Hospital Academic Status and Value of Care for Nonmetastatic Colon Cancer

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Abstract

Purpose: The relationship between oncologic hospital academic status and the value of care for stage II and III colon cancer is unknown.

Methods: Retrospective SEER-Medicare analysis of patients age ≥ 66 years with stage II or III colon cancer and seen by medical oncology. Eligible patients were diagnosed 2000 to 2009 and followed through December 31, 2010. Hospitals reporting a major medical school affiliation in the NCI Hospital File were classified as academic medical centers. The association between hospital academic status and survival was assessed using Kaplan-Meier curves and Cox proportional hazards models. The association with mean cost of care was estimated using generalized linear models with log link and gamma family and with cost of care at various quantiles using quantile regression models.

Results: Of 24,563 eligible patients, 5,707 (23%) received care from academic hospitals. There were no significant differences in unadjusted disease-specific median survival or adjusted risk of colon cancer death by hospital academic status (stage II hazard ratio = 1.12; 95% CI, 0.98 to 1.28; $P = .103$; stage III hazard ratio = 0.99; 95% CI, 0.90 to 1.08; $P = .763$). Excepting patients at the upper limits of the cost distribution, there was no significant difference in adjusted cost by hospital academic status.

Conclusion: We found no survival differences for elderly patients with stage II or III colon cancer, treated by a medical oncologist, between academic and nonacademic hospitals. Furthermore, cost of care was similar across virtually the full range of the cost distribution.

Introduction

Colorectal cancer (CRC) is the third most common cancer among both men and women in the United States, with nearly 150,000 new diagnoses each year.¹ It is also the second most expensive cancer to treat, behind only breast cancer in national cancer care expenditures.² Given this high and rising cost, it is important to identify factors that affect the value of colorectal cancer care and to focus on the delivery of high-value care, defined as care that maximizes patient outcomes while containing cumulative costs of care.³

The setting in which cancer care is delivered—specifically, the academic status of the treating hospital—is one factor that could affect the value of care. Although conventional wisdom holds that treatment at academic medical centers might improve patient outcomes but cost more,^{4,5} the empirical evidence is mixed. Care at an academic center has been associated with better outcomes for some conditions, including surgery for CRC.^{6,7} For other conditions, it has been associated with higher costs of care and little difference in quality measures.⁸⁻¹⁰

Despite the rapid growth in expensive diagnostic and therapeutic interventions in medical oncology, relatively little is known about the relationship between hospital academic status and the costs and outcomes of medical oncology care. It is plausible that oncologists affiliated with an academic center have better access than nonacademic oncologists to the latest technologic advances, such as positron emission tomography/computed tomography imaging and molecular sequencing,

which may increase costs of care. Conversely, care within an academic center may be better coordinated among specialties and more closely adherent to treatment guidelines than care in nonacademic centers, potentially decreasing costs and increasing survival. To provide additional insight into the relationship between the value of cancer care and hospital academic status, we evaluated whether the academic status of the hospital affiliated with the primary medical oncologist caring for patients with stage II or III colon cancer was associated with differences in costs and outcomes.

Methods

Institutional Review

This was a cohort study of the cost and outcomes of cancer care delivered to elderly patients with colon cancer who were seen by a medical oncologist and diagnosed 2000 to 2009. This study was exempted from review by the University of Pennsylvania Institutional Review Board.

Study Population

We identified 222,117 patients diagnosed with colon cancer between January 1, 2000, and December 31, 2009, from the SEER-Medicare files.

We excluded patients who met the following criteria: no histologic finding of adenocarcinoma ($n = 12,333$), diagnosis made at autopsy or on a death certificate ($n = 2,542$), younger

than 66 years (to enable inclusion of 1 year of claims for comorbidity assessment) or older than 99 years at the time of diagnosis ($n = 43,412$), with incomplete Medicare Part A or B coverage during the study period ($n = 46,529$), enrolled in a Medicare health maintenance organization 6 months before or 12 months after diagnosis ($n = 31,678$), with missing stage data or stage 0 ($n = 9,257$). Of the remaining 76,366 patients, 47,014 had stage II or stage III cancer at diagnosis, based on the American Joint Committee on Cancer overall cancer stage provided in the SEER files for each patient. We excluded 22,451 patients who did not have at least one visit with a medical oncologist, resulting in a final analytic cohort of 24,563 patients followed through December 31, 2010.

