Effects of Health Insurance and Race on Colorectal Cancer Treatments and Outcomes

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A B S T R A C T

Objectives. We hypothesized that health insurance payer and race might influence the care and outcomes of patients with colorectal cancer.

Methods. We examined treatments received for all incident cases of colorectal cancer occurring in Florida in 1994 (n=9551), using state tumor registry data. We also estimated the adjusted risk of death (through 1997), using proportional hazards regression analysis controlling for other predictors of mortality.

Results. Treatments received by patients varied considerably according to their insurance payer. Among non-Medicare patients, those in the following groups had higher adjusted risks of death relative to commercial fee-for-service insurance: commercial HMO (risk ratio [RR]=1.40; 95% confidence interval [CI]=1.18, 1.67; *P*=.0001), Medicaid (RR=1.44; 95% CI=1.06, 1.97; *P*=.02), and uninsured (RR=1.41; 95% CI=1.12, 1.77; *P*=.003). Non-Hispanic African Americans had higher mortality rates (RR=1.18; 95% CI=1.01, 1.37; *P*=.04) than non-Hispanic Whites.

Conclusions. Patients with colorectal cancer who were uninsured or insured by Medicaid or commercial HMOs had higher mortality rates than patients with commercial fee-for-service insurance. Mortality was also higher among non-Hispanic African American patients. (*Am J Public Health.* 2000;90:1746–1754)

Colorectal cancer is the second leading cause of cancer mortality in the United States, with an estimated 132 000 cases diagnosed in 1998 and 57 000 deaths in the same year.[1] Although detection of colorectal cancer at an early stage is critical to achieving good outcomes, proper treatment can also influence survival. In addition to surgical excision of the primary tumor, many patients benefit from adjuvant chemotherapy or radiation therapy.[2–11]

Previous studies have shown great variability in the care and outcome of patients with colorectal cancer.[12,13] Age-adjusted colon cancer mortality rates are significantly higher for Black patients than for White patients.[14–16] Colorectal cancer mortality rates are falling among White patients but rising among Black patients.[14] Disparate treatments have been suggested as one factor contributing to racial differences in survival.[17]

Health insurance has been suspected of influencing the type of health care that patients receive.[18] Few studies, however, have examined the effects of insurance payer on colorectal cancer care. Studies have found no difference in treatments or outcomes between fee-for-service (FFS) and HMO insurance types, but most studies have not been population based.[19–22] Lacking health insurance and having Medicaid as an insurance payer have both been associated with different treatment patterns and poor outcomes in patients with breast cancer, but they have not been adequately studied among patients with colorectal cancer.[23–26]

It is not certain, therefore, to what extent race and insurance payer influence the care and outcomes for patients diagnosed with colorectal cancer. We report results from a population-based study exploring the influence of race/ethnicity and insurance payer on the treatments and outcomes for colorectal cancer patients in Florida. We hypothesized that patients who were non-White would be less likely to receive adjuvant therapies and would have higher mortality rates than patients who were White. We also hypothesized that treatment and survival would be influenced by the patient's form of health insurance.

Methods

Sources of Data

Incident cases of colorectal cancer (n=9551) occurring in 1994 were identified from the Florida Cancer Data System (FCDS), Florida's population-based statewide cancer registry. The FCDS is a member of the North American Association of Central Cancer Registries, whose audits have estimated the completeness of case ascertainment for 1990 to 1994 to be 97% and the accuracy of an 8-category staging system to be 82%. Study cases included cancers of the colon (including the rectosigmoid junction) and rectum but excluded tumors of the anal canal because of differing pathology and treatment implications.[27]

FCDS cases were linked with the Florida Agency for Health Care Administration (AHCA) discharge abstracts, which comprise data on admissions to all nonfederal acute care hospitals and patient visits to ambulatory surgical centers, freestanding radiation therapy centers, and diagnostic imaging centers. Data abstracted include Social Security number, date of birth, sex, race/ethnicity, discharge diagnoses (up to 10), procedures performed (up to 10), and insurance payer. The methods of link-

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ing FCDS and AHCA records, which have been previously described,[28] resulted in a match rate of 82.8%, a rate similar to that achieved in a comparable study.[23] Unmatched cases were similar to matched cases regarding sex (P=.64), median income level (P=.43), median education level (P=.71), race/ethnicity (P=.29), and whether the case was a colon or rectal cancer (P=.96). Colorectal cancers that were diagnosed at the in situ stage or that were unstaged were less likely to match than were those diagnosed at other stages (P=.001).

Using 1990 US census data, we assigned each individual the median income/education level of their census tract (87% of cases) or, if this was unavailable, of their zip code of residence (13% of cases). The use of census-derived measures of socioeconomic status has been validated in previous studies.[29–32] Stage was defined at the time of diagnosis by the SEER Site-Specific Summary Staging Guide.[33] Stage at diagnosis was classified as in situ, local, regional, or distant and was available for 8933 (93.5%) of the incident colorectal cancer cases, with the remainder being unstaged. We assessed vital status through December 31, 1997, using FCDS-derived mortality files.

