Outcomes and Costs of Elective Surgery for Diverticular Disease

A Comparison With Other Diseases Requiring Colectomy

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Objective: To compare outcomes and costs of elective surgery for diverticular disease (DD) with those of other diseases commonly requiring colectomy.

Design: Multivariable analyses using the Nationwide Inpatient Sample to compare outcomes across primary diagnosis while adjusting for age, sex, race, year of admission, and comorbid disease.

Setting: A sample of US hospital admissions from 2003-2009.

Patients: All adult patients (≥18 years) undergoing elective resection of the descending colon or subtotal colectomy who had a primary diagnosis of DD, colon cancer (CC), or inflammatory bowel disease (IBD).

Main Outcome Measures: In-hospital mortality, postoperative complications, ostomy placement, length of stay, and hospital charges.

Results: Of the 74 879 patients, 50.52% had DD, 43.48% had CC, and 6.00% had IBD. After adjusting for other variables, patients with DD were significantly more likely than patients with CC to experience in-hospital mortality (adjusted odds ratio, 1.90; 95% CI, 1.37-2.63; $P < .001$), develop a postoperative infection (1.67; 1.48-1.89; $P < .001$), and have an ostomy placed (1.87; 1.65-2.11; $P < .001$). The adjusted total hospital charges for patients with DD were \$6678.78 higher (95% CI, \$5722.12-\$7635.43; $P < .001$) and length of stay was 1 day longer (95% CI, 0.86-1.14; $P < .001$) compared with patients with CC. Patients with IBD had the highest in-hospital mortality, highest rates of complications and ostomy placement, longest length of stay, and highest hospital charges.

Conclusions: Despite undergoing the same procedure, patients with DD have significantly worse and more costly outcomes after elective colectomy compared with patients with CC but better than patients with IBD. These relatively poor outcomes should be recognized when considering routine elective colectomy after successful nonoperative management of acute diverticulitis.

JAMA Surg. 2013;148(4):316-321. Published online December 17, 2012. doi:10.1001/jamasurg.2013.1010

Diverticular disease (DD) of the colon is a common medical condition accounting for more than 300 000 hospitalizations[1] and nearly \$2.4 billion in direct health care costs each year in the United States.[2] The decision to proceed with emergency surgical intervention in patients who present in extremis with a complicated episode of acute diverticulitis is relatively straightforward. However, controversy exists regarding indications for elective colectomy in patients whose acute diverticulitis was initially managed nonoperatively.

See Invited Critique at end of article

Although surgical intervention historically has been recommended following any episode of complicated diverticulitis or after 2 or more episodes of uncomplicated diverticulitis, these guidelines have recently come under greater scrutiny.[3,4] As with any surgical procedure, the benefits of the operation must be weighed against its risks, and the risk of complications after surgery for DD is considerable.[5] However, it is not clear what proportion of these risks is inherent to the surgical procedure itself (colectomy) as opposed to the specific disease setting (DD vs other) in which the surgical procedure is performed.

CME available online at jamanetworkcme.com and questions on page 311

To aid the decision-making process for patients and providers considering elective resection for DD, we used information from a national database to compare the in-hospital mortality, complication rates, lengths of stay, and costs of elective surgery for DD with those of other dis-

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eases requiring colectomy. We hypothesized that, because diverticulitis is inflammatory, outcomes after elective surgical resection for DD may be worse than those for the same operation performed for noninflammatory disease. In other words, we believed that the same operation in the setting of a different disease process may have significantly different outcomes independent of other variations in the patient populations.