Hospital Assignment

Numerous methodological challenges arise in assigning a patient to a treating hospital because most colon cancer care occurs in the outpatient setting. Using a method described previously,^{11,12} we assigned each patient in our cohort to a treating hospital based on the hospital affiliation of their primary medical oncologist, defined as the oncologist who billed for the greatest number of evaluation and management visits in the 6 months before and 12 months after diagnosis. Oncologists were assigned to the one hospital where they billed for the most inpatient care, and that hospital was designated their hospital of affiliation. Patients were then assigned to the hospital with which their primary oncologist was affiliated.

Outcome Measures

We examined three primary outcomes: disease-specific survival, overall survival, and cost of care. Disease-specific survival was calculated as the number of months from the date of initial colon cancer diagnosis to the date of death from colon cancer or to December 31, 2010, if the patient was alive at the end of follow-up. Overall survival was calculated as the number of months from the date of initial colon cancer diagnosis to the date of death from any cause or to December 31, 2010, if the patient was alive at the end of follow-up.

Cost of care was defined as the total payment made by Medicare for a patient's inpatient and outpatient care, determined by summing payments obtained from the inpatient Medicare Provider Analysis and Review file, the National Claims History file, and the Outpatient Standard Analytic File. Costs were summed and analyzed over the time interval from initial cancer diagnosis to 12 months later. All dollar values were inflated to 2009 using the annual Gross Domestic Product price index. All survival and cost analyses were performed separately for patients with stage II disease and patients with stage III disease.

Predictor Variable

The primary predictor of interest was academic status of the oncologic hospital for each patient. Consistent with prior studies,^{11,13} academic status was obtained from the National Cancer Institute Hospital File. This file includes information about hospitals obtained from the Healthcare Cost Report and the Provider of Service survey. Hospitals reporting a major medical

school affiliation were considered academic hospitals in our analyses. All other hospitals were considered nonacademic.

Covariables

Before data analysis, we identified potential confounders of the association between hospital academic status and the outcome variables. These included patient age, race, sex, Elixhauser comorbidity score¹⁴ excluding cancer-related diagnoses, ZIP code-based socioeconomic status, year of diagnosis, and the academic status of the hospital at which patients underwent colon cancer surgery (surgical hospital).

Statistical Analyses

To assess univariable associations between the type of hospital (academic versus nonacademic) and clinical and demographic factors, we used χ^2 tests for categorical variables and t tests for continuous variables. We constructed Kaplan-Meier curves to assess unadjusted survival. We estimated Cox proportional hazards models to assess the association between hospital academic status and survival while adjusting for potential confounders and accounting for censoring. We separately modeled time to colon cancer-related death and time to death from any cause.

To examine the association between hospital academic status and mean cost of care while adjusting for potential confounders, we estimated generalized linear models (GLM) with log link and gamma family. We also estimated quantile regression models to examine associations between hospital teaching status and cost of care at various percentiles (25th, 50th, 75th, 90th, 95th, 99th, 99.5th, 99.9th) along the cost distribution, while adjusting for potential confounders. In all models, standard errors were adjusted to account for clustering of patients within hospitals.

We assessed two-way interactions between hospital academic status and patient age, race, and number of comorbid conditions, using likelihood ratio or Wald tests to assess the joint significance of interaction terms. No interactions were statistically significant.

Statistical significance was set at $P < .05$. All statistical analyses were performed using STATA software (version 13.1; STATA Inc, College Station, TX).

