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Racial disparities in treatments and mortality among a large population-based cohort of older men and women with colorectal cancer

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Abstract

Background: There were racial disparities in treatment and mortality among patients with colorectal cancer, but few studies incorporated information on hypertension and diabetes and their treatment status.

Patients and methods: The study identified 101,250 patients from Surveillance, Epidemiology, and End Results (SEER)-Medicare linked database in the United States who were diagnosed with colorectal cancer at age ≥65 years between 2007 and 2015 with follow-up to December 2016.

Results: There were substantial racial and ethnic disparities in the prevalence of hypertension and diabetes in patients with colorectal cancer, in receiving chemotherapy and radiation therapy, and in receiving antihypertensive and antidiabetic treatment. Racial disparities in receiving these therapies remained significant in this large cohort of Medicare beneficiaries after stratifications by private health insurance status at the time of cancer diagnosis and by tumor stage. Non-Hispanic black patients had a significantly higher risk of all-cause mortality (hazard ratio: 1.07, 95% CI: 1.04–1.10), which remained significantly higher (1.05, 1.02–1.08) after adjusting for patient sociodemographics, tumor factors, comorbidity and treatments as compared to non-Hispanic white

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

CRediT authorship contribution statement

XLD contributed to the concept, design, data acquisition and data analysis. LS contributed to the data acquisition and data analysis. All authors contributed to the interpretation, manuscript writing and final approval of the submission.

Ethics approval and consent to participate

This study used the existing and de-identified SEER-Medicare linked datasets. There is no health risk to the subjects under study. Consent form was not applicable because of using existing datasets and no patient contact. This study was approved by the Committee for Protection of Human Subjects at the University of Texas Health Science Center in Houston.

Patient consent for publication

This study used the existing and de-identified datasets without patient name and any identifications. There is no contact with and no health risk to the subjects under study. Consent form was not applicable because of using existing datasets and no patient contact.

patients. The adjusted risk of colorectal cancer-specific mortality was also significantly higher (1.08, 1.04–1.12) between black and white patients.

Conclusions: There were substantial racial disparities in prevalence of hypertension and diabetes in men and women diagnosed with colorectal cancer and in receipt of chemotherapy, radiation therapy, antihypertensive and antidiabetic treatment. Black patients with colorectal cancer had a significantly higher risk of all-cause mortality and colorectal cancer-specific mortality than whites, even after adjusting for sociodemographic characteristics, tumor factors, comorbidity scores, and treatments.

Keywords

Colorectal cancer; Racial disparities; Cancer treatment; Hypertension; Diabetes; SEER areas

Introduction

Over the past several decades, numerous studies have reported racial or ethnic disparities in health care utilization and mortality in the United States [1–22]. Those racial disparities in receiving the guideline-recommended therapies for various medical illnesses and different types of cancer are extremely consistent according to the Institute of Medicine's report on unequal treatments in different ethnicities and other studies [22,23–33]. However, findings on racial disparities in mortality and survival in patients with cancer are less consistent because some studies demonstrated that racial disparities in mortality still existed [13–18], while other studies showed that racial disparities in mortality were substantially narrowed or were no longer present after adjusting for their differences in health insurance, health care utilization, and comorbidities [1,4,5,34]. Although many studies have incorporated variables in health insurance and health care utilization when examining racial disparities, few studies included information on comorbidities and especially treatment status for comorbidities due to lack of clinical drug data. Medicare Part-D comprehensive drug coverage was implemented from the year of 2006 in the United States, making it possible to examine the detailed drug treatment for comorbid conditions. We recently reported age and racial disparities in receiving cancer therapies and in mortality among women with breast cancer [35]. This study aimed to determine the prevalence of common comorbidities with emphasis on hypertension and diabetes and their treatment in a large cohort of men and women diagnosed with colorectal cancer in 2007–2015 and to examine whether racial disparities in the receipt of anticancer, antihypertensive and antidiabetic medications are present and, if so, whether eliminating these disparities in treatments for cancer, hypertension and diabetes could explain or reduce racial disparities in all-cause and disease-specific mortality in men and women with colorectal cancer.

Methods

Data sources

This study utilized the de-identified Surveillance, Epidemiology, and End Results (SEER)-Medicare linked database for patients diagnosed with colorectal cancer between 2007 and

2015 with follow-up to December 31, 2016 [35,36]. The detailed data source and SEER areas were reported elsewhere [35].

Study population

The study population consisted of 101,250 men and women who were diagnosed with colorectal cancer at age 65 years or older between January 2007 and December 2015, and who had a full coverage of both Medicare Part A and Part B but were not enrolled with Health Maintenance Organizations from the date of diagnosis to the date of death or the date of last follow-up on December 31, 2016.

Study variables

Sociodemographic variables

Main sociodemographic variables include race/ethnicity (classified as non-Hispanic white [whites], non-Hispanic black [blacks], non-Hispanic Asians or Pacific Islanders [Asians], Hispanics, others, or unknown/missing), gender, and age at diagnosis (65–69, 70–74, 75–79, 80–84, or ≥85 years). Other sociodemographic variables include marital status (married, unmarried, or unknown), health insurance status at the time of cancer diagnosis (insured for private insurance, Medicaid, uninsured, or unknown), year of diagnosis, and SEER areas.

Comorbidity

Comorbidities are defined as co-existing medical conditions other than the study interest of cancer under study. Hypertension and diabetes were separately examined for their prevalence and treatment. Hypertension was defined if there was an International Classification of Diseases (ICD)–9 diagnosis code of 401, 402, 403, 404 or 405, or if there was an ICD-10 diagnosis code of I10, I11, I12, I13, or I15 in Medicare claims (inpatient, outpatient and physician claim files), or if antihypertensive medications were received according to Medicare Part-D drug files [35]. Diabetes was defined if there was a diagnosis code of 250.1–250.9 or E08-E13, or if antidiabetic medications were received according to Medicare Part-D drug files [35]. Other comorbidities in this study included myocardial infarction, congestive heart failure, peripheral vascular disease, cerebrovascular disease, chronic pulmonary disease, congestive tissue disease, ulcer disease, mild liver disease, hemiplegia, moderate or severe renal disease, leukemia, moderate or severe liver disease, and acquired immunodeficiency syndrome (AIDS) or human immunodeficiency virus (HIV) positive. These co-existing medical conditions were identified through diagnoses or procedures in Medicare claims (inpatient, outpatient and physician claim files) made within 1 year prior to and 30 days after the date of colorectal cancer diagnosis based on the comorbidity codes of the National Cancer Institute [36]. Each comorbid disease was weighted according to the severity of comorbid conditions and was well validated using Medicare claims [36–38]. The sum of all scores was analyzed as a categorical variable (score of 0, 1, and ≥2).

Tumor characteristics

Tumor characteristics include tumor stage (in-situ, local, regional, distant stage, or unknown/missing), tumor size (in cm), tumor grade (well, moderately or poorly differentiated, or unknown), and tumor site (colon or rectal).