METHODS

STUDY POPULATION

We performed a retrospective analysis using data from the Nationwide Inpatient Sample file (2003-2009), which includes a 20% representative sample of hospitals in the United States.[6] *International Classification of Diseases, Ninth Revision* (*ICD-9*) coding was used to establish the desired study population. Included in the study were all patients with a primary admission diagnosis of DD (*ICD-9* diagnosis codes 562.11 and 562.13), colon cancer (CC) (*ICD-9* diagnosis codes 153.2, 153.3, 153.8, 153.9, and 154.0), or inflammatory bowel disease (IBD), including Crohn disease and ulcerative colitis (*ICD-9* diagnosis codes 555.1, 555.2, 555.9, 556.0, 556.1, 556.2, 556.3, 556.5, 556.6, 556.8, and 556.9) who underwent concomitant resection of the descending colon or subtotal colectomy (*ICD-9* procedure codes 45.71, 45.75, 45.76, 45.79, 45.8, 45.81, 45.82, 45.83, 48.63, 17.3, 17.31, 17.35, 17.36, and 17.39). Patients younger than 18 years and those who underwent nonelective colon resection were excluded from the analysis.

The Charlson Comorbidity Index,[7] a prognostic measure incorporating the presence or absence of a number of comorbid conditions into a weighted formula, was used as a measure of disease severity. Age was categorized as being 18 to 44, 45 to 64, 65 to 74, or 75 years or older; race as white, black, or other; admission year as 2003-2005, 2006-2007, or 2008-2009; and Charlson Comorbidity Index as 0, 1, or 2 or higher. This study was deemed exempt by the Johns Hopkins Medicine institutional review board.

OUTCOMES OF INTEREST

The primary outcome of interest was in-hospital mortality. Secondary outcomes examined were ostomy placement and a variety of postoperative complications, specifically, infection (defined as wound infection, pneumonia, or urinary tract infection), unexpected reoperation, hemorrhage, acute myocardial infarction, thromboembolic events, shock/sepsis, renal failure, and pulmonary compromise. Complications were defined according to previously validated *ICD-9* procedure and diagnosis codes[8-10] (**Table 1**). Length of hospital stay and total hospital charges (adjusted for inflation to reflect 2011 US dollars) were also examined.

STATISTICAL ANALYSIS

For continuous outcomes, comparisons were made using the Welch test because of heterogeneity of variance. For categorical outcomes, we used the Pearson χ^2 test. The Kruskal-Wallis test was used to compare median length of stay and total hospital charges. Multiple logistic regression models were used to compare the odds of each outcome across diagnosis (DD, CC, and IBD) while adjusting for age, sex, race, calendar year of admission, and comorbid disease as measured by the Charlson Comorbidity Index score. Patient race was missing in a substantial portion of patient records; these records were therefore omitted from the multivariable analyses to prevent bias. A separate multiple logistic regression stratified by age group was performed for the DD group only as a subgroup analysis. Quantile regression analysis, which models on the median, was applied for length of stay and total hospital charges because these outcomes were highly skewed. All tests were 2-sided, with statistical significance set at $\alpha = .05$. Analyses were performed with STATA statistical software, version 11.2/MP (StataCorp).

Table 1. *ICD-9* Procedure and Diagnosis Codes Used to Determine Complications

Type of Complication	*ICD-9* Code[a]
Infection	
Wound	998.5, 998.51, 998.59, 998.13, 998.3, 998.31, 998.32, 998.83, 998.81
Pneumonia	481, 482.0-482.4, 482.8-482.9, 483, 484, 485, 486, 507.0, 482.40, 482.41. 482.42, 482.49
Urinary tract infection	997.5, 599.0-599.9
Ostomy placement[b]	46.03, 48.62, 46.01, 46.1x, 46.2x
Other	
Unexpected reoperation[b]	54.12
Hemorrhage	998.1, 998.11, 998.12
Acute myocardial infarction	410.00-410.91
Thromboembolic event	415.1, 451.11, 451.19, 451.2, 451.81, 453.8
Shock/sepsis	998.0, 995.9, 995.90, 995.91, 995.92, 038
Renal failure	584.1-584.9
Pulmonary compromise	514, 518.4, 518.5, 518.81, 518.82

Abbreviation: *ICD-9*, *International Classification of Diseases, Ninth Revision*.
[a] Diagnosis codes are given unless otherwise indicated.
[b] Indicates that procedure codes are given.