Results

Sample Characteristics and Univariable Analysis

The final cohort consisted of 12,132 patients with stage II and 11,968 with stage III colon cancer at diagnosis. Twenty-three percent of patients with stage II disease and 24% of patients with stage III disease received cancer care from medical oncologists affiliated with an academic hospital. Table 1 shows baseline characteristics of the cohort and univariable analyses of associations between these characteristics and hospital academic status. Characteristics that varied by hospital academic status included vital status for stage II patients ($P = .010$), race for stage II ($P = .003$) and stage III ($P < .001$) patients, ZIP code-based income for stage II and stage III patients (both

Table 1. Association of Patient Characteristics and Hospital Academic Status*

Characteristic	Stage II			Stage III		
	Academic Hospital, No. (%)	Nonacademic Hospital, No. (%)	P	Academic Hospital, No. (%)	Nonacademic Hospital, No. (%)	P
No. of patients	2,767 (23%)	9,365 (77%)		2,810 (24%)	9,158 (77%)	
Vital status (12/2010)			.010			.771
Alive	1,774 (64%)	5,752 (61%)		1,504 (53%)	4,873 (53%)	
Dead	993 (36%)	3,613 (39%)		1,306 (46%)	4,285 (47%)	
Age, years			.776			.524
66-69	456 (16%)	1,533 (16%)		467 (17%)	1,665 (18%)	
70-74	676 (24%)	2,217 (24%)		729 (26%)	2,301 (25%)	
75-79	728 (26%)	2,447 (26%)		725 (26%)	2,353 (26%)	
80-84	570 (21%)	1,939 (21%)		563 (20%)	1,786 (20%)	
≥ 85	337 (12%)	1,229 (13%)		326 (12%)	1,053 (11%)	
Race			.003			< .001
White	2,366 (86%)	8,165 (87%)		2,363 (84%)	7,881 (86%)	
Black	271 (10%)	696 (7%)		306 (11%)	728 (8%)	
Other	130 (5%)	504 (5%)		141 (5%)	549 (6%)	
Sex			.840			.745
Female	1,236 (45%)	4,163 (44%)		1,266 (45%)	4,158 (45%)	
Male	1,531 (55%)	5,202 (56%)		1,544 (55%)	5,000 (55%)	
Comorbid conditions			.363			.580
0	153 (6%)	446 (5%)		140 (5%)	444 (5%)	
1	289 (10%)	979 (10%)		339 (12%)	1,034 (11%)	
≥ 2	2,325 (84%)	7,940 (85%)		2,331 (83%)	7,680 (84%)	
ZIP code-based income			< .001			< .001
0% to 25%	477 (17%)	2,490 (27%)		480 (17%)	2,426 (26%)	
> 25% to 50%	576 (21%)	2,398 (26%)		533 (19%)	2,355 (26%)	
> 50% to 75%	700 (25%)	2,279 (24%)		692 (25%)	2,207 (24%)	
> 75% to 100%	1,014 (37%)	2,198 (23%)		1,105 (39%)	2,170 (24%)	
Year of diagnosis			.001			.026
2000	257 (9%)	941 (10%)		271 (10%)	850 (9%)	
2001	261 (9%)	1,065 (11%)		271 (10%)	972 (11%)	
2002	307 (11%)	1,112 (12%)		347 (12%)	1,103 (12%)	
2003	289 (10%)	1,083 (12%)		346 (12%)	1,074 (12%)	
2004	290 (10%)	1,048 (11%)		275 (10%)	1,069 (12%)	
2005	294 (11%)	994 (11%)		310 (11%)	1,037 (11%)	
2006	325 (12%)	1,023 (11%)		257 (9%)	916 (10%)	
2007	304 (11%)	905 (10%)		284 (10%)	932 (10%)	
2008	242 (9%)	701 (7%)		271 (10%)	688 (8%)	
2009	198 (7%)	493 (5%)		178 (6%)	517 (6%)	
Surgical hospital†			< .001			< .001
Academic	1,802 (65%)	623 (7%)		1,843 (66%)	750 (8%)	
Nonacademic	797 (29%)	8,239 (88%)		811 (29%)	7,935 (87%)	
Missing	168 (6%)	503 (5%)		156 (6%)	473 (5%)	

NOTE. Proportions may not add to 100% because of rounding.

* This represents the hospital most closely affiliated with patients' primary medical oncologists.

† This represents the hospital at which patients underwent primary surgical resection of their colon cancer.

P s < .001), year of diagnosis for stage II (P = .001) and stage III (P = .026) patients, and surgical hospital teaching status for stage II and stage III patients (both P s < .001). There were no significant differences in age, sex, or comorbid conditions by hospital academic status.