Treatment for colorectal cancer, hypertension and diabetes

Radiation therapy was defined if either SEER indicated so or if Medicare claims indicated so within 12 months of cancer diagnosis [35]. Chemotherapy was defined if there were a claim or procedure for chemotherapy within 12 months of cancer diagnosis: the ICD-9 procedure code of 99.25 or ICD-10 procedure of Z51.11, the CPT codes 96, 400–96,549, J8530-J8999, J9000-J9999, or Q0083-Q0085, or revenue center codes 0331, 0332 or 0335 [36]. Antihypertensive and antidiabetic drugs were identified through both generic and brand drug names (variables GNN and BN) in Medicare Part-D drug files within 12 months of cancer diagnosis, which were reported elsewhere with a list of drug names [35].

Mortality outcome variables

All-cause mortality was defined as death from any cause as indicated in the SEER registry data or in Medicare data by December 31, 2016. Cause of death is identified by the SEER program through linking the SEER data with the National Death Index data from the National Center for Vital Statistics. Patients still alive at the last date of follow-up (December 31, 2016) were censored. Colorectal cancer-specific mortality was defined as colorectal cancer being the underlying cause of death in SEER data. In this specific analysis, patients who died of causes other than colorectal cancer or who were still alive at the date of last follow-up were censored. Survival time in months was calculated from the date of diagnosis to the date of death or to the date of last follow-up (December 31, 2016).

Analysis

Differences in the distribution of baseline characteristics among racial/ethnic groups were tested using the chi-square statistics for categorical variables or using the Kruskal-Wallis test for median age comparisons. The adjusted odds ratios (95% confidence intervals) of receiving chemotherapy, radiation therapy, antihypertensive and antidiabetic drugs were obtained from multiple logistic regression models, adjusting for patient demographic characteristics, tumor biological factors, comorbidity, year of diagnosis, and SEER areas. Cox proportional hazard regression model was used for analysis of survival in the SAS system version 9.4 (Cary, NC: SAS Institute, Inc). The proportionality assumption was considered to be satisfied when the log-log Kaplan-Meier curves for survival functions by race/ethnicity were parallel and did not intersect. In the Cox regression analyses, three models were presented. The first model was a crude analysis of mortality by race/ethnicity without adjustments for other factors. The second model adjusted for patient demographic characteristics (including gender, age and marital status), tumor factors (tumor stage, size, grade, and tumor site), comorbidity score, year of diagnosis, and SEER area. The third model adjusted for chemotherapy, radiation therapy, antihypertensive and antidiabetic medications in addition to factors in the second model.

Results

Table 1 presents the distribution of baseline characteristics by race/ethnicity in men and women with colorectal cancer. All baseline characteristics varied significantly by race/ethnicity. The median age at cancer diagnosis varied significantly by race/ethnicity, ranging from those with missing race/ethnicity (71) to black (74), Hispanic (75), Asian (76) and white patients (77). A higher proportion of colorectal cancer cases among blacks (25.86%) were diagnosed at age 65–69 years than among whites (19.36%), Asians (23.39%) and Hispanic patients (24.82%). There was a higher proportion of women than men with colorectal cancer among whites, blacks and Asians, but a slightly lower proportion of women in Hispanic patients and those with missing ethnicity. A higher percentage of Asian (54.84%) and Hispanic (48.24%) patients with colorectal cancer were married than in whites (45.94%) and blacks (30.04%). White patients had a much higher proportion (88.55%) of having insured for private health insurance coverage at the time of cancer diagnosis than Hispanics (76.42%), blacks (76.15%), and Asians (73.55%). There also were significant differences in tumor stage, size, grade and site among ethnic groups ($P<0.001$). The prevalence of hypertension, diabetes and comorbidity score of ≥2 was higher in black and Hispanic patients than white and Asian patients.

Table 2 presents the crude percentage of receiving chemotherapy and radiation therapy in men and women with colorectal cancer, and the percentage of receiving antihypertensive and antidiabetic treatment in those with colorectal cancer who had hypertension and diabetes by race/ethnicity and other factors. There were apparent differences in receiving these therapies between black and white men and women with colorectal cancer. For example, the receipt of chemotherapy was 15.62% for whites and 14.35% for blacks, whereas the receipt of antihypertensive and antidiabetic treatment was 79.77% and 50.50% for whites and 82.25% and 54.15% for blacks. The receipt of these therapies also varied by age, gender, marital status, insurance coverage at time of cancer diagnosis, tumor characteristics, year of diagnosis and SEER areas.

Table 3 presents the odds ratio of receiving these therapies by race/ethnicity after adjusting for potential confounding factors. As compared to whites, blacks were significantly less likely to receive chemotherapy (odds ratio: 0.74, 95% CI: 0.69–0.79) and radiation therapy (0.76, 0.68–0.86), but significantly more likely to receive antihypertensive (1.21, 1.14–1.29) and antidiabetic (1.14, 1.06–1.22) treatment. Asian patients were significantly more likely to receive chemotherapy (1.17, 1.08–1.27) and antidiabetic treatment (1.12, 1.02–1.22), significantly less likely to receive antihypertensive treatment (0.89, 0.82–0.97), and not significantly different in receiving radiation therapy; whereas Hispanics were significantly more likely to receive antihypertensive (1.24, 1.15–1.34) and antidiabetic (1.40, 1.30–1.51) treatment, but had no differences in receiving chemotherapy and radiation therapy as compared to whites. Older patients appeared significantly less likely to receive all these therapies. For example, subjects aged 80–84 years were significantly less likely to receive chemotherapy (0.29, 0.27–0.31), radiation therapy (0.67, 0.61–0.74), antihypertensive (0.85, 0.80–0.91) and antidiabetic treatment (0.71, 0.66–0.76) as compared to those aged 65–69 years. There was no significant difference in receiving chemotherapy between men and women, but women were significantly less likely to receive radiation therapy and

antidiabetic treatment and more likely to receive antihypertensive therapy. Those subjects who were unmarried at diagnosis were significantly less likely to receive chemotherapy, were more likely to receive antidiabetic treatment, and did not have difference in receiving radiation and antihypertensive therapy. As compared to patients who had private health insurance coverage at the time of cancer diagnosis, those with Medicaid coverage were significantly more likely to receive all therapies, whereas those without private insurance or Medicaid coverage had no significant difference in receiving chemotherapy and radiation therapy but were more likely to receive antihypertensive and antidiabetic treatment.

As expected, the receipt of chemotherapy and radiation therapy significantly increased with higher tumor stage, larger tumor size and poorer tumor grade. Those diagnosed with rectal cancer were significantly more likely to receive chemotherapy and radiation therapy than those with colon cancer, but their differences in receiving antihypertensive and antidiabetic treatment were small. Patients with comorbidity scores of 1 or ≥2 were significantly more likely to receive chemotherapy and radiation therapy but were significantly less likely to receive antihypertensive and antidiabetic treatment than those with a comorbidity score of 0. There were also some variations by year of diagnosis and SEER areas.