The FCDS records all cancer-directed treatments administered within 4 months of initiation of therapy, regardless of sequence or degree of completion and regardless of whether performed at the reporting institution or elsewhere. Cancer-directed surgical treatments are defined as procedures performed for definitive treatment of the cancer as opposed to diagnostic or palliative procedures (such as a biopsy, bypass procedure, or colostomy). To supplement information from the FCDS, we also identified cancer-directed surgical procedures from discharge abstracts, using *Current Procedural Terminology* (*CPT*) codes 44110–44111, 44140–44147, 44150–44160, 44392–44394, 45110–45123, 45126, 45160–45190, 45308, 45309, 45315, 45320, 45333, 45338, 45339, 45383–45385, and 46938 and *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) codes 45.03, 45.71–45.79, 48.32–48.35, and 48.40–48.69. We used discharge abstract data from all hospitalizations associated with the first course of treatment. To assess the degree of concordance between the 2 databases, we compared cases in which a cancer-directed surgical treatment was found in discharge abstracts with corresponding information recorded by the FCDS. In 94.2% of cases, there was agreement between the 2 sources of data regarding the surgical treatment performed, a rate similar to that of a study comparing tumor registry and claims data.[34] In a similar fashion, we used FCDS and discharge records to identify patients receiving radiation therapy or chemotherapy. Given the inherent limitations of capturing treatments with administrative databases, we considered cases in which only 1 database indicated that a treatment had been received to be presumptive evidence of treatment.

Insurance payer is defined similarly by both the FCDS and AHCA as the patient's primary method of payment for services provided by the reporting facility. Insurance payer was assessed at the time of diagnosis and included the following categories: Medicare FFS, Medicare HMO, Medicaid, commercial FFS, commercial HMO, other forms of insurance (CHAMPUS [Civilian Health and Medical Program, Uniformed Service], Department of Veterans Affairs, workers' compensation, other state/local government programs), and no health insurance (includes self-pay and charity). Insurance payer was known for 90.0% of patients. Patients were classified into the following 4 categories of race/ethnicity: White (non-Hispanic), Black (non-Hispanic), Hispanic, or other. Variables examined as possible confounders included age, sex, marital status, census-derived measures of median household income (<$15 000, $15 000–$24 999, $25 000–$34 999, $35 000–$49 999, ≥$50 000) and median education level (less than high school graduate, high school graduate, some college, college graduate), smoking status, site of cancer (colon vs rectum), stage at diagnosis, urban vs nonurban residence, and comorbidity.

Comorbidity was determined by methods described by Charlson et al[35] and Deyo et al.[36] The Charlson–Deyo comorbidity index is not an exhaustive list of all possible comorbid conditions but rather is a weighted index of 19 selected categories of disease that were found to be associated with mortality and other important health outcomes. Increasing scores on the Charlson–Deyo comorbidity index reflect an increasing burden of comorbid conditions. Charlson–Deyo comorbid conditions were identified through inpatient and outpatient hospital discharge abstracts for calendar year 1994. The Charlson–Deyo comorbidity index has been validated in previous studies.[35,37,38]

Analysis

Bivariate relationships between predictor variables and treatments received were examined by the χ^2 test for categorical variables and the t test for interval measures. Multivariate relationships between clinical variables and the odds of receiving surgical, radiation, or chemotherapy treatments were examined by multiple logistic regressions. Because patients 65 years and older are virtually all insured by Medicare, we analyzed the Medicare and non-Medicare populations separately to determine the effects of insurance payer on outcomes. Among patients insured by Medicare, we compared those having HMO and those having FFS insurance types. For non-Medicare patients, we created indicator variables for the following insurance payers: Medicaid, commercial HMO, commercial FFS, "other" insurance payers, and no health insurance. The statistical significance of predictor variables was tested with the χ^2 likelihood ratio test.[39]

The use of surgery and chemotherapy to treat colorectal cancer depends on tumor stage. We therefore stratified analysis of these outcomes by stage at diagnosis. There were too few cases of in situ or unstaged cancers, however, to allow meaningful analyses of these strata. Radiation therapy is used more commonly for rectal cancers than for colon cancers. We therefore examined the determinants of radiation therapy separately for colon and rectal cancers.

We examined the adjusted risk of death from all-cause mortality for patient subgroups with Cox proportional hazards regression analysis. Hazard rates were adjusted for other factors that might be associated with mortality, such as age, sex, comorbidity, marital status, smoking status, and community measures of socioeconomic status. To examine the extent to which differences in hazard rates could be explained by later stage at diagnosis or differences in treatment modalities received, 3 separate models were constructed in a hierarchical fashion. The first model excluded stage at diagnosis and treatment modalities. To assess the extent to which any observed mortality differences could be explained by later stage at diagnosis, the second model included indicator variables for stage. To further assess whether any mortality differences observed in the base mode could be explained by differences in stage at diagnosis and treatment modalities received, the third model included indicator variables for stage and treatment modalities.

All analysis was conducted with SAS statistical software (LOGISTIC, LIFETEST, PHREG procedures).[40] We present 95% confidence intervals for adjusted odds and risk ratios; unless specified, all P values are 2-tailed. We determined statistical significance by using an α level of .05.