RESULTS

STUDY POPULATION

A total of 74 879 patients met the study criteria, including 37 826 (50.52%) with DD, 32 560 (43.48%) with CC, and 4493 (6.00%) with IBD (**Table 2**). In the IBD group, 1570 patients (34.94%) had Crohn disease and 2923 (65.06%) had ulcerative colitis. The overall mean age was 60.1 years (median, 60 years); 50.59% were men, and 61.98% were white. Patients with IBD were generally younger (mean age, 46.2 years), whereas patients with CC were older (mean age, 65.7 years). Among patients whose race was identified, patients with CC were more frequently black (6.06%) compared with patients with DD (2.77%) or IBD (3.00%). Patients with CC had significantly greater comorbidity, with a mean (SD) Charlson Comorbidity Index score of 4.52 (2.90) compared with scores of 0.39 (0.80) and 0.30 (0.79) for patients with DD and IBD, respectively.

UNADJUSTED OUTCOMES

The overall in-hospital mortality rate was 0.80%, with the highest unadjusted mortality seen in patients with CC (1.22%), which was significantly higher than the mor-

Table 2. Baseline Demographic and Clinical Characteristics of the Patient Groups[a]

Characteristic	Total (N = 74 879)	DD (n = 37 826) [50.52%]	CC (n = 32 560) [43.48%]	IBD (n = 4493) [6.00%]
Age, mean (median), y[b]	60.1 (60)	56.9 (57)	65.7 (67)	46.2 (46)
Age category, y[b]				
18-44	**10 694** (14.28)	6758 (17.87)	1790 (5.50)	2146 (47.76)
45-64	**34 399** (45.94)	20 115 (53.18)	12 597 (38.69)	1687 (37.55)
65-74	**16 649** (22.23)	7114 (18.81)	9083 (27.90)	452 (10.06)
≥75	**13 137** (17.54)	3839 (10.15)	9090 (27.92)	208 (4.63)
Sex[b,c]				
Male	**37 882** (50.59)	17 730 (46.87)	17 775 (54.60)	2377 (52.90)
Female	**36 994** (49.41)	20 096 (53.13)	14 782 (45.40)	2116 (47.10)
Race				
White[b]	**46 413** (61.98)	24 569 (64.95)	19 031 (58.45)	2813 (62.61)
Black	**3155** (4.21)	1048 (2.77)	1972 (6.06)	135 (3.00)
Other	**5312** (7.09)	2430 (6.42)	2641 (8.11)	241 (5.36)
Missing	**19 999** (26.71)	9779 (25.85)	8916 (27.38)	1304 (29.02)
Charlson Comorbidity Index score				
Mean (SD)[b]	2.18 (2.87)	0.39 (0.80)	4.52 (2.90)	0.30 (0.79)
0	**30 993** (41.39)	27 410 (72.46)	0	3583 (79.75)
1	**8384** (11.20)	7735 (20.45)	0	649 (14.44)
≥2	**35 502** (47.41)	2681 (7.09)	32 560 (100)	261 (5.81)

Abbreviations: CC, colon cancer; DD, diverticular disease; IBD, inflammatory bowel disease; SD, standard deviation.
[a] Data are given as number (percentage) of patients unless otherwise indicated.
[b] Differences across the groups were significant at $P < .001$.
[c] Data on sex were missing for 3 patients.

