Failure to Screen: Predictors and Burden of Emergency Colorectal Cancer Resection

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Objective: To evaluate predictors and burden of emergency colorectal cancer resection (E-CCR).

Study Design: Cross-sectional study of 127 975 discharges of patients with colorectal cancer undergoing resection.

Methods: We used the 2002 Nationwide Inpatient Sample of the Healthcare Cost and Utilization Project; E-CCR was identified based on the presence of bowel perforation, peritonitis, or obstruction. Bivariate and multilevel multivariable analyses were used to study the association between E-CCR and patient attributes, including demographics, insurance status, comorbidities, health status, and teaching hospital status.

Results: Among younger patients, Medicaid enrollees (adjusted odds ratio [AOR], 2.08; 95% confidence interval [CI], 1.68-2.58) and the uninsured [AOR], 2.62; 95% CI, 2.05-3.34) were at higher risk for E-CCR. Among older patients, those dually eligible for Medicare and Medicaid were at higher risk for E-CCR (AOR, 1.37; 95% CI, 1.11-1.70). Emergency colorectal cancer resection was associated with greater than 3-fold increased in-hospital mortality, 54 979 (95% CI, 38 731-71 226) excess hospital days as a result of longer lengths of stay, and more than $250 million (95% CI, $180 million-$334 million) in hospital charges.

Conclusion: Targeted interventions to increase colorectal cancer screening in vulnerable subgroups of the population would reduce the substantial patient and societal burden associated with failure to screen

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In 2006, an estimated 148 610 individuals were affected by colorectal cancer.[1] It is the second leading cause of cancer-related deaths in the United States, claiming 55 170 lives in 2006 alone.[1] The incidence of colorectal cancer increases with age,[2,3] and 94% of all cases are diagnosed in individuals older than 50 years.[4,5] Individuals with a family history of colorectal cancer, certain familial cancer syndromes, or inflammatory bowel disease are at increased risk for colorectal cancer.[4]

Colorectal cancer is curable if detected at an early stage,[6] yet 40% of all patients presenting with colorectal cancer are beyond the stage at which a definitive cure is achievable.[7] Although colorectal cancer screening is recommended for persons 50 years and older,[8] its use has remained low,[9,10] especially among older individuals, those of minority descent, or persons with compromised access to preventive care.[11,12]

Early detection and treatment can prevent potentially fatal complications of colorectal cancer, including bowel perforation, peritonitis, and obstruction. These complications, often associated with increased morbidity and mortality, are considered surgical emergencies and elicit the initial presentation of colorectal cancer in an estimated 15% to 30% of patients with colorectal cancer.[13] A clinical presentation necessitating emergency colorectal cancer resection (E-CCR) has been identified as "the clearest evidence on an individual level for a failure of screening,"[14(p28)] resulting from factors such as inadequate access to care or underutilization of cancer screening services and contributing to the disparities in colorectal cancer outcomes.

Most large-scale studies[2,3,5,7,13,15-24] exploring E-CCR originate from Europe. However, given important differences in the healthcare delivery and financing systems, as well as in the population characteristics between Europe and the United States, the generalizability of these studies to the United States is limited. In particular, the role of enabling factors such as insurance status relative to E-CCR and the health and economic burden of care associated with E-CCR have remained unexplored, to our knowledge. This study aims to identify predictors and burden of E-CCR relative to length of stay, hospital charges, and in-hospital mortality through the analysis of a large nationally representative sample of patients with colorectal cancer undergoing resection procedures.

In this issue
Take-away Points / p164
www.ajmc.com
Full text and PDF
Web exclusive
Appendix

For author information and disclosures, see end of text.