Results

Most patients received some type of cancer-directed surgical treatment, whereas fewer patients received radiation or chemotherapy (Table 1). In bivariate analysis, insurance payer, but not race/ethnicity, was associated with the types of treatment received. Patients who received a cancer-directed surgical procedure were similar in age to those who did not (71.6 years vs 72.1 years, t test=1.58, P=.11). Patients who received radiation therapy were younger than those who did not (68.9 years vs 72.6 years, t test=14.0,

TABLE 1—Treatment Modalities Used for Patients Diagnosed with Colorectal Cancer: Florida, 1994

Characteristic	n	Surgery, n (%)	Radiation Therapy, n (%)	Chemotherapy, n (%)
Sex				
Male	4875	3873 (79.5)*	1327 (27.2)***	1052 (21.6)
Female	4673	3792 (81.2)	1122 (24.0)	953 (20.4)
Race/ethnicity				
White, non-Hispanic	8138	6538 (80.3)	2100 (25.8)	1702 (20.9)
Black, non-Hispanic	575	449 (78.1)	145 (25.2)	136 (23.7)
Hispanic	754	619 (82.1)	181 (24.0)	149 (19.8)
Other	84	61 (72.6)	24 (28.6)	18 (21.4)
Marital status				
Married	5719	4653 (81.4)**	1563 (27.3)***	1357 (23.7)***
Not married	3620	2856 (78.9)	824 (22.8)	620 (17.1)
Education level				
<High school	363	277 (76.3)	87 (24.0)	74 (20.4)
≥High school graduate	9130	7344 (80.4)	2343 (25.7)	1914 (21.0)
Income				
<$15 000	447	331 (74.1)	122 (27.3)**	88 (19.7)
$15 000–$24 999	3067	2491 (81.2)	843 (27.5)	627 (20.4)
$25 000–$34 999	4623	3719 (80.5)	1133 (24.5)	1008 (21.8)
$35 000–$49 999	1162	925 (79.6)	286 (24.6)	231 (19.9)
≥$50 000	195	156 (80.0)	47 (24.1)	34 (17.4)
Smoking status				
Smoker	1405	1115 (79.4)	404 (28.8)**	378 (26.9)***
Nonsmoker	8146	6552 (80.4)	2046 (25.1)	1627 (20.0)
Insurance payer				
Medicare FFS	5618	4797 (85.4)***	1456 (25.9)***	998 (17.8)***
Medicare HMO	477	433 (90.8)	73 (15.3)	83 (17.4)
Medicaid	126	98 (77.8)	52 (41.3)	44 (34.9)
Commercial HMO	702	621 (88.5)	190 (27.1)	146 (20.8)
Commercial FFS	1251	1086 (86.8)	434 (34.7)	453 (36.2)
Uninsured	250	194 (77.6)	85 (34.0)	102 (40.8)
Other	162	120 (74.1)	56 (34.6)	51 (31.5)
Place of residence				
Urban	5019	4058 (80.9)	1188 (23.7)***	987 (19.7)***
Nonurban	4532	3609 (79.6)	1262 (27.9)	1018 (22.5)
Stage at diagnosis				
In situ	612	365 (59.6)***	86 (14.1)***	3 (0.5)***
Local	2858	2476 (86.6)	703 (24.6)	164 (5.7)
Regional	3977	3607 (90.7)	1067 (26.8)	1164 (29.3)
Distant	1486	1017 (68.4)	417 (28.1)	597 (40.2)
Unstaged	618	202 (32.7)	177 (28.6)	77 (12.5)
Anatomic site				
Colon	7992	6616 (82.8)***	1669 (20.9)***	1599 (20.0)***
Rectal	1559	1051 (67.4)	781 (50.1)	406 (26.0)
Comorbidity index				
0	6813	5246 (77.0)***	1810 (26.6)***	1522 (22.3)***
1	1998	1773 (88.7)	484 (24.2)	379 (19.0)
≥2	740	648 (87.6)	156 (21.1)	104 (14.1)

Note. FFS = fee-for-service.
*P<.05; **P<.01; ***P<.001, comparing the proportion of patients receiving the specified treatment.

P<.001), as were patients who received chemotherapy (65.6 years vs 73.3 years, t test=27.1, P<.0001).

Multivariate determinants of receiving definitive surgical treatment are presented in Table 2. There were no overall racial differences in the receipt of definitive surgical treatment. In a stratified analysis, Hispanics and non-Hispanic Blacks with regional-stage disease were more likely to receive definitive surgical treatment than were non-Hispanic Whites. Among Medicare patients, those having HMO insurance were more likely to receive definitive surgical treatment, a difference that increased with the cancer's advancing stage. Among non-Medicare patients, those having Medicaid, those who were uninsured, and those having other forms of health insurance were less likely to receive surgical treatment than were private FFS patients. Use of definitive surgery was also more common among younger patients, those with higher levels of education, and those who were married.