Table 3. Observed Unadjusted Rates of Postoperative Outcomes Across the Patient Groups[a]

Outcome	Total (N = 74 879)	DD (n = 37 826) [50.52%]	CC (n = 32 560) [43.48%]	IBD (n = 4493) [6.00%]
In-hospital mortality, No. (%)	**599** (0.80)	165 (0.44)	396 (1.22)	38 (0.85)
Infection, No. (%)[b]	**7782** (10.39)	3414 (9.03)	3676 (11.29)	692 (15.40)
Wound	**3238** (4.32)	1570 (4.15)	1340 (4.12)	328 (7.3)
Pneumonia	**1810** (2.42)	680 (1.80)	1007 (3.09)	123 (2.74)
Urinary tract infection	**2734** (3.65)	1164 (3.08)	1329 (4.08)	241 (5.36)
Ostomy placement, No. (%)	**9162** (12.24)	2857 (7.55)	3025 (9.29)	3280 (73.00)
Other complication, No. (%)				
Unexpected reoperation	**403** (0.54)	182 (0.48)	167 (0.51)	54 (1.20)
Hemorrhage	**1366** (1.82)	685 (1.81)	546 (1.68)	135 (3.00)
Acute myocardial infarction	**502** (0.67)	155 (0.41)	327 (1.00)	20 (0.45)
Thromboembolic event	**472** (0.63)	157 (0.42)	250 (0.77)	65 (1.45)
Shock/sepsis	**893** (1.19)	381 (1.01)	409 (1.26)	103 (2.29)
Renal failure	**1574** (2.10)	571 (1.51)	896 (2.75)	107 (2.38)
Pulmonary compromise	**2226** (2.97)	835 (2.21)	1261 (3.87)	130 (2.89)
Length of stay, d				
Mean (SD)	7.02 (5.39)	6.37 (4.73)	7.54 (5.76)	8.79 (6.82)
Median	6	5	6	7
Total hospital charges, $				
Mean (SD)	44 470.78 (43 674.56)	40 935.43 (37 095.08)	46 715.31 (47 880.07)	58 003.43 (57 202.67)
Median	34 423.74	32 862.82	35 228.12	43 129.76

Abbreviations: CC, colon cancer; DD, diverticular disease; IBD, inflammatory bowel disease.
[a] Data are given as the number (percentage) of patients unless indicated otherwise. For all the postoperative outcomes listed, differences across the groups were significant at $P < .001$.
[b] Data are given as the number (percentage) of infection events.

tality rates of 0.44% and 0.85% in patients with DD and IBD, respectively ($P < .001$) (**Table 3**). A total of 7782 postoperative infections (10.39%) were identified. Patients with DD less frequently had postoperative infections (9.03%) compared with patients with IBD (15.40%) and CC (11.29%) (both $P < .001$). Patients with CC had significantly higher rates of acute myocardial infarction ($P < .001$) and pulmonary compromise ($P < .001$). Patients with IBD had significantly higher rates of unexpected reoperation ($P < .001$), hemorrhage ($P < .001$), thromboembolic events ($P < .001$), and shock/sepsis ($P < .001$).

An ostomy was placed in 9162 patients (12.24%) and significantly more frequently in patients with IBD

Table 4. Postoperative Complications[a]

Complication	Group	AOR (95% CI)	P Value
In-hospital mortality	DD	1.90 (1.37-2.63)	<.001
	IBD	6.54 (4.13-10.35)	<.001
Infection	DD	1.67 (1.48-1.89)	<.001
	IBD	3.34 (2.85-3.91)	<.001
Wound	DD	1.64 (1.37-1.96)	<.001
	IBD	3.14 (2.52-3.91)	<.001
Pneumonia	DD	1.87 (1.53-2.29)	<.001
	IBD	3.94 (2.98-5.23)	<.001
Urinary tract infection	DD	1.41 (1.17-1.71)	<.001
	IBD	2.82 (2.21-3.59)	<.001
Ostomy placement	DD	1.87 (1.65-2.11)	<.001
	IBD	71.42 (61.28-83.24)	<.001
Other			
Unexpected reoperation	DD	1.48 (0.92-2.41)	.11
	IBD	4.08 (2.34-7.11)	<.001
Hemorrhage	DD	1.71 (1.31-2.24)	<.001
	IBD	2.67 (1.91-3.75)	<.001
Acute myocardial infarction	DD	5.33 (4.16-6.84)	<.001
	IBD	9.10 (5.32-15.57)	<.001
Thromboembolic event	DD	1.58 (1.05-2.38)	.03
	IBD	7.36 (4.62-11.73)	<.001
Shock/sepsis	DD	1.96 (1.49-2.59)	<.001
	IBD	7.03 (5.01-9.86)	<.001
Renal failure	DD	2.61 (2.15-3.16)	<.001
	IBD	5.70 (4.28-7.59)	<.001
Pulmonary compromise	DD	2.49 (2.11-2.93)	<.001
	IBD	4.63 (3.58-5.97)	<.001