Table 4 presents the adjusted odds ratio of receiving chemotherapy, radiation therapy, antihypertensive and antidiabetic therapy by race/ethnicity, stratified by health insurance coverage at the time of cancer diagnosis and by tumor stage. In patients with private insurance coverage at the time of cancer diagnosis, blacks and Hispanics were still significantly less likely to receive chemotherapy and radiation therapy but more likely to receive antihypertensive and antidiabetic therapy, whereas Asians had no significant difference in receiving these therapies except that they were more likely to receive antidiabetic treatment as compared to whites. In patients with Medicaid coverage at the time of cancer diagnosis, only Asians and Hispanics were significantly more likely to receive chemotherapy and blacks were significantly more likely to receive antihypertensive therapy than whites. In subjects with no private insurance or Medicaid coverage, there were mostly no significant differences in receiving these therapies by race/ethnicity. There were still substantial disparities in receiving these therapies regardless of early or late tumor stages.

Table 5 presents the crude and adjusted risk of all-cause mortality and colorectal cancer-specific mortality by race/ethnicity. Black men and women had a significantly 7% higher risk of all-cause mortality (1.07, 1.04–1.10), which remained significantly higher (1.05, 1.02–1.08) after adjusting for sociodemographic characteristics, tumor factors, comorbidity scores, year of diagnosis and SEER areas; and were still significantly higher (1.05, 1.02–1.08) after adjusting for treatments. Similarly, the risk of colorectal cancer-specific mortality was significantly higher (1.08, 1.04–1.12) in blacks as compared to white men and women even after adjusting for sociodemographic and tumor factors, comorbidity scores, and treatments. The risk of all-cause mortality was significantly lower in Asians (0.78, 0.75–0.82) and Hispanics (0.92, 0.89–0.95) from adjusted regression models as compared to whites. The risk of colorectal cancer-specific mortality was also significantly lower in Asians and Hispanics.

The adjusted risk of all-cause mortality and colorectal cancer-specific mortality increased substantially by age, was significantly lower in women than in men, and was significantly higher in patients with rectal cancer than in those with colon cancer (Table 5). Patients who received chemotherapy had a significantly lower risk of all-cause mortality and colorectal cancer-specific mortality as compared to those who did not receive it, but those receiving radiation therapy did not have a significant difference in the risk of mortality. As compared to those without hypertension and diabetes, those who received antihypertensive or antidiabetic treatment had a significantly reduced risk of all-cause mortality and colorectal cancer-specific mortality, whereas those who did not receive treatment for hypertension or diabetes had an elevated risk of all-cause mortality and colorectal cancer-specific mortality.

Discussion

This study demonstrated substantial racial and ethnic disparities in the prevalence of hypertension and diabetes in men and women who were diagnosed with colorectal cancer, in receiving chemotherapy and radiation therapy, and in receiving antihypertensive and antidiabetic treatment. Racial disparities in receiving these therapies remained significant in this large cohort of Medicare beneficiaries even after being stratified by private health insurance status at the time of cancer diagnosis and by tumor stage. There were still significant racial and ethnic disparities in the risk of all-cause mortality and colorectal cancer-specific mortality, where black men and women with colorectal cancer had a significantly higher risk of all-cause mortality and colorectal cancer-specific mortality, while Asians and Hispanics had a significantly lower risk of all-cause mortality and colorectal cancer-specific mortality as compared to whites, even after adjusting for sociodemographics, tumor factors, comorbidity scores, and treatments.

Disparities in health care services by race and ethnicity have been widely and consistently reported in the United States [1–33]. There are no exceptions for colorectal cancer in which racial disparities also existed in health care deliveries and in clinical outcomes such as mortality [23–33,39–50]. For example, several population-based studies demonstrated that black patients with stage-III colon cancer were less likely to undergo definitive surgery and receive adjuvant chemotherapy as part of standard therapy than whites [26–34]. More recent studies demonstrated persistent racial disparities in colorectal cancer screening, early-onset disease, treatment, and survival [39–44]. Among patients with colon cancer in 2006–2016 in north America, blacks with private or Medicare insurance were still significantly less likely to receive resection and adjuvant chemotherapy than whites [45–50]. Findings from our study on racial disparities in the receipt of chemotherapy and radiation therapy for colorectal cancer were very consistent with those of previous reports [45–50].

The current study also demonstrated substantial racial disparities in mortality among patients with colorectal cancer. Racial disparities in both the risk of all-cause mortality and the risk of colorectal cancer-specific mortality among men and women with colorectal cancer remained significant even after adjusting for patient demographic factors, tumor characteristics, therapies, and socioeconomic factors such as private health insurance coverage at the time of cancer diagnosis. These findings were also consistent with those of previous reports [45–50]. For example, a systematic review and meta-analysis of numerous

previous studies showed that the pooled hazard ratio for blacks compared to whites was 1.14 (95% CI=1.00–1.29) for all-cause mortality and 1.13 (95% CI=1.01–1.28) for colon cancer-specific mortality [34]. Regardless of age at onset, private insurance coverage, and residence in communities with higher income and education, black patients had a worse overall survival rates than whites [47].

Even though some previous studies did consider comorbidities in their analyses on racial disparities in mortality for colorectal cancer [33, 39,45], none of those studies has incorporated information on the prevalence of hypertension and diabetes, which are often the most prevalent comorbidities among the older populations, and particularly information on antihypertensive or antidiabetic treatment. Since Medicare Par-D comprehensive drug coverage was implemented in 2006, antihypertensive and antidiabetic medications can be well captured from a comprehensive list of available antihypertensive and antidiabetic drugs [35]. Hence, our study had this data advantage to examine racial disparities in the prevalence of hypertension and diabetes and in the receipt of antihypertensive and antidiabetic drug therapies in multiple ethnic men and women with colorectal cancer. The study did demonstrate that those who received antihypertensive and antidiabetic treatment had a significantly lower risk of mortality. However, racial disparities in the risk of all-cause mortality and colorectal cancer-specific mortality were still significantly different by race/ethnicity after adjusting for their differences in treatment for hypertension and diabetes in addition to other patient and tumor factors. Hence, these findings indicated that persistent racial disparities in the risk of mortality may have been explained by other factors that are not measured in this study.

Based on research findings so far, the observed racial and ethnic disparities in cancer mortality and survival appeared to be due to multiple factors, including personal lifestyle and health behaviors, physical activities, health insurance coverage, access to medical care, early detection, and receipt of definitive treatment. Although our study considered patient demographic characteristics, private health insurance at the time of cancer diagnosis, tumor factors, chemotherapy, radiation therapy, comorbidities, hypertension, diabetes, and treatment for hypertension and diabetes, some other factors such as genetic differences, family history of cancer, cancer screening, social support and self-care during the surveillance periods after completion of primary or adjuvant therapies may have played a role. Several studies did address some of these issues (such as screening and socioeconomic factors) and still found racial disparities in mortality and survival in men and women with colorectal cancer [33,34,39–47]. A few articles have demonstrated a poorer survival in association with comorbidities in patients with or without a history of cancer [38,51–53], but racial disparities in mortality were still significant after adjusting for their differences in comorbidities [32–35,51–53]. It remains challenging to determine what specific factors drive the persistent differences in clinical outcomes by race/ethnicity, which certainly requires multidisciplinary and national efforts to minimize or ultimately eliminate the health disparities.