METHODS

Data Source

This was a cross-sectional study using data from the 2002 Nationwide Inpatient Sample (NIS) of the Healthcare Cost and Utilization Project of the Agency for Healthcare Research and Quality. This study was approved for institutional review board exemption at the University Hospitals of Cleveland. The NIS is a publicly available data set in which stratified random probability sampling was used to obtain a 20% subsample of nonfederal US community hospitals as defined by the American Hospital Association containing 7 853 982 discharges from 995 hospitals and 35 states in 2002. This sample can be generalized to 37 804 021 discharges using sampling weights. A more detailed description of the data set is available elsewhere.[25] The NIS data have been used in several population-based studies[26-28] on outcomes for hospitalized patients. Data quality and coding errors vary across hospitals, payers, and states,[29] with some variables being unavailable for discharges from certain states, as discussed herein. Despite these challenges commonly posed by the analysis of administrative data, the NIS is a unique data resource allowing for the analysis of outcomes regardless of payer status.

Study Population

International Classification of Diseases, Ninth Revision, Clinical Modification codes present in any of 15 fields in the data set were used to identify discharges for patients with colorectal cancer undergoing resection procedures (n = 26 269, which is representative of 127 975 discharges nationally). The codes used to identify patients with colorectal cancer included diagnosis codes for malignant neoplasms of the colon (codes 153.0-9) and rectum (codes 154.0-1). Procedure codes were used to identify patients with colorectal cancer who underwent resection. These codes include partial excision of the large intestine (code 45.7), total intra-abdominal colectomy (code 45.8), other operations on the intestine (codes 46.1-2), abdominoperineal resection of the rectum (code 48.5), anterior resection of the rectum with synchronous colostomy (code 48.62), and other anterior resection of the rectum (code 48.63). From these patients, a subset presenting with a diagnosis requiring E-CCR, including bowel perforation, peritonitis, or obstruction, was identified (n = 2753). The diagnosis codes used to determine which patients met these criteria included other specified intestinal obstruction (code 560.8), unspecified intestinal obstruction (code 560.9), peritonitis in infectious diseases (code 567.0), other suppurative peritonitis (code 567.2), other specified peritonitis (code 567.8), unspecified peritonitis (code 567.9), and perforation of the intestine (code 569.83).

Operationalization of Variables

Sociodemographic and Insurance Status Variables. Patients were grouped into the following age categories: 0 to 44, 45 to 64, 65 to 74, 75 to 84, and 85 years and older. Because of differences in insurance status (ie, Medicare was the predominant payer among older persons), variations in healthcare utilization patterns, and disparities in treatment between younger and older patients, 2 subpopulations were defined by stratifying the population into those younger than 65 years and those 65 years and older.

In the original data set, race/ethnicity was defined as white, African American, Hispanic, Asian or Pacific Islander, Native American, and other. Because of insufficient numbers of Asian or Pacific Islanders and Native Americans, we categorized race/ethnicity as white, African American, Hispanic, and other. In addition, several states participating in the Healthcare Cost and Utilization Project did not make the race/ethnicity variable available in the discharge data. As a result, almost one third of all records lacked race/ethnicity variables. Such cases were assigned the category of missing race/ethnicity, making it possible for us to account for them in the analyses. Income level was based on the median household income level within the patient's ZIP code. This variable had missing values in almost 2% of the cases. We included these cases in bivariate analyses but not in multivariable analyses.

Insurance status was determined from the primary and secondary payers given in the original data. These payers were categorized as Medicare, Medicaid, private insurance (including health maintenance organizations), self-pay, no charge, and other. The self-pay and no charge groups in the primary payer variable were combined to represent the uninsured. For analyses pertaining to the older cohort, we combined information from the primary and secondary payer variables to create the following insurance status categories: Medicare only, Medicare or private insurance (including health maintenance organizations), Medicare or Medicaid (dually eligible), and Medicare or other.