Abbreviations: AOR, adjusted odds ratio; CC, colon cancer; DD, diverticular disease; IBD, inflammatory bowel disease.

[a] All analyses were adjusted for age, sex, race, admission year, and Charlson Comorbidity Index score. Results are in comparison with the colon cancer group.

(73.00%) compared with patients with DD (7.55%) and CC (9.29%) (both $P < .001$). The mean length of a hospital stay and the mean total hospital charges were greater for patients with IBD (8.79 days and \$58 003.43, respectively) compared with patients with DD (6.37 days and \$40 935.43) and CC (7.54 days and \$46 715.31).

ADJUSTED OUTCOMES

After adjusting for other factors, patients with DD were nearly twice as likely as patients with CC to experience in-hospital mortality (adjusted odds ratio [AOR], 1.90; 95% CI, 1.37-2.63; $P < .001$) (**Table 4**). Patients with DD were also significantly more likely than patients with CC to develop a postoperative infection (AOR, 1.67; 95% CI, 1.48-1.89; $P < .001$). Of note, patients with DD were significantly more likely than patients with CC to develop all the postoperative complications examined except for the need for an unexpected reoperation. Finally, patients with DD were nearly twice as likely as patients with CC to have an ostomy placed during their operation (AOR, 1.87; 95% CI, 1.65-2.11; $P < .001$).

Patients with IBD were even more likely than patients with DD to have a poor outcome (Table 4). After adjusting for other factors, patients with IBD were more than 6 times more likely than patients with CC to experience in-hospital mortality (AOR, 6.54; 95% CI, 4.13-10.35; $P < .001$). Patients with IBD were also significantly more likely than patients with CC to develop a postoperative infection (AOR, 3.34; 95% CI, 2.85-3.91; $P < .001$). Patients with IBD were significantly more likely than patients with CC to develop all the postoperative complications examined. Finally, patients with IBD were more than 71 times more likely than patients with CC to have an ostomy placed during their operation (AOR, 71.42; 95% CI, 61.28-83.24; $P < .001$).

The total hospital charges for patients with DD, adjusted for age, sex, race, admission year, and Charlson Comorbidity Index score, were \$6678.78 higher (95% CI, \$5722.12-\$7635.43; $P < .001$) than those for patients with CC. Patients with DD also had an adjusted length of stay that was 1 day longer (95% CI, 0.86-1.14; $P < .001$) than that of patients with CC. Patients with IBD had even greater hospital charges and length of stay, with adjusted total hospital charges \$18 557.13 higher (95% CI, \$17 348.63-\$19 765.63; $P < .001$) and adjusted length of stay 3 days longer (2.83-3.17; $P < .001$) than those for patients with CC.