This study has some limitations to be kept in mind. First, although the study considered health insurance for private or Medicaid coverage at the time of cancer diagnosis, there is lack of information on patient’s socioeconomic status (income, education or occupation),

personal health knowledge, and preference and compliance to cancer therapies, which are associated with the success of cancer control. Second, information on screening or early detection for early-stage colorectal cancer was not available for the analysis. Therefore, their effects on racial disparities in clinical outcomes cannot be addressed. Third, there was no information on differences in health care system, hospital and physician characteristics related to race and ethnicity. Hence, potential racial discriminations by these factors and their potential impacts on mortality cannot be examined. Finally, this study only included men and women with colorectal cancer at age ≥65 years who were Medicare beneficiaries. The findings may not be generalizable to younger patients.

In conclusion, there were substantial racial and ethnic disparities in the prevalence of hypertension and diabetes in men and women with colorectal cancer and in the receipt of chemotherapy, radiation therapy, antihypertensive and antidiabetic treatment. Black men and women with colorectal cancer had a significantly higher risk of all-cause mortality and colorectal cancer-specific mortality, while Asians and Hispanics had a significantly lower risk of all-cause mortality and colorectal cancer-specific mortality than whites, even after adjusting for sociodemographic characteristics, tumor factors, comorbidity scores, and treatments. Implications of the study findings to patients and care providers are that patients should receive guideline-recommended therapies for cancer and comorbid conditions to minimize the disparities and improve outcomes, even though this approach alone cannot eliminate the disparities. More studies may be needed to identify other determinants of health disparities in men and women with colorectal cancer in order to minimize or ultimately eliminate the health disparities. A prospective cohort study may be helpful to quantify the extent to which patient's survival and quality of life can be improved after patients of all ethnicities with colorectal cancer receive timely standard of care for cancer and comorbid conditions as compared to those who do not.

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Availability of data and materials

SEER-Medicare linked data are available to researchers from the National Cancer Institute. The detailed data sharing was reported elsewhere (35).

Abbreviations

AIDS	acquired immunodeficiency syndrome
BN	brand drug names

CI	confidence interval
CMS	Centers for Medicare and Medicaid Services
GNN	generic drug names
HIV	human immunodeficiency virus
ICD	International Classification of Diseases
IMS	Information Management Services
NCI	National Cancer Institute
NH	Non-Hispanic
SAS	Statistical Analysis System
SEER	Surveillance, Epidemiology, and End Results

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Table 1

Comparison of baseline characteristics in patients with colorectal cancer by race/ethnicity.

	Number of cases (column%) by race/ethnicity						
Patient and Tumor Characteristics **Median age (range)** **Age (years)**	**NH-Whites** **77 (65–108)**	**NH-Blacks** **74 (65–108)**	**NH-Asians/PI** **76 (65–108)**	**Hispanics** **75 (65–102)**	**Others** **73 (65–100)**	**Unknown/missing** **71 (65–94)**	**P Value*** **<0.001**
65–69	14,154 (19.36)	2675 (25.86)	1765 (23.39)	2333 (24.82)	109 (27.53)	170 (37.78)	<0.001
70–74	14,707 (20.11)	2515 (24.31)	1636 (21.68)	2162 (23.00)	119 (30.05)	139 (30.89)	
75–79	14,248 (19.49)	2023 (19.56)	1443 (19.13)	1960 (20.85)	81 (20.45)	60 (13.33)	
80–84	13,848 (18.94)	1555 (15.03)	1322 (17.52)	1551 (16.50)	50 (12.63)	51 (11.33)	
85 or older	16,159 (22.10)	1576 (15.24)	1379 (18.28)	1393 (14.82)	37 (9.34)	30 (6.67)	
Gender							
Men	32,923 (45.03)	4196 (40.56)	3730 (49.44)	4775 (50.8)	182 (45.96)	235 (52.22)	<0.001
Women	40,193 (54.97)	6148 (59.44)	3815 (50.56)	4624 (49.2)	214 (54.04)	215 (47.78)	
Marital status							
Married	33,588 (45.94)	3107 (30.04)	4138 (54.84)	4534 (48.24)	143 (36.11)	118 (26.22)	<0.001
Unmarried	35,329 (48.32)	6476 (62.61)	2933 (38.87)	4266 (45.39)	217 (54.80)	105 (23.33)	
Unknown	4199 (5.74)	761 (7.36)	474 (6.28)	599 (6.37)	36 (9.09)	227 (50.44)	
Health Insurance at time of cancer diagnosis							
Insured for private	64,745 (88.55)	7877 (76.15)	5549 (73.55)	7183 (76.42)	283 (71.46)	244 (54.22)	<0.001
Medicaid	5436 (7.43)	2025 (19.58)	1699 (22.52)	1820 (19.36)	91 (22.98)	22 (4.89)	
Not insured/Missing	2935 (4.01)	442 (4.27)	297 (3.93)	396 (4.22)	22 (5.55)	184 (40.89)	
Tumor stage							
In situ or local stage	31,719 (43.38)	4307 (41.64)	3326 (44.08)	4087 (43.48)	144 (36.36)	306 (68.00)	<0.001
Regional stage	22,926 (31.36)	3020 (29.20)	2477 (32.83)	3079 (32.76)	127 (32.07)	58 (12.89)	
Distant stage	14,375 (19.66)	2357 (22.79)	1294 (17.15)	1703 (18.12)	96 (24.24)	21 (4.67)	
Unknown/Missing	4096 (5.60)	660 (6.38)	448 (5.94)	530 (5.64)	29 (7.32)	65 (14.44)	
Tumor size (cm)							
<1	2830 (3.87)	494 (4.78)	395 (5.24)	386 (4.11)	14 (3.54)	36 (8.00)	<0.001
1–<2	3915 (5.35)	485 (4.69)	492 (6.52)	484 (5.15)	19 (4.8)	28 (6.22)	
2–<3	6941 (9.49)	816 (7.89)	764 (10.13)	867 (9.22)	37 (9.34)	23 (5.11)	
3–<4	9417 (12.88)	1192 (11.52)	1052 (13.94)	1202 (12.79)	47 (11.87)	24 (5.33)	