Survival Analysis

Unadjusted Kaplan-Meier curves for disease-specific and overall survival by stage are shown in [Figure 1](#). Univariable analyses using log-rank testing indicated that academic status was not significantly associated with survival. Median disease-specific survival was

Figure 1. Kaplan-Meier survival estimates, by hospital academic status, for (A, B) stage II and (C, D) stage III disease.

not reached. Median overall survival for patients with stage II colon cancer treated at academic hospitals was 8.4 years, versus 8.3 years for patients treated at nonacademic hospitals ($P = .605$). Median overall survival for patients with stage III disease treated at academic hospitals was 6.2 years, versus 6.3 years for patients treated at nonacademic hospitals ($P = .720$).

After adjustment, hospital academic status was not significantly associated with the hazard of colon cancer death (hazard ratio [HR] = 1.12; 95% CI, 0.98 to 1.28; $P = .103$) or death from any cause (HR = 1.03; 95% CI, 0.95 to 1.11; $P = .531$) in patients with stage II disease. Similarly, hospital academic status was not significantly associated with the hazard of colon cancer death (HR = 0.99; 95% CI, 0.90 to 1.08; $P = .763$) or death from any cause (HR = 1.03; 95% CI, 0.96 to 1.10; $P = .378$) in patients with stage III disease. [Appendix Table A1](#) (online only) shows the results of the Cox proportional hazards models.

Cost of Care

Twelve-month unadjusted and adjusted cost of care is shown in [Table 2](#). Among patients with stage II disease, the unadjusted mean cost of care was \$2,709 higher for patients treated at academic medical centers (95% CI, \$334 to \$5,084; $P = .025$), and the unadjusted median cost of care was \$1,668 higher for patients treated at academic medical centers (95% CI, $-\$1,278$ to \$4,614; $P = .267$). Nominal differences in unadjusted me-

dian costs of care increased across the 25th, 50th, 75th, 90th, 95th, 99th, and 99.5th percentiles. At the 99.5th percentile the unadjusted median difference in cost was $-\$45,381$, indicating a lower cost associated with academic medical centers, though this was not statistically significant (95% CI, $-\$94,719$ to \$3,957; $P = .071$). Only the unadjusted difference in median cost at the 95th percentile was statistically significant ($P = .022$).

Among patients with stage III disease, the unadjusted mean cost of care was \$2,870 higher for patients treated at academic medical centers (95% CI, \$318 to \$5,422; $P = .028$), and the unadjusted median cost of care was \$2,859 higher for patients treated at academic medical centers (95% CI, $-\$1,170$ to \$6,888; $P = .164$). Nominal differences in unadjusted median cost of care increased across the 25th, 50th, 75th, 90th, and 95th percentiles. The unadjusted median differences in cost were negative at the 99th and 99.5th percentiles, indicating a lower cost associated with academic medical centers though neither difference was statistically significant ($P = .955$, $P = .723$, respectively). The only statistically significant unadjusted difference in median cost was that seen at the 99.5th percentile; unadjusted median cost was \$70,175 higher for patients in this percentile treated at academic medical centers (95% CI, \$22,890 to \$117,459; $P = .024$).

Hospital academic status was included in a generalized linear model that adjusted for patient characteristics. After adjust-