DD OUTCOMES BY AGE

The odds of mortality, infection, and ostomy placement within the DD group varied significantly across patient age (**Table 5**). After adjusting for other factors, patients aged 65 to 74 years (AOR, 8.49, 95% CI, 2.55-28.20; $P < .001$) and those 75 years or older (27.20; 8.29-89.19; $P < .001$) were significantly more likely to experience in-hospital mortality compared with those aged 18 to 44 years. Patients aged 65 to 74 years (AOR, 1.37; 95% CI, 1.18-1.61; $P < .001$) and those 75 years or older (1.86; 1.57-2.19; $P < .001$) were also more likely to have a postoperative infection compared with those aged 18 to 44 years. Finally, patients aged 45 to 64 years (AOR, 1.25; 95% CI, 1.08-1.46; $P = .003$), 65 to 74 years (1.61; 1.35-1.91; $P < .001$), and 75 years or older (3.21; 2.70-3.83; $P < .001$) also more frequently had an ostomy placed during their operation compared with those aged 18 to 44 years.

COMMENT

This national study examined the outcomes and costs for elective colon resections performed for DD in comparison with 2 other conditions for which elective colon resections are frequently performed. Overall, the mortality from an elective colectomy of the descending colon was acceptably low in all 3 patient groups. Not surprisingly, the IBD group, a patient population frequently receiving chronic immunosuppression treatment and often malnourished, had the highest risk of in-hospital mortality, complications, and ostomy placement as well as the highest costs and longest length of stay. However, more remarkable was our finding that patients undergoing colon resection for DD had higher adjusted mortality, complication rates, length of stay, and costs compared with patients undergoing colon resection for CC. Although, as one might expect, unadjusted mortality was highest in the CC group, the DD group was nearly twice as likely as the CC group to experience in-hospital

Table 5. Mortality, Infection, and Ostomy Placement by Age Among DD Group Patients

	AOR (95% CI)[a]		
	In-Hospital Mortality (n = 165)	Infection (n = 3414)	Ostomy Placement (n = 2857)
Age, y			
18-44	1 [Reference]	1 [Reference]	1 [Reference]
45-64	1.39 (0.40-4.87)	1.01 (0.88-1.15)	1.25 (1.08-1.46)[b]
65-74	8.49 (2.55-28.20)[b]	1.37 (1.18-1.61)[b]	1.61 (1.35-1.91)[b]
≥75	27.20 (8.29-89.19)[b]	1.86 (1.57-2.19)[b]	3.21 (2.70-3.83)[b]

Abbreviations: AOR, adjusted odds ratio; DD, diverticular disease.
[a] In addition to age, all analyses were adjusted for sex, race, admission year, and Charlson Index score.
[b] Indicates a statistically significant difference.

mortality after adjusting for other factors, most notably patient age and the presence of other comorbidities. Within the DD group, these higher rates of mortality, complications, and ostomy placement were accentuated among older patients.

Given this high rate of complications after surgical resection for DD, surgeons and patients may be more likely to consider nonsurgical management of uncomplicated DD. With the recent increasing national emphasis on public reporting of hospitals' outcomes data and pay-for-performance programs to improve the quality of care in the United States,[11-14] this study also highlights the importance of not merely comparing patient outcome measures as indicators of health care quality irrespective of the specific disease process. Colon resections are clearly not all the same; we found disparate outcomes depending on the particular disease process for which the procedure was performed. This finding of dissimilar outcomes after this procedure must be accounted for in any comparison of hospitals and/or surgeons.

In patients experiencing an acute diverticulitis episode, the need for elective colectomy is uncertain, unlike that in patients with CC or refractory IBD, for whom the role of nonoperative management is limited. Clinical practice guidelines for the treatment of sigmoid diverticulitis from the American Society of Colon and Rectal Surgeons state that the decision to offer elective surgery after acute diverticulitis should be made on a case-by-case basis.[15] Previous studies have suggested that patient age and the number of recurrent episodes of diverticulitis should be the major factors in these individual decisions.[16-18] Others have pointed to the low recurrence rates after a first episode of acute diverticulitis as evidence that routine elective surgery is unnecessary after initial successful nonoperative management.[19]

