total hospital charges remain. The value gap produced by these results warrants further investigation, both in cohorts of patients undergoing surgical resection of the sigmoid colon and patients undergoing other procedures.

## References:

1. Barbieux J, Plumereau F, Hamy A. Current indications for the Hartmann procedure. *Journal of Visceral Surgery*. 2016; 153(1):31–38.
2. Herzog T, Janot M, Belyaev O, et al. Complicated sigmoid diverticulitis–Hartmann’s procedure or primary anastomosis? *Acta Chir Belg*. 2011;111(6):378–383.
3. Vennix S, Lips DJ, Di Saverio S, et al. Acute laparoscopic and open sigmoidectomy for perforated diverticulitis: a propensity score-matched cohort. *Surg Endosc*. 2016;30:3889–3896.
4. Magistris LD, Azagra JS, Goergen M, Blasi VD, Arru L, Facy O. Laparoscopic sigmoidectomy in moderate and severe diverticulitis: analysis of short-term outcomes in a continuous series of 121 patients. *Surg Endosc*. 2013;27(5):1766–1771.
5. Silva-Velazco J, Stocchi L, Costedio M, Gorgun E, Kessler H, Remzi FH. Is there anything we can modify among factors associated with morbidity following elective laparoscopic sigmoidectomy for diverticulitis? *Surg Endosc*. 2016;30(8):3541–3551.
6. Dik VK, Aarts MJ, Van Grevenstein WMU, et al. Association between socioeconomic status, surgical treatment and mortality

- in patients with colorectal cancer. *Br J Surg*. 2014;101(9):1173–1182.
7. Inneh IA, Iorio R, Slover JD, Bosco JA. Role of sociodemographic, co-morbid and intraoperative factors in length of stay following primary total hip arthroplasty. *J Arthroplasty*. 2015; 30(12):2092–2097.
8. Henry AJ, Hevelone ND, Hawkins AT, Watkins MT, Belkin M, Nguyen LL. Factors predicting resource utilization and survival after major amputation. *J Vasc Surg*. 2013;57(3):784–790.
9. Reames BN, Birkmeyer NJO, Dimick JB, Ghaferi AA. Socioeconomic disparities in mortality after cancer surgery: the role of failure to rescue. *JAMA Surg*. 2014;149(5):475–481.
10. Birkmeyer NJO, Gu N, Baser O, Morris AM, Birkmeyer JD. Socioeconomic status and surgical mortality in the elderly. *Med Care*. 2008;46(9):893–899.
11. HCUP National Inpatient Sample (NIS). Healthcare Cost and Utilization Project (HCUP). 2013. Agency for Healthcare Research and Quality, Rockville, MD. [www.hcup-us.ahrq.gov/nisoverview.jsp](http://www.hcup-us.ahrq.gov/nisoverview.jsp).
12. HCUP National Inpatient Sample (NIS). Healthcare Cost and Utilization Project (HCUP). 2014. Agency for Healthcare Research and Quality, Rockville, MD. [www.hcup-us.ahrq.gov/nisoverview.jsp](http://www.hcup-us.ahrq.gov/nisoverview.jsp).
13. Berkowitz SA, Traore CY, Singer DE, Atlas SJ. Evaluating area-based socioeconomic status indicators for monitoring disparities within health care systems: results from a primary care network. *Health Serv Res*. 2015;50(2):398–417.
14. 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(6):1046–1053.
15. Yeo H, Niland J, Milne D, et al. Incidence of minimally invasive colorectal cancer surgery at National Comprehensive Cancer Network Centers. *J Natl Cancer Inst*. 2014;107(1).
16. Gabriel E, Thirunavukarasu P, Al-Sukhni E, Attwood K, Nurkin SJ. National disparities in minimally invasive surgery for rectal cancer. *Surg Endosc*. 2016;30(3):1060–1067.
17. Biondi A, Grosso G, Mistretta A, et al. Laparoscopic vs. open approach for colorectal cancer: evolution over time of minimal invasive surgery. *BMC Surg*. 2013;13(Suppl 2):S12.
18. Lee SL, Yaghoubian A, Kaji A. County versus private hospitals: access of care, management and outcomes for patients with appendicitis. *JLS*. 2012;16(2):283–286.
19. Csikesz NG, Singla A, Simons JP, Tseng JF, Shah SA. The impact of socioeconomic status on presentation and treatment of diverticular disease. *J Gastrointest Surg*. 2009;13(11):1993.
20. Subherwal S, Patel MR, Tang F, et al. Socioeconomic disparities in the use of cardioprotective medications among patients with peripheral artery disease: an analysis of the American College of Cardiology's NCDR PINNACLE Registry. *J Am Coll Cardiol*. 2013;62(1):51–57.
21. Pollack CE, Mallya G, Polsky D. The impact of consumer-directed health plans and patient socioeconomic status on physician recommendations for colorectal cancer screening. *J Gen Intern Med*. 2008;23(10):1595–1601.
22. Timbie JW, Hussey PS, Adams JL, Ruder TW, Mehrotra A. Impact of socioeconomic adjustment on physicians' relative cost of care. *Med Care*. 2013;51(5):454–460.
23. Yorio JT, Yan J, Xie Y, Gerber DE. Socioeconomic disparities in lung cancer treatment and outcome persist within a single academic medical center. *Clin Lung Cancer*. 2012;13(6):448–457.
24. Krieger N, Chen JT, Waterman PD, Rehkopf DH, Subramanian SV. Race/ethnicity, gender, and monitoring socioeconomic gradients in health: a comparison of area-based socioeconomic measures—the public health disparities geocoding project. *Am J Public Health*. 2003;93(10):1655–1671.
25. Chhabra KR, Dimick JB. Hospital networks and value-based payment: fertile ground for regionalizing high-risk surgery. *JAMA*. 2015;314(13):1335–1336.
26. Pimentel L, Anderson D, Golden B, Wasil E, Barrueto F, Hirshon JM. Impact of health policy changes on emergency medicine in Maryland stratified by socioeconomic status. *West J Emerg Med*. 2017;18(3):356–365.