Multivariate predictors of radiation therapy are presented in Table 3. There were no racial differences in the use of radiation therapy. Among Medicare patients, those having HMO insurance types were less likely to receive radiation therapy, an effect that was primarily restricted to patients with colon cancer. Among non-Medicare patients, there were no insurance-related differences in the receipt of radiation therapy. Other predictors of using radiation therapy included younger age, lower levels of income, nonurban residence, being married, having rectal cancer, and having lower levels of comorbidity.

Multivariate predictors of receiving chemotherapy are presented in Table 4. Hispanics were less likely than non-Hispanic Whites to receive chemotherapy. Among non-Medicare patients, persons with commercial HMO insurance were less likely than those with commercial FFS insurance to receive chemotherapy. Otherwise, among patients of all tumor

TABLE 2—Multivariate Predictors of Receiving Definitive Surgery[a] for Colorectal Cancer: Florida, 1994

Characteristic	Stage at Diagnosis, OR (95% CI)			
	All Stages[b]	Local	Regional	Distant
Age[c]	0.99 (0.98, 0.99)***	0.97 (0.96, 0.99)**	0.99 (0.98, 1.01)	1.00 (0.99, 1.01)
Sex				
Male	1.00	1.00	1.00	1.00
Female	1.18 (1.02, 1.37)*	1.09 (0.79, 1.50)	1.28 (0.96, 1.71)	1.19 (0.92, 1.54)
Race/ethnicity				
White, non-Hispanic	1.00	1.00	1.00	1.00
Black, non-Hispanic	0.89 (0.65, 1.22)	0.55 (0.29, 1.05)	2.19 (1.01, 4.78)*	0.77 (0.46, 1.29)
Hispanic	1.17 (0.88, 1.57)	0.87 (0.48, 1.56)	2.07 (1.11, 3.86)*	1.48 (0.87, 2.53)
Other	0.94 (0.47, 1.90)	0.53 (0.14, 2.00)	0.62 (0.18, 2.09)	4.15 (0.48, 36.0)
Education level				
<High school	0.68 (0.47, 0.99)*	0.40 (0.19, 0.86)**	0.42 (0.19, 0.92)*	0.97 (0.49, 1.91)
≥High school graduate	1.00	1.00	1.00	1.00
Median income level[c]	0.93 (0.85, 1.02)	0.77 (0.64, 0.92)**	0.91 (0.76, 1.09)	1.09 (0.91, 1.29)
Marital status				
Not married	1.00	1.00	1.00	1.00
Married	1.23 (1.06, 1.44)**	1.18 (0.85, 1.63)	1.20 (0.89, 1.62)	1.16 (0.88, 1.52)
Place of residence				
Nonurban	1.00	1.00	1.00	1.00
Urban	1.08 (0.94, 1.24)	1.05 (0.78, 1.42)	1.00 (0.76, 1.33)	1.01 (0.78, 1.30)
Insurance payer				
Medicare patients				
Medicare FFS	1.00	1.00	1.00	1.00
Medicare HMO	1.61 (1.12, 2.31)**	1.14 (0.53, 2.47)	1.51 (0.78, 2.93)	1.85 (0.98, 3.52)
Non-Medicare patients				
Private FFS	1.00	1.00	1.00	1.00
Private HMO	1.06 (0.75, 1.48)	0.91 (0.44, 1.91)	1.63 (0.84, 3.19)	1.20 (0.64, 2.24)
Medicaid	0.44 (0.26, 0.75)**	0.40 (0.14, 1.63)	0.68 (0.20, 1.42)	0.36 (0.13, 1.02)
Other	0.49 (0.31, 0.78)**	0.30 (0.15, 0.99)*	0.64 (0.29, 2.02)	0.26 (0.11, 0.64)**
Uninsured	0.57 (0.38, 0.86)**	0.65 (0.28, 2.36)	0.66 (0.28, 1.28)	0.45 (0.23, 0.90)*
Comorbidity index				
0	1.00	1.00	1.00	1.00
1	1.23 (1.03, 1.47)*	1.07 (0.75, 1.54)	1.68 (1.17, 2.42)**	1.23 (0.91, 1.67)
≥2	1.04 (0.80, 1.35)	1.10 (0.65, 1.87)	0.88 (0.56, 1.37)	1.67 (0.95, 2.96)
Anatomic site				
Colon	1.00	1.00	1.00	1.00
Rectum	0.29 (0.24, 0.34)***	0.27 (0.20, 0.36)***	0.19 (0.14, 0.25)***	0.37 (0.26, 0.52)***
Stage at diagnosis				
In situ	0.57 (0.40, 0.81)**	NA	NA	NA
Local	1.00			
Regional	1.08 (0.88, 1.31)			
Distant	0.17 (0.14, 0.21)***			
Unstaged	0.52 (0.04, 0.07)***			

Note. CI = confidence interval; FFS = fee-for-service; NA = not applicable.
[a]Odds ratios (ORs) for having received definitive surgery are adjusted for age, sex, marital status, smoking, urban residence, comorbidity, anatomic site, stage at diagnosis, and community measures of education and income level (total, n = 8351; local, n = 2530; regional, n = 3679; distant, n = 1344).
[b]Includes in situ (n = 332) and unstaged (n = 466) cancers.
[c]Indicates change in the odds of receiving the treatment with each additional year of age or increase in income category.
*P < .05; **P < .01; ***P < .001

stages, there were no insurance-related differences in the receipt of chemotherapy. Other factors predictive of receiving chemotherapy included younger age, higher levels of education, being married, having rectal cancer, having advanced tumor stage, and having lower levels of comorbid illness.