Colectomy is not curative in all cases of diverticulitis; its recurrence rate following surgery is 2.6% to 10%.[20-22] Some studies have also suggested that prophylactic colectomy does not always result in improvement of the preoperative symptoms and may lead to worsening of symptoms in some cases.[23,24] In addition, the rate of requiring intestinal diversion (colostomy or protective ileostomy) during an elective operation has been variously reported to be between 2.9% and 12.7%.[25-27] In this study, 7.55% of patients undergoing elective colectomy for DD had an ostomy placed. The functional and emotional impact of an ostomy—especially if it is permanent—cannot be ignored. Moreover, reversal of a colostomy carries considerable risk of further adverse postoperative outcomes.[28,29] Our study showing unexpectedly poor outcomes for these elective operations for DD adds to the growing body of evidence that elective surgery for uncomplicated diverticulitis has considerable risks.

One potential explanation for our finding of notably worse outcomes in patients with DD (and IBD) compared with CC may be related to colectomy being a more technically difficult surgical dissection secondary to scarred and fibrotic tissue planes resulting from prior episodes of inflammation. These added difficulties may result more often in conversion from laparoscopic to open resection, which has been associated with worse postoperative outcomes.[30,31] Another possible explanation is that patients treated for recurrent episodes of diverticulitis may receive multiple courses of antibiotic therapy, leading to the development of antibiotic-resistant bacteria that make these patients more prone to infectious complications after surgery. Indeed, high rates of antibiotic-resistant organisms have been isolated from patients undergoing elective colorectal surgery after antibiotic prophylaxis has failed.[32]

Our study has several limitations. First, the use of administrative claims-based databases, which are constructed primarily for reimbursement rather than research purposes, is inherently dependent on accurately entered codes.[33] For example, no specific *ICD-9* codes exist to differentiate laparoscopic from open resection, precluding our ability to more closely examine outcomes in patients who underwent laparoscopic surgery, which may offer improved outcomes over open surgery.[34,35] This issue is unlikely to affect our findings, however, since the comparison groups (CC and IBD) also consisted of patients undergoing open and laparoscopic resections. In addition, no *ICD-9* code was available to identify anastomotic leak, which is another relevant outcome we would like to have examined.

Second, some complications, such as wound infections, can be underreported in administrative databases given that these complications are often identified on readmission (and not included in the Nationwide Inpatient Sample) rather than captured during the initial inpatient admission. Although this bias could lead to an underestimation of the overall frequency of complications in our study, one would expect that this bias would be equally present across all patient groups and therefore be unlikely to generate an artificial difference in complications between patient groups.

Third, the database used for this study did not allow us to examine the number of episodes of uncomplicated diverticulitis before the operation, a factor often considered in the decision regarding elective colectomy. Therefore, our study could not assess the relationship between outcomes and the number of diverticulitis episodes before surgery.

Finally, while our study design attempted to exclude patients with complicated diverticulitis by including only those undergoing elective operations, we recognize that some patients with complicated disease were likely coded (correctly or incorrectly) as having an elective operation and were thereby included in our study. However, one would expect that patients with the most severe complicated disease (eg, involving free perforation) would undergo an emergency operation and would be coded as such. Therefore, any bias toward worse outcomes that may be introduced by those inadvertently included with complicated disease would likely be limited.

In conclusion, the outcomes of elective colectomy appear to vary dramatically according to the underlying diagnosis requiring surgery. After risk adjustment, patients with DD have significantly worse surgical outcomes and increased hospital costs compared with patients with CC. This unanticipated disproportionate risk of poor postoperative outcome should be considered when contemplating elective colectomy for DD. The contrasting outcomes of the same procedure within different disease settings also underscores the limitations of comparing health care quality based on patients' surgical outcomes alone without also addressing the specific disease process requiring surgery.

Accepted for Publication: August 21, 2012.
Published Online: December 17, 2012. doi:10.1001/jamasurg.2013.1010
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Conflict of Interest Disclosures: None reported.
Funding/Support: Edwin Lewis provided generous support of Dr Lidor's Department of Surgery Research Fund.

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