Table 2. Twelve-Month Costs, by Hospital Academic Status

Outcome	Stage II				Stage III			
	Academic	Nonacademic	Unadjusted Difference (95% CI)	Adjusted Difference (95% CI)	Academic	Nonacademic	Unadjusted Difference (95% CI)	Adjusted Difference (95% CI)
Mean cost	\$49,240	\$46,531	\$2,709 (\$334 to \$5,084)*	\$1,272 (–\$834 to \$3,379)	\$66,949	\$64,078	\$2,870 (\$318 to \$5,422)§	\$2,525 (\$372 to \$4,677)
Median cost	\$37,616	\$35,948	\$1,668 (–\$1,278 to \$4,614)	\$1,231 (–\$541 to \$3,003)	\$61,645	\$58,786	\$2,859 (–\$1,170 to \$6,888)	\$2,206 (–\$900 to \$5,312)
25th percentile	\$25,937	\$24,787	\$1,150 (–\$948 to \$3,249)	\$730 (–\$689 to \$2,148)	\$38,834	\$37,237	\$1,597 (–\$2,277 to \$5,471)	\$856 (–\$1275 to \$29,866)
75th percentile	\$62,400	\$57,973	\$4,427 (–\$1,705 to \$10,559)	\$2,192 (–\$826 to \$5,209)	\$84,786	\$82,038	\$2,748 (–\$2,130 to \$7,626)	\$3,162 (–\$373 to \$6,697)
90th percentile	\$96,443	\$88,792	\$7,651 (–\$1,310 to \$16,613)	\$452 (–\$5,607 to \$4,702)	\$112,200	\$108,441	\$3,759 (–\$2,855 to \$10,374)	\$5,329 (\$849 to \$9,808)
95th percentile	\$119,366	\$108,929	\$10,437 (\$1,498 to \$19,374)†	\$2138 (–\$5,929 to \$10,204)	\$132,198	\$125,774	\$6,424 (–\$1,085 to \$13,933)	\$4,183 (\$2,257 to \$10,624)
98th percentile	\$184,122	\$168,342	\$15,780 (–\$7,785 to \$39,345)	\$2964 (–\$16,982 to \$22,910)	\$178,640	\$179,254	–\$614 (–\$21,940 to \$20,711)	\$11,640 (\$2,111 to \$21,168)
99.5th percentile	\$216,996	\$207,492	\$9,504 (–\$45,418 to \$63,426)	\$10,739 (–\$60,298 to \$81,777)	\$207,112	\$213,864	–\$6,752 (–\$44,102 to \$30,597)	\$14,486 (\$950 to \$28,022)¶
99.9th percentile	\$245,396	\$290,777	–\$45,381 (–\$94,719 to \$3,957)	\$22,981 (\$11,045 to \$44,916)‡	\$339,225	\$269,049	\$70,175 (\$22,890 to \$117,459)#	\$14,861 (–\$16,907 to \$46,628)

NOTE. Unadjusted mean costs were obtained via two-sample *t* test, and adjusted differences in mean costs were obtained via generalized linear modeling. Unadjusted and adjusted median and percentile-based costs were obtained using quantile regression. Only significant *P*s are listed below; all other *P*s were nonsignificant. All dollar values were inflated to 2009 using the annual Gross Domestic Product price index.

* *P* = .025

† *P* = .022

‡ *P* = .001

§ *P* = .028

|| *P* = .022

¶ *P* = .036

P = .024

ment, there was no longer a significant association between hospital academic status and difference in mean cost for patients with stage II disease. The adjusted mean cost of care was \$1,272 higher (95% CI, -\$834 to \$3,379; $P = .233$) for patients with stage II disease treated at academic medical centers, and the adjusted median cost of care was \$1,231 higher (95% CI, -\$541 to \$3,003; $P = .174$). For patients with stage III disease treated at academic medical centers, the adjusted mean cost of care was \$2,525 higher (95% CI, \$372 to \$4,677; $P = .022$), and the adjusted median cost of care was \$2,206 higher (95% CI, -\$900 to \$5,312; $P = .164$). The only statistically significant adjusted differences in cost from the quantile regressions were those seen among stage II patients at the 99.ninth percentile of costs ($P = .001$) and stage III patients at the 99.fifth percentile of costs ($P = .036$), for whom costs were higher at academic medical centers.

Discussion

In summary, in this sample of 24,563 patients with stage II or stage III colon cancer and at least one medical oncology visit drawn from the SEER-Medicare database, there were no significant differences in survival or 12-month cost of care associated with the academic status of the treating hospital. We found similar disease-specific and overall survival regardless of hospital academic status for patients with either stage of disease. We did find significantly higher unadjusted mean costs of care for patients with stage II and patients with stage III disease treated at academic medical centers, and the adjusted mean costs of care remained significant among stage III patients. However, mean costs were skewed by a small group of patients for whom treatment was very expensive. Among patients with stage II disease and stage III disease, the adjusted differences in costs were significant only for those patients whose costs fell within the 99.ninth and 99.fifth percentiles, respectively. For these small groups, the 12-month cost was \$22,981 higher for stage II patients treated at academic medical centers and \$14,486 higher for stage III patients treated at academic medical centers.