At the end of follow-up, crude survival of patients according to their insurance payer was as follows: Medicare FFS, 3048 of 5496 (55.5%); Medicare HMO, 258 of 475 (54.3%); Medicaid, 71 of 122 (58.2%); commercial HMO, 416 of 687 (60.6%); commercial FFS, 831 of 1221 (68.1%); other insurance, 99 of 156 (63.5%); and uninsured, 132 of 246 (53.7%) (χ^2 for insurance differences = 73.3, P < .001). Crude survival for patients according to their race was as follows: non-Hispanic White, 4689 of 7966 (58.9%); non-Hispanic African American, 299 of 566 (52.8%); Hispanic, 415 of 731 (56.8%); and other race, 58 of 81 (71.6%) (χ^2 for racial differences = 14.5, P = .002).

Results of proportional hazards regression models are presented in Table 5. Non-Hispanic African Americans had a higher mortality rate than non-Hispanic Whites in all models. There was a trend for lower mortality among patients of other race/ethnicity in the base model, which reached statistical significance when stage and treatment modality were also controlled for. Among Medicare patients, those belonging to HMOs had a mortality rate similar to those in FFS plans. Among non-Medicare patients, mortality rates were higher in all models for patients with commercial HMO insurance or who were uninsured compared with patients with commercial FFS insurance. There was a statistically nonsignificant trend for patients with Medicaid

TABLE 3—Multivariate Predictors of Receiving Radiation Therapy[a] for Colorectal Cancer: Florida, 1994

Characteristic	Colon and Rectal Cancers Combined, OR (95% CI)	Colon Cancers, OR (95% CI)	Rectal Cancers, OR (95% CI)
Age[b]	0.98 (0.97, 0.99)***	0.98 (0.97, 0.99)***	0.98 (0.96, 0.99)***
Sex			
Male	1.00	1.00	1.00
Female	0.94 (0.85, 1.05)	0.97 (0.86, 1.10)	0.87 (0.67, 1.12)
Race/ethnicity			
White, non-Hispanic	1.00	1.00	1.00
Black, non-Hispanic	0.88 (0.69, 1.13)	0.90 (0.68, 1.19)	0.75 (0.42, 1.31)
Hispanic	0.88 (0.71, 1.08)	0.94 (0.74, 1.19)	0.64 (0.40, 1.03)
Other	0.86 (0.49, 1.53)	0.91 (0.46, 1.83)	0.70 (0.24, 2.02)
Education level			
<High school	0.83 (0.61, 1.13)	0.78 (0.55, 1.10)	1.02 (0.49, 2.15)
≥High school graduate	1.00	1.00	1.00
Median income level[b]	0.89 (0.83, 0.95)***	0.90 (0.83, 0.98)*	0.79 (0.67, 0.93)**
Marital status			
Not married	1.00	1.00	1.00
Married	1.12 (1.00, 1.26)*	1.18 (1.03, 1.35)*	0.96 (0.74, 1.24)
Place of residence			
Nonurban	1.00	1.00	1.00
Urban	0.86 (0.78, 0.96)**	0.88 (0.78, 0.99)*	0.80 (0.62, 1.02)
Insurance payer			
Medicare patients			
Medicare FFS	1.00	1.00	1.00
Medicare HMO	0.50 (0.38, 0.66)***	0.39 (0.28, 0.55)***	0.90 (0.50, 1.61)
Non-Medicare patients			
Private FFS	1.00	1.00	1.00
Private HMO	0.96 (0.76, 1.22)	0.91 (0.70, 1.18)	1.22 (0.70, 2.16)
Medicaid	1.39 (0.90, 2.15)	1.18 (0.71, 1.95)	2.40 (0.78, 7.38)
Other	1.07 (0.73, 1.57)	0.91 (0.58, 1.42)	2.15 (0.86, 5.39)
Uninsured	0.77 (0.55, 1.08)	0.84 (0.57, 1.25)	0.65 (0.34, 1.26)
Comorbidity index			
0	1.00	1.00	1.00
1	0.90 (0.79, 1.02)	0.87 (0.76, 1.01)	0.93 (0.68, 1.27)
≥2	0.78 (0.64, 0.95)*	0.82 (0.65, 1.02)	0.58 (0.35, 0.96)*
Stage at diagnosis			
In situ	0.54 (0.40, 0.74)***	0.74 (0.52, 1.05)	0.27 (0.14, 0.52)***
Local	1.00	1.00	1.00
Regional	1.01 (0.88, 1.14)	0.95 (0.82, 1.10)	1.33 (1.00, 1.77)
Distant	0.87 (0.73, 1.03)	0.96 (0.79, 1.16)	0.57 (0.38, 0.87)**
Unstaged	1.14 (0.89, 1.46)	1.25 (0.94, 1.68)	1.01 (0.64, 1.60)
Anatomic site			
Colon	1.00	NA	NA
Rectum	3.68 (3.23, 4.18)***		