Patient and Tumor Characteristics	Number of cases (column %) by race/ethnicity						
Median age (range)	**NH-Whites**	**NH-Blacks**	**NH-Asians/PI**	**Hispanics**	**Others**	**Unknown/missing**	**P Value***
Age (years)	**77 (65–108)**	**74 (65–108)**	**76 (65–108)**	**75 (65–102)**	**73 (65–100)**	**71 (65–94)**	**<0.001**
≥4	32,683 (44.70)	4541 (43.90)	3110 (41.22)	4123 (43.87)	170 (42.93)	88 (19.56)	
Missing	17,330 (23.70)	2816 (27.22)	1732 (22.96)	2337 (24.86)	109 (27.53)	251 (55.78)	
Tumor grade							
Well-differentiated	5703 (7.80)	931 (9.00)	597 (7.91)	946 (10.06)	40 (10.10)	51 (11.33)	<0.001
Moderately-differentiated	40,679 (55.64)	5702 (55.12)	4548 (60.28)	5376 (57.2)	220 (55.56)	195 (43.33)	
Poorly-differentiated	13,142 (17.97)	1315 (12.71)	1084 (14.37)	1337 (14.22)	63 (15.91)	32 (7.11)	
Unknown/Missing	13,592 (18.59)	2396 (23.16)	1316 (17.44)	1740 (18.51)	73 (18.43)	172 (38.22)	
Tumor site							
Colon	56,379 (77.11)	8276 (80.01)	5417 (71.80)	6898 (73.39)	282 (71.21)	306 (68)	<0.001
Rectal	16,737 (22.89)	2068 (19.99)	2128 (28.20)	2501 (26.61)	114 (28.79)	144 (32)	
Comorbidity Scores							
0	37,074 (50.71)	5178 (50.06)	4499 (59.63)	5780 (61.5)	193 (48.74)	326 (72.44)	<0.001
1	19,104 (26.13)	2471 (23.89)	1663 (22.04)	1907 (20.29)	105 (26.52)	79 (17.56)	
≥2	16,938 (23.17)	2695 (26.05)	1383 (18.33)	1712 (18.21)	98 (24.75)	45 (10.00)	
Hypertension							
No	14,102 (19.29)	1408 (13.61)	1721 (22.81)	2083 (22.16)	89 (22.47)	109 (24.22)	<0.001
Yes	59,014 (80.71)	8936 (86.39)	5824 (77.19)	7316 (77.84)	307 (77.53)	341 (75.78)	
Diabetes							
No	50,376 (68.90)	5820 (56.26)	4530 (60.04)	5409 (57.55)	213 (53.79)	310 (68.89)	<0.001
Yes	22,740 (31.10)	4524 (43.74)	3015 (39.96)	3990 (42.45)	183 (46.21)	140 (31.11)	
Year of Diagnosis							
2007	8398 (11.49)	1173 (11.34)	793 (10.51)	946 (10.06)	37 (9.34)	33 (7.33)	<0.001
2008	8489 (11.61)	1142 (11.04)	779 (10.32)	1017 (10.82)	30 (7.58)	32 (7.11)	
2009	8139 (11.13)	1135 (10.97)	829 (10.99)	998 (10.62)	33 (8.33)	34 (7.56)	
2010	7797 (10.66)	1067 (10.32)	805 (10.67)	985 (10.48)	50 (12.63)	44 (9.78)	
2011	7913 (10.82)	1107 (10.70)	863 (11.44)	1037 (11.03)	43 (10.86)	46 (10.22)	
2012	8320 (11.38)	1179 (11.4)	874 (11.58)	1054 (11.21)	40 (10.10)	54 (12.00)	
2013	8091 (11.07)	1173 (11.34)	883 (11.70)	1129 (12.01)	53 (13.38)	62 (13.78)	
2014	8121 (11.11)	1165 (11.26)	890 (11.80)	1066 (11.34)	53 (13.38)	63 (14.00)	

Patient and Tumor Characteristics	Number of cases (column%) by race/ethnicity						
Median age (range)	**NH-Whites**	**NH-Blacks**	**NH-Asians/PI**	**Hispanics**	**Others**	**Unknown/missing**	**P Value***
Age (years)	**77 (65–108)**	**74 (65–108)**	**76 (65–108)**	**75 (65–102)**	**73 (65–100)**	**71 (65–94)**	**<0.001**
2015	7848 (10.73)	1203 (11.63)	829 (10.99)	1167 (12.42)	57 (14.39)	82 (18.22)	
Total	73,116 (100.00)	10,344 (100.00)	7545 (100.00)	9399 (100.00)	396 (100.00)	450 (100.00)	<0.001

* P values were from Kruskal-Wallis Test for median ages and from the chi-square test for categorical variables.

Table 2

Percentages of receiving cancer therapies, antihypertensive and antidiabetic drugs in men and women with colorectal by race/ethnicity.

	In patients with colorectal cancer (*N* = 101,250)		In patients with colorectal cancer who also had hypertension (*N* = 81,738)	In patients with colorectal cancer who also had diabetes(*N* = 34,592)
Characteristics	**Chemotherapy**	**Radiation therapy**	**Anti-hypertensives**	**Anti-diabetics**
Race/ethnicity				
NH-Whites	15.62	5.34	79.77	50.50
NH-Blacks	14.35	4.15	82.25	54.16
NH-Asians/Pacific Islanders	14.83	5.09	82.85	57.65
Hispanics	15.20	5.10	85.83	62.93
Others	18.69	7.32	77.52	44.81
Unknown/missing	6.00	3.56	83.87	55.00
Age (years)				
65–69	24.45	7.13	83.77	60.36
70–74	20.98	6.25	83.78	58.16
75–79	16.23	5.12	82.17	53.81
80–84	9.98	4.07	80.41	49.33
85 or older	4.17	3.09	74.42	40.61
Gender				
Men	16.99	6.15	79.47	54.78
Women	14.00	4.37	81.89	51.39
Marital status				
Married	18.05	5.61	81.19	54.41
Unmarried	13.29	4.89	80.33	51.69
Unknown	12.17	4.27	82.04	53.44
Health Insurance at the time of cancer diagnosis				
Insured for private insurance	15.01	5.00	80.61	52.52
Medicaid	20.45	7.42	83.67	55.85
Not insured	14.63	5.23	84.33	64.29
Unknown/Missing	8.77	2.83	75.89	51.02
Tumor stage				
In situ or local stage	5.09	3.67	85.49	57.67
Regional stage	24.12	7.68	82.50	54.60
Distant stage	26.71	4.61	69.66	41.42
Unknown/Missing	6.45	4.89	70.84	44.38
Tumor size (cm)				
<1	5.51	2.53	84.99	58.800
1–<2	10.16	4.41	83.89	58.83
2–<3	13.83	4.58	84.86	56.91