In previous work, we found that patients with stage IV colon cancer received higher value care, with longer overall survival at similar cost, when treated at an academic medical center.¹¹ However, in the current study, we find no difference in value based on academic status for patients with nonmetastatic colon cancer. Faced with the conventional wisdom that academic medical centers deliver better outcomes but at higher costs,^{4,5} we must question what it is about nonmetastatic colon cancer that drives our findings.

Guidelines for the treatment of stage III colon cancer have been in place since 1990.¹⁵ On the basis of rigorous clinical trials,¹⁶⁻¹⁸ surgical resection followed by 6 months of adjuvant chemotherapy is the standard treatment recommendation for stage III disease. Primary surgical resection is also standard care for stage II colon cancer, though the question of which patients with stage II disease stand to benefit from the addition of adjuvant chemotherapy has been debated,¹⁹⁻²³ and the discussion and consideration of adjuvant chemotherapy is recommended for patients with high-risk stage II colon cancer.²⁴ For patients

with nonmetastatic colon cancer and at least one medical oncology visit, our results suggest that these guidelines may have standardized care and leveled the playing field in terms of survival, cost of care, and value of care.

In contrast to the more standardized approaches for patients with stage II and stage III disease, the treatment of metastatic colon cancer has become increasingly complex and personalized. Patients may undergo surgical resection of the primary colon tumor and metastatic liver or lung lesions with curative intent, targeted radiation may be used with palliative or perhaps even curative intent, and chemotherapy regimens include molecularly targeted agents in addition to multiple cytotoxic agents.²⁵⁻²⁹ There is little randomized clinical evidence to direct patient care in this setting, and treatment is much less guideline driven. Perhaps it is this scenario in which academic medical centers, with multidisciplinary expertise and highly specialized providers, are most likely to contribute to improved patient outcomes.

Our study was designed to test the hypothesis that the academic status of the hospital providing medical oncology care may influence the value of such care, and thus only includes patients with stage II and stage III colon cancer who were seen by a medical oncologist. Many patients with stage II disease do not require chemotherapy and never see a medical oncologist. Our study excludes these patients, whose survival and costs may reflect the value of surgical care rather than that of medical oncologic care. We would welcome future studies investigating the association between the value of care and surgical hospital teaching status in this patient group.

There are several limitations to our study. Patients were assigned to a treating oncologic hospital using the primary medical oncologist as an intermediary. It was not possible to assign all patients using this method, and some may have been assigned incorrectly. We used a binary measure of academic status derived from the National Cancer Institute hospital file to classify hospitals with a major medical school affiliation as academic. This does not afford a more nuanced understanding of the variation in institutional features, such as volume of colon cancer cases treated, between the hospitals in our study. It also does not allow us to study variations in access to or use of costly technologies, such as molecular tumor sequencing, though claims data may be inaccurate in assessing such care, and medical records review would be required to capture these variations.

We attempted to expand our investigation of the value of colon cancer care by comparing rates of chemotherapy use according to hospital academic status, but were limited by concerns about the quality of chemotherapy coding in SEER-Medicare after 2004. When usable claims data to accurately identify colon cancer chemotherapy after 2004 become available, we would encourage further studies of potential variation in chemotherapy receipt by hospital teaching status.

Despite adjustment for multiple factors in our analyses, there may be unmeasured differences between patients who receive care at academic centers and those who receive care at

nonacademic centers. Our study population is restricted to patients over age 65, and our findings may not be generalized to younger patients with colon cancer. However, the average age of colon cancer diagnosis in the United States is 69, with the majority of patients diagnosed after age 65.³⁰

Unlike metastatic colon cancer, for which treatment is highly individualized, with potential for substantial variation depending on care setting, stage II and stage III colon cancers are treated using standardized approaches following clear guidelines for care. Using robust, population-based data, we showed that survival was not significantly different for elderly patients with stage II and stage III colon cancer and at least one medical oncology visit based on the teaching status of the hospital from which they received cancer care. Furthermore, cost of care was similar across virtually the full range of the cost distribution. Most patients in our study did not receive colon cancer care from oncologists affiliated with academic medical centers. Our results indicate that this inequity did not affect the value of their colon cancer care.