Main Effect and Outcome Variables. Based on the criteria already described, an indicator variable for the presence or absence of E-CCR was created and was defined based on the presence of any of the diagnosis codes indicating bowel perforation, peritonitis, or obstruction in any of the 15 fields in the data set. Length of stay was provided as a continuous variable in the data set representing the number of days from admission to discharge. Hospital charges was a continuous variable representing the total charges in dollars for the patient's entire hospital admission. In-hospital mortality as provided in the original data set was a dichotomous variable indicating whether the patient died in the hospital or was

alive at discharge. To satisfy the normality assumption of linear regression analysis, length of stay and hospital charges were logarithmically transformed to correct for the skewed distributions.

Comorbidity and Health Status Variables. The disease severity measures file available through the 2002 NIS was used as a source for variables reflecting comorbidities, health status, and metastatic cancer. These conditions, which were based on *International Classification of Diseases, Ninth Revision* diagnosis codes documented for each discharge, were adapted from a comorbidity index incorporating 30 conditions as described by Elixhauser et al[30] in 1998. Metastatic cancer and solid tumor without metastasis were not included in our count of comorbidities. Rather, metastatic cancer was considered a separate variable, and its association with E-CCR was tested in bivariate and multivariable analyses. Despite the limitations of claims-based variables in determining cancer stage,[31] and the fact that metastatic cancer may reflect metastasis from anatomic sites other than the colon or rectum, we opted to explore its association with E-CCR, with the hypothesis that metastatic cancer would be strongly and positively associated with E-CCR and the other outcomes of interest.

Several studies[3,15,32,33] have identified the health status of the patient as an important predictor of surgical morbidity and mortality. Conditions most indicative of the health status of the patient at the time of presentation were considered separately from other comorbidities to determine their independent effect on the likelihood of presenting as a surgical emergency. We created a dichotomous variable (yes or no), referred to as compromised health status, indicating the presence of any of the following conditions: weight loss, electrolyte disorders, blood loss anemia, deficiency anemia, and coagulation disorders. All other conditions noted in the listing by Elixhauser et al[30] were considered comorbidities. A 4-category summary variable was created as a count of the total number of comorbidities, categorized as 0, 1, 2, or 3 or more.

Relevant variables in the NIS disease severity measures file were unavailable for the state of Pennsylvania. These discharges, accounting for 5% of the total, were considered in bivariate analyses but not in multivariable analyses. In assessing disease burden, however, we applied estimates obtained from the multivariable analyses to the total number of admissions, including ones from Pennsylvania.

Teaching Hospital Status. This dichotomous variable was retrieved from the NIS hospital weights file. Teaching hospital status indicates that a hospital has an American Medical Association–approved residency program, is a member of the Council of Teaching Hospitals, or has a ratio of full-time–equivalent interns and residents to beds of at least 0.25.

Statistical Analysis

Patients were stratified into younger (<65 years) and older (≥65 years) cohorts. Bivariate and multivariable analytic methods were used to determine the effect of teaching hospital status and patient-level characteristics, including demographics, comorbidities, health status, and metastatic cancer on the likelihood of E-CCR. Given the multilevel nature of the data and the variations within and across hospitals, we used hierarchical nonlinear and linear models, respectively, for dichotomous and continuous outcomes. Dichotomous outcomes included E-CCR and in-hospital mortality. Continuous outcomes included log-transformed length of stay and hospital charges.

Results obtained from multivariable models were used to assess the burden of E-CCR relative to length of stay, hospital charges, and in-hospital mortality. A retransformation method incorporating a smearing function, described by Duan[34] in 1983 and by Mullahy[35] in 1998, was used to estimate the mean length of stay and hospital charges for patients who did and did not undergo E-CCR. These predicted means accounted for hospital- and patient-level characteristics considered in the models. SAS software version 9.1 (SAS Institute, Cary, NC) was used for data management and in bivariate analyses using the procedures surveyfreq and surveymeans to account for weighted data. HLM software version 6.0 (Scientific Software International, Lincolnwood, Ill) was used in multilevel multivariable analyses, also incorporating sample weights.

RESULTS

Two thirds of discharges for colorectal cancer resections were among individuals 65 years and older. Characteristics of individuals in the younger and older cohorts are given in the **Appendix**, available at **www.ajmc.com**.