Note. CI = confidence interval; FFS = fee-for-service; NA = not applicable.
[a]Odds ratios (ORs) for having received radiation therapy are adjusted for age, sex, marital status, smoking, urban residence, comorbidity, anatomic site, stage at diagnosis, and community measures of education and income level (total, n = 8351; colon, n = 6980; rectal, n = 1371).
[b]Indicates change in the odds of receiving the treatment with each additional year of age or increase in income category.
*P < .05; **P < .01; ***P < .001.

insurance to have higher mortality rates than those with commercial FFS insurance in the base model; this trend reached statistical significance when stage at diagnosis and treatment were also considered.

Discussion

We found significant differences in the treatment and survival of colorectal cancer patients according to their insurance payer. Among non-Medicare patients, those with commercial HMO insurance were less likely to receive chemotherapy and had greater mortality than those with commercial FFS insurance. Similarly, patients who were uninsured or who were insured by Medicaid were less likely to receive cancer-directed surgery and had higher mortality rates than patients with commercial FFS health insurance. Although there were differences in care between patients with Medicare HMO and those with Medicare FFS insurance, their mortality rates were similar.

Our results differ from those of previous studies that reported similar treatments and outcomes for colorectal cancer patients having FFS vs HMO insurance types.[19–22,41] Studies reported by Retchin et al.[20,21] and Merrill et al.[41] were restricted to patients insured by Medicare, a group for which we also found no differences in outcomes. Studies reported by Francis et al.[22] and by Vernon et al.[19] were not population based and were restricted to patients residing in single metropolitan areas (Seattle and Houston, respectively) that may not be representative of other parts of the country. Our results suggest that care and outcomes for non-Medicare colorectal cancer patients with FFS insurance and for those patients with HMO insurance may be different.

The survival differences between commercial HMO and FFS insurance do not appear to be due to later stage at diagnosis for patients having HMO insurance, given that the 2 insurance groups were found to have similar stages at diagnosis in a previous

TABLE 4—Multivariate Predictors of Receiving Chemotherapy[a] for Colorectal Cancer: Florida, 1994

Characteristic	Stage at Diagnosis, OR (95% CI)			
	All Stages[b]	Local	Regional	Distant
Age[c]	0.94 (0.94, 0.95)***	0.96 (0.94, 0.98)***	0.94 (0.93, 0.95)***	0.94 (0.93, 0.95)***
Sex				
Male	1.00	1.00	1.00	1.00
Female	1.06 (0.94, 1.20)	1.10 (0.76, 1.58)	1.20 (1.02, 1.41)***	0.86 (0.67, 1.10)
Race/ethnicity				
White, non-Hispanic	1.00	1.00	1.00	1.00
Black, non-Hispanic	0.87 (0.66, 1.14)	0.80 (0.34, 1.89)	0.78 (0.53, 1.14)	0.94 (0.56, 1.57)
Hispanic	0.78 (0.61, 0.99)*	1.09 (0.52, 2.25)	0.75 (0.55, 1.02)	0.72 (0.44, 1.18)
Other	0.79 (0.40, 1.55)	0.46 (0.06, 3.85)	1.10 (0.44, 2.72)	0.42 (0.09, 2.00)
Education level				
<High school	0.84 (0.59, 1.19)*	1.16 (0.37, 3.70)	0.86 (0.54, 1.38)	0.90 (0.47, 1.73)
≥High school graduate	1.00	1.00	1.00	1.00
Median income level[c]	0.98 (0.90, 1.06)	1.05 (0.83, 1.32)	1.02 (0.92, 1.13)	0.89 (0.75, 1.05)
Marital status				
Not married	1.00	1.00	1.00	1.00
Married	1.38 (1.21, 1.58)***	1.35 (0.91, 2.01)	1.42 (1.19, 1.69)***	1.50 (1.15, 1.97)**
Place of residence				
Nonurban	1.00	1.00	1.00	1.00
Urban	1.04 (0.92, 1.17)	1.12 (0.78, 1.61)	1.03 (0.88, 1.21)	1.16 (0.90, 1.48)
Insurance payer				
Medicare patients				
Medicare FFS	1.00	1.00	1.00	1.00
Medicare HMO	0.87 (0.66, 1.15)	1.36 (0.57, 3.25)	0.76 (0.54, 1.09)	0.85 (0.48, 1.51)
Non-Medicare patients				
Private FFS	1.00	1.00	1.00	1.00
Private HMO	0.61 (0.47, 0.78)***	0.66 (0.29, 1.47)	0.54 (0.39, 0.75)***	0.60 (0.35, 1.02)
Medicaid	0.95 (0.59, 1.51)	1.19 (0.29, 4.85)	0.99 (0.54, 1.81)	1.13 (0.41, 3.10)
Other	0.99 (0.66, 1.50)	2.09 (0.84, 5.19)	0.73 (0.41, 1.30)	0.84 (0.34, 2.06)
Uninsured	1.09 (0.80, 1.52)	2.64 (1.01, 6.87)*	1.23 (0.78, 1.92)	0.71 (0.37, 1.36)
Comorbidity index				
0	1.00	1.00	1.00	1.00
1	0.86 (0.74, 0.99)*	1.03 (0.66, 1.59)	0.86 (0.71, 1.04)	0.78 (0.58, 1.04)
≥2	0.68 (0.54, 0.87)**	0.86 (0.42, 1.78)	0.63 (0.47, 0.85)*	0.79 (0.47, 1.34)
Anatomic site				
Colon	1.00	1.00	1.00	1.00
Rectum	1.37 (1.16, 1.62)***	1.81 (1.24, 2.65)**	1.30 (1.03, 1.64)*	1.19 (0.82, 1.72)
Stage at diagnosis				
In situ	0.14 (0.05, 0.45)**	NA	NA	NA
Local	1.00			
Regional	7.83 (6.47, 9.46)***			
Distant	12.4 (9.97, 15.3)***			
Unstaged	2.72 (1.92, 3.85)***			