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Authors' Disclosures of Potential Conflicts of Interest

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Appendix

Table A1. Effect of Hospital Academic Status on Adjusted Survival: Cox Proportional Hazards Models

Characteristic	All-Cause Mortality		Colon Cancer-Specific Mortality	
	Hazard Ratio (95% CI)	P	Hazard Ratio (95% CI)	P
Stage II				
Hospital academic status (v nonacademic)				
Academic	1.03 (0.95 to 1.11)	.531	1.12 (0.98 to 1.28)	0.103
Age, years (v 66-69)				
70-74	1.17 (1.04 to 1.31)	.009	0.96 (0.80 to 1.15)	0.672
75-79	1.57 (1.41 to 1.75)	< .001	1.13 (1.05 to 1.35)	0.161
80-84	2.07 (1.85 to 2.32)	< .001	1.27 (1.06 to 1.53)	0.009
≥ 85	3.14 (2.83 to 3.58)	< .001	1.79 (1.47 to 2.17)	< .001
Race (v white)				
Black	1.03 (0.92 to 1.16)	.601	1.13 (0.94 to 1.38)	.191
Other	0.94 (0.81 to 1.08)	.390	0.92 (0.71 to 1.20)	.541
Sex (v female)				
Male	1.30 (1.23 to 1.39)	< .001	1.14 (1.03 to 1.28)	.012
Comorbid conditions (v 0 conditions)				
1	1.98 (1.41 to 2.80)	< .001	1.97 (1.18 to 3.29)	.009
≥ 2	5.46 (4.00 to 7.46)	< .001	3.83 (2.41 to 6.12)	< .001
Median household income (v 0% to 25%)				
> 25% to 50%	1.04 (0.95 to 1.13)	.420	1.01 (0.87 to 1.18)	.861
> 50% to 75%	1.00 (0.87 to 1.03)	.204	0.95 (0.81 to 1.10)	.479
> 75% to 100%	1.03 (0.83 to 0.99)	.032	0.87 (0.75 to 1.02)	.093
Surgical hospital (v nonacademic)				
Academic	0.95 (0.89 to 1.01)	.083	0.88 (0.79 to 0.98)	.026
Stage III				
Hospital academic status (v nonacademic)				
Academic	1.03 (0.96 to 1.10)	.378	0.99 (0.90 to 1.08)	.763
Age (v 66-69)				
70-74	1.20 (1.09 to 1.32)	< .001	1.03 (0.92 to 1.16)	.596
75-79	1.38 (1.26 to 1.52)	< .001	1.10 (0.98 to 1.24)	.097
80-84	1.81 (1.65 to 1.99)	< .001	1.38 (1.22 to 1.55)	< .001
≥ 85	2.39 (2.16 to 2.65)	< .001	1.54 (1.34 to 1.77)	< .001
Race (v white)				
Black	1.10 (0.99 to 1.21)	.069	1.11 (0.97 to 1.26)	.137
Other	0.94 (0.83 to 1.06)	.330	0.91 (0.77 to 1.07)	.241
Sex (v female)				
Male	1.26 (1.20 to 1.33)	< .001	1.11 (1.03 to 1.19)	.007
Comorbid conditions (v 0 conditions)				
1	1.17 (0.95 to 1.45)	.133	1.07 (0.85 to 1.36)	.562
≥ 2	2.20 (1.83 to 2.64)	< .001	1.51 (1.23 to 1.86)	< .001
Median household income (v 0% to 25%)				
> 25% to 50%	0.96 (0.91 to 1.13)	.257	0.96 (0.86 to 1.06)	.413
> 50% to 75%	0.98 (0.89 to 1.09)	.667	1.00 (0.90 to 1.12)	.934
> 75% to 100%	0.94 (0.84 to 1.04)	.341	0.99 (0.90 to 1.11)	.935
Surgical hospital (v nonacademic)				
Academic	0.97 (0.92 to 1.03)	.343	0.98 (0.87 to 1.15)	.993

NOTE. Year of diagnosis was also included in the model; output not shown here.