The proportions of individuals undergoing E-CCR are given in **Table 1**. For most of the covariates that we considered in the study, we observed statistically significant differences in the proportions undergoing E-CCR. The proportion undergoing E-CCR in the younger cohort was highest among the uninsured compared with the privately insured (19.9% vs 8.5%); compromised health status and metastatic cancer were associated with high rates of E-CCR (16.4% vs 7.9% for non-compromised health status and 13.9% vs 7.3% for absence of metastatic cancer). The number of comorbidities was negatively and significantly associated with E-CCR, with the proportion undergoing E-CCR decreasing with increasing numbers of comorbidities. The results in the older cohort were similar to those in the younger cohort. Of note is the association of E-CCR with older age, with the oldest age

Table 1. Patients Undergoing Emergency Colorectal Cancer Resection*

Patient Characteristic	Younger Cohort	*P*	Older Cohort	*P*
Age, y		.53		<.001
0-44	10.6		—	
45-64	10.3		—	
65-74	—		9.3	
75-84	—		11.0	
≥85	—		13.4	
Sex		<.001		.24
Male	11.1		10.8	
Female	9.3		10.5	
Race/ethnicity		<.001		<.001
White	10.2		10.6	
African American	13.6		13.1	
Hispanic	10.7		8.5	
Other	11.1		10.0	
Missing	9.3		10.6	
Median income level by ZIP code, $		<.001		<.001
1-24 999	11.0		11.4	
25 000-34 999	11.6		10.4	
35 000-44 999	9.8		10.5	
≥45 000	10.1		10.6	
Missing	10.2		13.8	
Insurance status, younger cohort/ older cohort		<.001		<.001
Medicare/Medicare only	14.6		10.5	
Medicaid/Medicare or Medicaid (dually eligible)	16.8		14.3	
Private insurance/Medicare or private insurance	8.5		10.3	
Uninsured	19.9		—	
Other/Medicare or other	13.0		10.1	
Health status	<.001		<.001	
Noncompromised	7.9		8.2	
Compromised	16.4		13.9	
Missing	11.3		10.5	
Metastatic cancer		<.001		<.001
Absent	7.3		8.3	
Present	13.9		14.6	
Missing	11.3		10.5	
No. of comorbidities		<.001		<.001
0	11.1		13.8	
1	10.2		10.8	
2	8.9		8.5	
≥3	7.6		8.8	
Missing	11.3		10.5	
Teaching hospital status		<.001		.006
No	10.9		11.0	
Yes	9.8		10.2	
Total	10.3	—	10.6	—

*Data are given as percentages.

group (≥85 years) undergoing more E-CCR.

Results from the multivariable multilevel logistic regression analyses were consistent with those of the bivariate analyses (Table 2). In the younger cohort, Medicaid enrollees (adjusted odds ratio [AOR], 2.08; 95% confidence interval [CI], 1.68-2.58) and the uninsured (AOR, 2.62; 95% CI, 2.05-3.34) were at higher risk for E-CCR compared with privately insured patients. Those with compromised health status (AOR, 2.16; 95% CI, 1.86-2.51) or metastatic cancer (AOR, 1.91; 95% CI, 1.66-2.20) were significantly more likely than their healthier counterparts to undergo E-CCR. Compared with those with no documented comorbidities, patients with 3 or more comorbidities were almost half as likely to undergo E-CCR (AOR, 0.53; 95% CI, 0.37-0.77).

In the older cohort, compared with those aged 65 to 74 years, individuals 85 years and older were at higher risk for E-CCR (AOR, 1.44; 95% CI, 1.26-1.66) (Table 3). Compared with those with Medicare only, those who were dually eligible for Medicare and Medicaid were at significantly increased risk for E-CCR (AOR, 1.37; 95% CI, 1.11-1.70). African American race/ethnicity was associated with increased risk for E-CCR in the older cohort (AOR, 1.22; 95% CI, 1.01-1.49). Results

relative to compromised health status, metastatic cancer, and comorbidities were consistent with those observed in the younger cohort. Of note are the results indicating that women were significantly less likely to undergo E-CCR, a finding that held true in the younger and older cohorts.