Note. CI = confidence interval; FFS = fee-for-service; NA = not applicable.
[a]Odds ratios (ORs) for having received chemotherapy are adjusted for age, sex, marital status, smoking, urban residence, comorbidity, anatomic site, stage at diagnosis, and community measures of education and income (total, n = 8351; local, n = 2530; regional, n = 3679; distant, n = 1344).
[b]Includes in situ (n = 332) and unstaged (n = 466) cancers.
[c]Indicates change in the odds of receiving the treatment with each additional year of age or increase in income category.
*P < .05; **P < .01; ***P < .001.

study.[28] In addition, adjusting for both stage at diagnosis and treatment modalities used did not reduce the higher mortality rate observed for commercial HMO patients relative to FFS patients.

It is possible that commercial HMO patients were generally less healthy than patients with commercial FFS insurance. We adjusted mortality rates for age, sex, and comorbidity, however, and patients belonging to an HMO were usually found to be healthier than patients with FFS insurance.[42,43] We found, though, that patients with commercial HMO insurance and those with commercial FFS insurance had similar measures on the Charlson–Deyo comorbidity index. We did not have detailed information on the specific types or intensities of treatments received, nor on the overall quality of care rendered, so it is also possible that the health care that FFS and HMO patients received differed in other important ways not captured by our study.

There are several reasons why HMO and FFS insurance types might have different effects on health care delivery. On the one hand, HMOs, especially staff- and group-model forms, may have the resources and organizational structure to disseminate standards of care and to ensure that current practice patterns are consistent with these standards.[44,45] Staff-model HMOs have in some cases demonstrated care as good as, if not better than, FFS plans.[46–48] There is concern, however, that financial considerations might inappropriately influence the care of patients in capitated arrangements.[49] Unfortunately, there have been many such examples in Florida.[50–53] The effect that HMOs have on quality of care, therefore, may vary considerably depending on the type and structure of the HMO.[54]

Lacking health insurance or having Medicaid has been associated with different treat-

TABLE 5—Proportional Hazards Regression Models[a] With Colorectal Cancer: Florida, 1994

Characteristic	Model 1 Risk Ratio (95% CI)	Model 2 Risk Ratio (95% CI)	Model 3 Risk Ratio (95% CI)
Age at diagnosis	1.03 (1.02, 1.03)***	1.03 (1.03, 1.04)***	1.03 (1.025, 1.034)***
Sex			
Male	1.00	1.00	1.00
Female	0.88 (0.82, 0.95)***	0.91 (0.85, 0.98)**	0.92 (0.86, 0.99)*
Race/ethnicity			
White, non-Hispanic	1.00	1.00	1.00
Black, non-Hispanic	1.22 (1.05, 1.42)**	1.20 (1.03, 1.40)*	1.18 (1.01, 1.37)*
Hispanic	1.08 (0.95, 1.23)	1.11 (0.97, 1.26)	1.11 (0.97, 1.27)
Other	0.65 (0.41, 1.02)	0.56 (0.36, 0.88)**	0.58 (0.37, 0.92)*
Marital status			
Married	0.85 (0.79, 0.92)***	0.88 (0.82, 0.95)***	0.90 (0.83, 0.97)**
Not married	1.00	1.00	1.00
Insurance payer			
Medicare			
Medicare FFS	1.00	1.00	1.00
Medicare HMO	1.08 (0.94, 1.25)	1.03 (0.89, 1.19)	1.05 (0.91, 1.21)
Non-medicare			
Private FFS	1.00	1.00	1.00
Medicaid	1.36 (1.00, 1.85)	1.53 (1.12, 2.08)**	1.44 (1.06, 1.97)*
Private HMO	1.22 (1.03, 1.45)*	1.40 (1.18, 1.66)***	1.40 (1.18, 1.67)***
Uninsured	1.64 (1.32, 2.05)***	1.51 (1.21, 1.89)***	1.41 (1.12, 1.77)**
Other insurance	1.16 (0.87, 1.55)	1.22 (0.91, 1.63)	1.17 (0.88, 1.57)
Education level			
<High school	1.23 (1.03, 1.48)*	1.23 (1.03, 1.48)*	1.20 (1.00, 1.45)*
≥High school graduate	1.00	1.00	1.00
Median income level	0.98 (0.94, 1.02)	0.99 (0.95, 1.04)	0.99 (0.94, 1.03)
Place of residence			
Urban	0.95 (0.89, 1.02)	0.97 (0.91, 1.04)	0.98 (0.91, 1.05)
Nonurban	1.00	1.00	1.00
Anatomic site			
Colon	1.00	1.00	1.00
Rectal	0.92 (0.84, 1.01)	1.05 (0.97, 1.17)	0.98 (0.89, 1.09)
Comorbidity index			
0	1.00	1.00	1.00
1	1.14 (1.05, 1.23)	1.19 (1.10, 1.29)***	1.22 (1.12, 1.32)***
≥2	1.37 (1.23, 1.53)***	1.50 (1.34, 1.68)***	1.52 (1.36, 1.70)***
Smoking status			
Smoker	1.21 (1.10, 1.33)***	1.14 (1.04, 1.26)**	1.13 (1.03, 1.24)**
Nonsmoker	1.00	1.00	1.00
Stage at diagnosis			
In situ	NA	1.22 (0.97, 1.54)	1.18 (0.94, 1.49)
Local	NA	1.00	1.00
Regional	NA	1.93 (1.75, 2.13)***	1.98 (1.79, 2.19)***
Distant	NA	8.94 (8.06, 9.92)***	8.50 (7.62, 9.48)***
Unstaged	NA	3.51 (3.02, 4.09)***	2.74 (2.33, 3.22)***
Treatment modality[b]			
Definitive surgery	NA	NA	0.61 (0.55, 0.67)***
Radiation therapy	NA	NA	0.96 (0.88, 1.04)
Chemotherapy	NA	NA	0.90 (0.83, 0.99)*