	In patients with colorectal cancer (*N* = 101,250)		In patients with colorectal cancer who also had hypertension (*N* = 81,738)	In patients with colorectal cancer who also had diabetes(*N* = 34,592)
Characteristics	**Chemotherapy**	**Radiation therapy**	**Anti-hypertensives**	**Anti-diabetics**
3–<4	16.67	4.89	84.27	54.70
≥4	18.35	5.25	80.51	52.59
Missing	12.64	6.03	76.42	49.09
Tumor grade				
Well-differentiated	9.70	3.76	83.72	57.18
Moderately-differentiated	16.25	5.66	82.83	54.83
Poorly-differentiated	21.02	4.77	78.05	49.87
Unknown/Missing	10.21	4.72	75.83	48.19
Tumor site				
Colon	13.67	1.01	80.73	52.49
Rectal	20.91	18.8	81.11	54.96
Comorbidity Scores				
0	14.46	4.73	85.20	60.68
1	18.45	6.18	78.18	48.52
≥2	14.04	5.11	75.49	46.83
Year of Diagnosis				
2007	15.84	5.10	82.37	56.88
2008	15.35	4.78	83.07	56.67
2009	14.94	4.79	83.17	57.08
2010	15.47	5.03	82.17	56.00
2011	15.02	5.05	81.25	52.93
2012	15.75	5.05	79.72	52.20
2013	14.77	4.78	79.80	51.65
2014	15.26	5.35	78.57	47.24
2015	15.85	6.66	76.55	46.57
SEER Areas				
Connecticut	15.99	4.83	78.20	51.76
Detroit	17.33	5.65	74.45	41.22
Hawaii	8.57	3.45	85.57	61.77
Iowa	20.25	6.35	80.10	54.42
New Mexico	17.19	5.81	79.65	54.41
Seattle	15.23	5.33	82.65	51.43
Utah	13.45	5.29	81.02	54.11
Georgia	17.55	6.10	78.90	54.32
Kentucky	17.34	6.35	79.91	51.13
Louisiana	16.99	5.86	80.43	54.75
New Jersey	20.88	6.63	74.41	43.72
California	11.94	4.06	84.68	57.96
Total	15.36	5.18	80.81	53.02

Table 3

Adjusted odds ratio of receiving cancer therapies, antihypertensive and antidiabetic drugs in patients with colorectal cancer by race/ethnicity.

	Odds ratio (95% CI) of receiving therapy			
	In patients with colorectal cancer (*N* = 101,250)		In patients with colorectal cancer who also had hypertension(*N* = 81,738)	In patients with colorectal cancer who also had diabetes(*N* = 34,592)
Characteristics	**Chemotherapy**	**Radiation therapy**	**Anti-hypertensives**	**Anti-diabetics**
Race/ethnicity				
NH-Whites	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
NH-Blacks	0.74 (0.69–0.79)	0.76 (0.68–0.86)	1.21 (1.14–1.29)	1.14 (1.06–1.22)
NH-Asians/Pacific Islanders	1.17 (1.08–1.27)	1.00 (0.88–1.14)	0.89 (0.82–0.97)	1.12 (1.02–1.22)
Hispanics	0.99 (0.92–1.06)	0.94 (0.84–1.05)	1.24 (1.15–1.34)	1.40 (1.30–1.51)
Others	0.98 (0.74–1.30)	1.05 (0.69–1.61)	0.76 (0.57–1.00)	0.70 (0.52–0.95)
Unknown/Missing	0.62 (0.41–0.94)	0.88 (0.52–1.50)	0.96 (0.71–1.29)	0.89 (0.63–1.25)
Age (years)				
65–69	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
70–74	0.79 (0.75–0.83)	0.95 (0.87–1.03)	1.02 (0.96–1.08)	0.94 (0.88–1.00)
75–79	0.54 (0.51–0.57)	0.82 (0.75–0.89)	0.93 (0.87–0.99)	0.82 (0.76–0.87)
80–84	0.29 (0.27–0.31)	0.67 (0.61–0.74)	0.85 (0.80–0.91)	0.71 (0.66–0.76)
85 or older	0.12 (0.11–0.12)	0.56 (0.51–0.63)	0.63 (0.60–0.67)	0.52 (0.48–0.56)
Gender				
Men	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Women	1.00 (0.96–1.04)	0.91 (0.85–0.97)	1.25 (1.20–1.30)	0.92 (0.88–0.96)
Marital status				
Married	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Unmarried	0.78 (0.75–0.82)	0.95 (0.89–1.01)	1.01 (0.97–1.06)	1.06 (1.01–1.11)
Unknown	0.79 (0.72–0.86)	0.83 (0.72–0.96)	1.16 (1.07–1.26)	1.11 (1.01–1.23)
Health Insurance at the time of cancer diagnosis				
Insured for private insurance	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Medicaid	1.63 (1.54–1.73)	1.55 (1.41–1.69)	1.25 (1.18–1.33)	1.12 (1.05–1.19)
Not insured	0.96 (0.67–1.38)	1.07 (0.61–1.88)	1.48 (1.02–2.16)	1.73 (1.13–2.65)
Unknown/Missing	0.86 (0.76–0.98)	0.59 (0.48–0.73)	0.93 (0.84–1.02)	1.06 (0.94–1.20)

	Odds ratio (95% CI) of receiving therapy			
	In patients with colorectal cancer (*N* = 101,250)		In patients with colorectal cancer who also had hypertension(*N* = 81,738)	In patients with colorectal cancer who also had diabetes(*N* = 34,592)
Characteristics	**Chemotherapy**	**Radiation therapy**	**Anti-hypertensives**	**Anti-diabetics**
Tumor stage				
In situ or local stage	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Regional stage	2.21 (1.95–2.49)	1.26 (1.09–1.45)	0.54 (0.50–0.58)	0.75 (0.68–0.84)
Distant stage	5.87 (5.57–6.20)	2.28 (2.11–2.45)	0.80 (0.76–0.84)	0.89 (0.85–0.94)
Unknown/Missing	8.23 (7.76–8.72)	1.40 (1.28–1.54)	0.42 (0.40–0.45)	0.56 (0.52–0.60)
Tumor size (cm)				
<1	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
1–<2	1.50 (1.26–1.77)	1.74 (1.36–2.22)	0.93 (0.82–1.05)	1.03 (0.89–1.19)
2–<3	1.61 (1.38–1.87)	1.88 (1.49–2.36)	1.09 (0.97–1.23)	1.00 (0.87–1.14)
3–<4	1.73 (1.49–2.01)	1.96 (1.57–2.45)	1.13 (1.00–1.26)	0.97 (0.85–1.11)
≥4	1.70 (1.47–1.97)	2.14 (1.73–2.64)	0.98 (0.88–1.09)	0.96 (0.85–1.08)
Missing	1.59 (1.37–1.84)	2.32 (1.88–2.87)	0.92 (0.82–1.02)	0.92 (0.81–1.04)
Tumor grade				
Well-differentiated	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Moderately-differentiated	1.33 (1.22–1.44)	1.32 (1.16–1.5)	1.02 (0.95–1.09)	0.97 (0.89–1.05)
Poorly-differentiated	1.53 (1.40–1.67)	1.39 (1.20–1.61)	0.86 (0.79–0.93)	0.90 (0.82–0.99)
Unknown/Missing	0.85 (0.78–0.94)	1.08 (0.93–1.24)	0.90 (0.83–0.97)	0.89 (0.81–0.98)
Tumor site				
Colon	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Rectal	1.80 (1.72–1.88)	24.44 (22.57–26.48)	0.95 (0.91–0.99)	0.98 (0.93–1.04)
Comorbidity Scores				
0	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
1	1.48 (1.42–1.55)	1.60 (1.49–1.72)	0.68 (0.65–0.71)	0.66 (0.63–0.70)
≥2	1.11 (1.05–1.17)	1.39 (1.28–1.5)	0.61 (0.59–0.64)	0.65 (0.62–0.69)
Year of Diagnosis				
2007	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
2008	0.96 (0.89–1.04)	0.92 (0.81–1.05)	1.05 (0.98–1.14)	0.98 (0.89–1.07)
2009	0.90 (0.84–0.98)	0.94 (0.82–1.07)	1.06 (0.98–1.15)	0.98 (0.90–1.08)