When the effects of patient demographics, comorbidities, health status, metastatic cancer, and teaching hospital status were controlled for in multivariable analyses, E-CCR remained a significant predictor of length of stay, hospital charges, and in-hospital mortality (Table 3). In particular, compared with those undergoing elective colorectal cancer resection, patients presenting with a diagnosis requiring emergency surgery had a mean predicted length of stay that was 4 days longer than that of the nonemergency patients. Emergency colorectal cancer resection was associated with mean excess hospital charges of $19 073, and patients undergoing E-CCR were more than 3 times as likely to die in the hospital, statistics that held true in the younger and older cohorts (Table 4). In 2002, the mean excess length of stay and hospital charges associated with E-CCR, compared with nonemergency colorectal cancer resection, amounted to 54 979 hospital days and more than $250 million.

Table 2. Results of the Multivariable Multilevel Logistic Regression Models Predicting Emergency Colorectal Cancer Resection*

Age, y		
0-44	Referent	
45-64	1.08 (0.87-1.34)	
65-74		Referent
75-84		1.20 (1.07-1.33)
≥85		1.44 (1.26-1.66)
Sex		
Male	Referent	Referent
Female	0.74 (0.64-0.86)	0.90 (0.81-0.99)
Race/ethnicity		
White	Referent	Referent
African American	1.11 (0.88-1.41)	1.22 (1.01-1.49)
Hispanic	0.78 (0.59-1.04)	0.74 (0.54-1.02)
Other	0.98 (0.69-1.41)	0.81 (0.60-1.08)
Missing	0.87 (0.73-1.04)	0.95 (0.84-1.09)
Median income level by ZIP code, $		
1-24 999	Referent	Referent
25 000-34 999	1.14 (0.82-1.61)	0.81 (0.65-1.02)
35 000-44 999	1.03 (0.75-1.42)	0.83 (0.67-1.03)
≥45 000	1.18 (0.87-1.60)	0.84 (0.67-1.04)
Insurance status, younger cohort/older cohort		
Medicare/Medicare only	1.72 (1.27-2.33)	Referent
Medicaid/Medicare or Medicaid (dually eligible)	2.08 (1.68-2.58)	1.37 (1.11-1.70)
Privately insurance/Medicare or private insurance	Referent	0.96 (0.85-1.08)
Uninsured	2.62 (2.05-3.34)	—
Other/Medicare or other	1.58 (1.14-2.20)	0.96 (0.55-1.66)
Health status		
Noncompromised	—	—
Compromised	2.16 (1.86-2.51)	1.78 (1.60-1.98)
Metastatic cancer		
Absent	Referent	Referent
Present	1.91 (1.66-2.20)	1.80 (1.63-1.99)
No. of comorbidities		
0	Referent	Referent
1	1.08 (0.87-1.35)	0.73 (0.65-0.81)
2	0.69 (0.55-0.86)	0.56 (0.49-0.64)
≥3	0.53 (0.37-0.77)	0.57 (0.48-0.68)
Teaching hospital status		
No	Referent	Referent
Yes	0.92 (0.79-1.07)	0.96 (0.85-1.09)

*Data are given as odds ratio (95% confidence interval).