Note. CI = confidence interval; FFS = fee-for-service; NA = not applicable.
[a]Proportional hazards regression models were performed in hierarchical fashion (n = 8128). Model 1 is the base model, model 2 adds a variable for stage at diagnosis, and model 3 adds a variable for stage at diagnosis and treatment modalities used.
[b]Referent group for each category is patients not receiving the specified treatment modality.
*P < .05; **P < .01; ***P < .001.

ment patterns and poor outcomes in patients with breast cancer.[23–26] Our results extend this finding to patients with colorectal cancer. Until ways are found to provide health insurance to all citizens, it seems likely that the uninsured will continue to suffer poor health outcomes.[55,56]

We found few racial differences in treatment, but we found higher mortality rates for patients who were Black. Others have similarly found higher mortality for Black patients with colorectal cancer.[17,57–59] Potential factors explaining higher mortality among Black patients in previous studies included later stage at diagnosis[59] and lower rates of surgical interventions.[17] In our study, African Americans had higher mortality even after stage at diagnosis and treatment modalities used were controlled for. Studies conducted in Department of Veterans Affairs hospitals, where presumably all patients have equal access to care, have found no differences in treatments and outcomes by race.[60,61] Black patients have higher mortality from other causes of death and have overall lower life expectancy than Whites, which may partially explain our findings.[62–64]

This study has a number of important limitations. We relied solely on administrative data, which, although generally accurate in studies of cancer care, could not be independently verified.[65–68] The Florida AHCA, for example,

does not have a system for validating treatment information contained in discharge abstracts. It was not possible to ascertain all patient comorbidities, nor their individual severities, from administrative data. Data from state tumor registries may not fully capture treatments given in outpatient settings and may not capture treatments received out of state. Insurance status was assessed at the time of diagnosis and may have changed over the follow-up period.[42,69]

Other limitations include lack of detailed staging information, such as the Dukes Classification or the more clinically detailed TNM staging system of the American Joint Committee on Cancer.[70] We also did not have information on the type of HMO coverage (staff model vs Independent Practice Association [IPA], for example), or information on the cause of death (to allow differentiation of colorectal cancer mortality from other causes). Finally, our study was restricted to cases of colorectal cancer in Florida, which may not be representative of other states or other cancers.

In conclusion, we found significant differences in the treatment and survival of colorectal cancer patients according to their insurance payer and race. African American patients had higher mortality rates that were not explained by differences in stage at diagnosis or treatment modalities used. Among non-Medicare patients, those who were uninsured, insured by Medicaid, or insured by commercial HMOs had different patterns of treatment and higher mortality than did patients with commercial FFS insurance. More detailed clinical studies are needed to confirm these findings and, if they are confirmed, to better understand the mechanisms by which insurance payer influences care. □

Contributors

R. G. Roetzheim, J. P. Krischer, and N. Pal conceptualized and designed the study. N. Pal and R. G. Roetzheim analyzed the data. E. C. Gonzalez, J. M. Ferrante, and D. J. Van Durme assisted with the analysis and interpretation of the data. R. G. Roetzheim, E. C. Gonzalez, J. M. Ferrante, and D. J. Van Durme drafted and revised the manuscript. All authors approved the final version.

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