	Odds ratio (95% CI) of receiving therapy			
	In patients with colorectal cancer (*N* = 101,250)		In patients with colorectal cancer who also had hypertension(*N* = 81,738)	In patients with colorectal cancer who also had diabetes(*N* = 34,592)
Characteristics	**Chemotherapy**	**Radiation therapy**	**Anti-hypertensives**	**Anti-diabetics**
2010	0.93 (0.86–1.01)	0.96 (0.84–1.09)	1.01 (0.93–1.09)	0.96 (0.88–1.06)
2011	0.89 (0.82–0.97)	0.97 (0.85–1.11)	0.94 (0.87–1.01)	0.84 (0.76–0.92)
2012	0.93 (0.86–1.01)	0.97 (0.85–1.11)	0.85 (0.79–0.92)	0.81 (0.74–0.89)
2013	0.85 (0.79–0.92)	0.92 (0.80–1.04)	0.86 (0.80–0.93)	0.79 (0.72–0.87)
2014	0.85 (0.79–0.92)	1.03 (0.91–1.17)	0.80 (0.74–0.86)	0.65 (0.59–0.71)
2015	0.89 (0.82–0.96)	1.34 (1.19–1.52)	0.73 (0.68–0.78)	0.64 (0.58–0.70)
SEER Areas				
Connecticut	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Detroit	0.94 (0.83–1.06)	1.14 (0.94–1.40)	0.82 (0.74–0.92)	0.69 (0.60–0.79)
Hawaii	0.33 (0.27–0.40)	0.58 (0.42–0.79)	1.59 (1.32–1.92)	1.22 (0.99–1.51)
Iowa	1.21 (1.08–1.36)	1.62 (1.33–1.96)	1.11 (1.00–1.24)	1.14 (0.99–1.33)
New Mexico	0.84 (0.72–0.99)	1.08 (0.84–1.40)	0.97 (0.83–1.13)	0.88 (0.72–1.07)
Seattle	0.69 (0.61–0.79)	1.05 (0.85–1.30)	1.32 (1.16–1.49)	0.98 (0.84–1.15)
Utah	0.65 (0.55–0.78)	1.15 (0.87–1.52)	1.12 (0.94–1.32)	1.01 (0.82–1.26)
Georgia	0.87 (0.79–0.97)	1.22 (1.02–1.45)	0.94 (0.85–1.04)	1.02 (0.90–1.16)
Kentucky	0.87 (0.78–0.98)	1.25 (1.05–1.50)	1.07 (0.97–1.19)	0.96 (0.84–1.1)
Louisiana	0.85 (0.76–0.96)	1.23 (1.02–1.48)	1.01 (0.91–1.12)	1.04 (0.90–1.18)
New Jersey	1.40 (1.27–1.55)	1.40 (1.19–1.65)	0.84 (0.76–0.92)	0.75 (0.66–0.84)
California	0.56 (0.51–0.62)	0.74 (0.63–0.87)	1.41 (1.29–1.53)	1.13 (1.01–1.27)

*Odds ratios from logistic regression were adjusted for variables listed in this table.

Table 4

Adjusted odds ratio (95% CI) of receiving cancer therapies, antihypertensive and antidiabetic drugs in patients with colorectal cancer by race/ethnicity, stratified by health insurance at time of diagnosis and tumor stage.

	Odds ratio (95% CI) of receiving therapy			
	In patients with colorectal cancer (*N* = 101,250)		**In patients with colorectal cancer who also had hypertension (*N* = 81,738)**	**In patients with colorectal cancer who also had diabetes (*N* = 34,592)**
Characteristics	**Chemotherapy**	**Radiation therapy**	**Anti-hypertensives**	**Anti-diabetics**
Had private insurance at the time of cancer diagnosis				
Race/ethnicity				
NH-Whites	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
NH-Blacks	0.74 (0.68,0.80)	0.78 (0.68,0.89)	1.19 (1.11,1.28)	1.17 (1.08,1.27)
NH-Asians/Pacific Islanders	1.04 (0.94,1.15)	0.98 (0.84,1.14)	0.93 (0.84,1.02)	1.17 (1.05,1.30)
Hispanics	0.85 (0.78,0.92)	0.82 (0.71,0.94)	1.34 (1.23,1.46)	1.46 (1.33,1.60)
Others	0.94 (0.66,1.32)	1.10 (0.65,1.88)	0.73 (0.52,1.01)	0.69 (0.48,0.99)
Unknown/Missing	0.60 (0.36,1.01)	1.05 (0.55,2.02)	1.20 (0.77,1.87)	0.59 (0.37,0.93)
Had Medicaid coverage				
Race/ethnicity				
NH-Whites	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
NH-Blacks	0.89 (0.75,1.04)	0.83 (0.64,1.07)	1.19 (1.01,1.40)	0.90 (0.77,1.06)
NH-Asians/Pacific Islanders	1.45 (1.23,1.71)	0.98 (0.76,1.26)	0.90 (0.75,1.06)	1.02 (0.85,1.22)
Hispanics	1.44 (1.23,1.68)	1.23 (0.97,1.55)	1.04 (0.88,1.23)	1.23 (1.04,1.45)
Others	1.18 (0.69,2.03)	1.02 (0.48,2.19)	0.88 (0.49,1.60)	0.71 (0.39,1.26)
Unknown/Missing	1.06 (0.32,3.55)	0.73 (0.07,7.29)	0.29 (0.11,0.77)	1.08 (0.30,3.96)
Had no private insurance/ unknown				
Race/ethnicity				
NH-Whites	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
NH-Blacks	0.83 (0.56,1.23)	0.63 (0.31,1.28)	1.20 (0.89,1.61)	1.38 (0.97,1.96)
NH-Asians/ Pacific Islanders	0.70 (0.37,1.31)	0.96 (0.38,2.45)	0.98 (0.64,1.51)	1.24 (0.75,2.04)
Hispanics	1.18 (0.78,1.80)	0.80 (0.40,1.63)	1.61 (1.12,2.31)	2.10 (1.37,3.20)
Others	1.14 (0.28,4.63)	-**	0.74 (0.18,2.97)	1.02 (0.13,7.76)
Unknown/Missing	0.50 (0.21,1.20)	0.57 (0.18,1.74)	0.86 (0.52,1.41)	1.78 (0.90,3.51)
Early tumor stage (in-situ or local stage)				
Race/ethnicity				
NH-Whites	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
NH-Blacks	0.71 (0.60,0.84)	0.68 (0.55,0.84)	1.26 (1.13,1.40)	1.18 (1.06,1.31)
NH-Asians/Pacific Islanders	0.89 (0.73,1.09)	0.94 (0.74,1.18)	0.81 (0.71,0.92)	0.99 (0.86,1.13)
Hispanics	1.05 (0.89,1.24)	0.96 (0.78,1.18)	1.16 (1.03,1.31)	1.35 (1.20,1.51)
Others	1.04 (0.53,2.02)	1.36 (0.65,2.85)	0.67 (0.41,1.09)	0.94 (0.57,1.53)
Unknown/Missing	0.38 (0.16,0.94)	0.32 (0.10,1.03)	0.77 (0.53,1.12)	0.79 (0.52,1.21)