DISCUSSION

This study identified predictors of emergency presentation in a nationally representative sample of patients with colorectal cancer undergoing resection and determined its health and economic burden relative to length of stay, hospital charges, and in-hospital mortality. The results showed significant effects of patient age and insurance status on the risk of pre-

Table 3. Association Between Emergency Colorectal Cancer Resection (E-CCR) and Hospital Outcomes, Adjusted for Patient Characteristics, Comorbidities, and Health Status*

	Transformed Length of Stay		Transformed Hospital Charges		In-Hospital Mortality
Variable	β (SE)	Predicted Mean (95% CI)	β (SE)	Predicted Mean, $ (95% CI)	Adjusted Odds Ratio
Younger cohort	0.42 (0.02)	—	0.45 (0.02)	—	3.74 (2.32-6.02)
Emergency	—	10.61 (9.23-11.99)	—	40 990 (35 628-46 352)	—
Nonemergency	—	6.48 (5.57-7.39)	—	23 652 (20 218-27 086)	—
Older cohort	0.34 (0.02)	—	0.44 (0.02)	—	3.49 (2.89-4.20)
Emergency	—	11.94 (10.23-13.65)	—	48 630 (39 744-57 516)	—
Nonemergency	—	7.89 (6.68-9.10)	—	28,731 (24 106-33 356)	—

*CI indicates confidence interval.

senting with colorectal cancer as surgical emergency, placing Medicaid enrollees, the uninsured, and older persons at high risk for E-CCR (Table 2). Interventions to facilitate or improve access to screening in these vulnerable subgroups of the population may lead to decreased E-CCR.

Consistent with previous studies,[3,5,14,16,17,22] patients who underwent E-CCR had extended lengths of stay, increased hospital charges, and substantially higher in-hospital mortality. This placed an excess burden on the healthcare system of 54 979 hospital days and more than $250 million in hospital charges in 2002 (Table 4).

Compromised health status proved to be significantly and positively associated with E-CCR. Such presentation, which is suggestive of advanced-stage cancer, may place patients at increased risk for surgical complications or for poor surgical outcomes. Early detection of disease may enable patients to avoid E-CCR, unfavorable surgical outcomes, and health status decline. A significantly negative association was found between greater numbers of comorbidities and E-CCR in the older cohort. As speculated in a previous study,[36] frequent contact with the healthcare system may increase the probability of early detection of cancer. However, it is also possible that sicker patients in whom resection could not be performed safely or those who elected not to undergo resection may not have been represented in our study population.

A study of Medicare beneficiaries by Cooper et al[37] in 1996 found decreased rates of surgery and increased mortality among African Americans with colorectal cancer. In our younger and older cohorts, African Americans had the highest proportions of E-CCR compared with other racial/ethnic groups. In multivariable analyses, this association proved to be statistically significant in the older cohort but not in the younger cohort. Racial/ethnic disparities may be explained by variations in patient attributes. A significant predictor of emergency presentation in this study was insurance status, the inclusion of which in the multivariable models may have masked the effect of race/ethnicity relative to E-CCR. In our study population, higher proportions of uninsured patients and Medicaid enrollees were observed among African Americans (16.9% and 8.6%, respectively) and among Hispanics (19.1% and 12.8%, respectively) compared with among whites (6.5% and 4.0%, respectively). However, the unfavorable case

Table 4. Burden of Emergency Colorectal Cancer Resection (E-CCR) to the Healthcare System*

	No. of Patients With E-CCR	Mean Length of Stay	Excess Associated With E-CCR		
Variable			Total Length of Stay	Mean Hospital Charges, $	Total Hospital Charges, $
Younger cohort	4351	4.13 (2.48-5.78)	17 970 (10 797-25 142)	17 338 (10 971-23 705)	75 437 638 (47 733 867-103 141 409)
Older cohort	9138	4.05 (1.96-6.14)	37 009 (17 899-56 118)	19 899 (9881-29 917)	181 837 062 (90 293 603-273 380 521)
Total	13 489	4.08 (2.87-5.28)	54 979 (38 731-71 226)	19 073 (13 367-24 779)	257 274 700 (180 302 905-334 246 495)

*Data are given as value (95% confidence interval) unless otherwise indicated.

mix by insurance status negatively affected African Americans but not Hispanics, as evidenced by the significantly lower proportions of E-CCR among the latter subgroup. Possible explanations include the much-debated Hispanic paradox[38] and the fact that the study population was limited to patients undergoing colorectal cancer resection, as already discussed.

A study[23] of patients with colorectal cancer conducted in the United Kingdom found that socioeconomic status was significantly related to having more advanced disease at presentation and to having a lower likelihood of survival. While this association was not confirmed in our study, the lack of significance of income level may be potentially explained by the fact that income level was measured based on ZIP code. Because there can be wide variation in income levels within a ZIP code, individual differences related to emergency resection may have been masked.

To our knowledge, this is the first population-based study of patients undergoing E-CCR in the United States. This study not only identified predictors of E-CCR but also quantified its burden on the healthcare system, filling an important gap in the literature. Several limitations should be borne in mind when interpreting the findings, however.

First, our study used hospital discharge data, the quality of which may not be comparable to that of medical records. The stage of the tumor at presentation could not be determined from these data, and there was no information available to distinguish between resection procedures of curative vs palliative intent. One study[33] found that up to 29% of patients presenting in surgical emergency settings received palliative care only.

Second, because the study population was limited to those undergoing resection procedures, many patients presenting in emergency settings may have been unrepresented in the study population, as already noted. These might have comprised severe cases in which surgical resection may have been indicated but was unlikely to be successful, the health status of the patient was unsuitable for surgery, the patient refused treatment, or some interim measure was completed in the emergency setting with a resection being scheduled electively. This selection bias may have led to an underestimation of particular characteristics of the study population, including the rates of comorbidity and mortality. Of note is our use of a variable for metastatic cancer, although it might reflect the presence of any metastatic cancer, not just colorectal cancer. As noted earlier, rather than considering this variable as a comorbidity, we chose to use it as a separate covariate in our multivariable models. Limitations of claims data relative to their ability to identify cancer stage have been documented previously.[31] However, as hypothesized, we found a positive and significant association between metastatic cancer and E-CCR.

Third, the study used cross-sectional data, which did not allow us to distinguish between patients presenting as emergencies because of improper management and those presenting because of failure of screening or diagnosis or because of recurrence of a previously treated malignancy. Also, given the nature of the data, mortality statistics presented in this study cannot be extended to the postdischarge period.

Fourth, there was differential reporting of some variables across states, including race/ethnicity, insurance status, and diagnosis and procedure codes. There were up to 15 diagnosis codes used in this data set; however, some states reported only 10 diagnosis codes and 6 procedure codes, while others reported as many as 30 diagnosis codes and 21 procedure codes. There may be additional bias in reporting health status indicators and comorbidities, especially common conditions such as hypertension, which may be underreported in the presence of a more severe diagnosis such as colorectal cancer.

Fifth, the insurance status is likely to reflect health coverage at the time the patient underwent resection for colorectal cancer, warranting caution in interpreting the association between insurance status and E-CCR. This is particularly relevant to Medicaid enrollees, as it has been shown that longer periods of enrollment in Medicaid are likely to be associated with greater use of screening mammography.[39] In addition, individuals enrolled in Medicaid around the time of diagnosis or after being diagnosed as having cancer are more likely than those enrolled in Medicaid before a cancer diagnosis to be diagnosed as having advanced-stage breast[40,41] or colorectal[42] cancer.

In closing, failure to screen, as evidenced by E-CCR, results in significant but preventable costs economically and in terms of morbidity and mortality. Early identification of patients most at risk for E-CCR, particularly older persons, those without private insurance, and others with limited access to care may reduce the disparities and decrease the burden of these procedures on patients and on the healthcare system.

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Take-away Points

- Among a younger cohort (<65 years), Medicaid enrollees and the uninsured were at higher risk for emergency colorectal cancer resection (E-CCR).
- Among an older cohort (≥65 years), patients dually eligible for Medicare and Medicaid were at higher risk for E-CCR.
- Emergency colorectal cancer resection was associated with greater than 3-fold increased in-hospital mortality, 54 979 excess hospital days, and more than $250 million in hospital charges.

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