	Odds ratio (95% CI) of receiving therapy			
	In patients with colorectal cancer (*N* = 101,250)		In patients with colorectal cancer who also had hypertension (*N* = 81,738)	In patients with colorectal cancer who also had diabetes (*N* = 34,592)
Characteristics	**Chemotherapy**	**Radiation therapy**	**Anti-hypertensives**	**Anti-diabetics**
Late tumor stage (regional or distant stage or unknown)				
Race/ethnicity				
NH-Whites	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
NH-Blacks	0.75 (0.69,0.80)	0.79 (0.68,0.90)	1.16 (1.08,1.26)	1.10 (1.00,1.20)
NH-Asians/Pacific Islanders	1.21 (1.11,1.32)	1.03 (0.88,1.21)	0.95 (0.86,1.05)	1.23 (1.09,1.38)
Hispanics	0.96 (0.89,1.03)	0.94 (0.82,1.07)	1.29 (1.18,1.42)	1.45 (1.31,1.61)
Others	0.97 (0.72,1.31)	0.96 (0.58,1.62)	0.82 (0.59,1.15)	0.59 (0.39,0.87)
Unknown/Missing	0.59 (0.37,0.94)	1.60 (0.84,3.03)	1.30 (0.79,2.13)	1.11 (0.60,2.07)

*
Odds ratios from logistic regression were adjusted for age, gender, marital status, tumor stage, tumor size, tumor grade, tumor site, comorbidity score, year of diagnosis, and SEER registries.

**
no case.

Table 5

Risk of all-cause and cancer-specific mortality in association with therapies for colorectal cancer, hypertension and diabetes by race/ethnicity.

	Hazard ratio* (95% CI) of all-cause mortality			Hazard ratio* (95% CI) of colorectal cancer-specific mortality		
	Model-1	**Model-2**	**Model-3**	**Model-1**	**Model-2**	**Model-3**
Race/ethnicity						
NH-Whites	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
NH-Blacks	1.07 (1.04–1.10)	1.05 (1.02–1.08)	1.05 (1.02–1.08)	1.09 (1.05–1.13)	1.06 (1.02–1.10)	1.08 (1.04–1.12)
NH-Asians/Pacific Islanders	0.74 (0.72–0.77)	0.80 (0.77–0.83)	0.78 (0.75–0.82)	0.78 (0.75–0.82)	0.84 (0.80–0.88)	0.83 (0.79–0.87)
Hispanics	0.83 (0.80–0.85)	0.92 (0.89–0.95)	0.92 (0.89–0.95)	0.88 (0.85–0.92)	0.95 (0.91–0.99)	0.96 (0.92–1.00)
Others	1.05 (0.92–1.20)	1.14 (1.00–1.30)	1.10 (0.96–1.26)	1.18 (1.00–1.39)	1.15 (0.97–1.36)	1.12 (0.94–1.32)
Unknown/missing	0.17 (0.13–0.22)	0.24 (0.18–0.31)	0.23 (0.18–0.31)	0.15 (0.10–0.23)	0.22 (0.15–0.32)	0.21 (0.14–0.32)
Age (years)						
65–69	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
70–74	1.26 (1.22–1.30)	1.27 (1.23–1.31)	1.26 (1.22–1.30)	1.18 (1.14–1.23)	1.22 (1.18–1.27)	1.21 (1.17–1.26)
75–79	1.66 (1.61–1.71)	1.67 (1.62–1.72)	1.62 (1.58–1.67)	1.45 (1.40–1.51)	1.51 (1.45–1.57)	1.47 (1.42–1.53)
80–84	2.28 (2.21–2.35)	2.25 (2.19–2.32)	2.14 (2.07–2.20)	1.90 (1.83–1.97)	1.95 (1.87–2.02)	1.86 (1.79–1.93)
85 or older	3.63 (3.53–3.73)	3.28 (3.18–3.37)	2.99 (2.90–3.07)	2.99 (2.88–3.09)	2.76 (2.66–2.87)	2.52 (2.42–2.62)
Gender						
Men	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Women	0.97 (0.95–0.99)	0.80 (0.79–0.82)	0.82 (0.81–0.84)	1.01 (0.99–1.04)	0.88 (0.85–0.90)	0.90 (0.88–0.92)
Tumor site						
Colon	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)	1.00 (ref)
Rectal	0.93 (0.91–0.95)	1.05 (1.02–1.07)	1.07 (1.05–1.09)	1.00 (0.98–1.03)	1.12 (1.09–1.15)	1.13 (1.10–1.17)
Chemotherapy						
No	1.00 (ref)	–	1.00 (ref)	1.00 (ref)	–	1.00 (ref)
Yes	0.91 (0.89–0.94)	–	0.68 (0.66–0.69)	1.23 (1.19–1.26)	–	0.74 (0.72–0.76)
Radiotherapy						
No	1.00 (ref)	–	1.00 (ref)	1.00 (ref)	–	1.00 (ref)
Yes	0.95 (0.92–0.99)	–	0.99 (0.95–1.03)	1.08 (1.03–1.13)	–	1.01 (0.96–1.06)
Hypertension treatment						
No Hypertension	1.00 (ref)	–	1.00 (ref)	1.00 (ref)	–	1.00 (ref)

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	Hazard ratio* (95% CI) of all-cause mortality			Hazard ratio* (95% CI) of colorectal cancer-specific mortality		
	Model-1	**Model-2**	**Model-3**	**Model-1**	**Model-2**	**Model-3**
Hypertension – no treatment	1.84 (1.79–1.89)	–	1.26 (1.23–1.30)	1.62 (1.57–1.68)	–	1.22 (1.18–1.27)
Hypertension – received treatment	0.83 (0.81–0.85)	–	0.71 (0.70–0.73)	0.63 (0.61–0.65)	–	0.65 (0.63–0.66)
Diabetes treatment						
No diabetes	1.00 (ref)	–	1.00 (ref)	1.00 (ref)	–	1.00 (ref)
Diabetes – no treatment	1.37 (1.34–1.40)	–	1.19 (1.16–1.21)	1.26 (1.22–1.30)	–	1.15 (1.11–1.19)
Diabetes – received treatment	0.89 (0.87–0.91)	–	1.06 (1.04–1.09)	0.70 (0.68–0.73)	–	0.93 (0.90–0.96)

*Model-1 were crude hazard ratios without adjusting for other factors; Model-2 adjusted for age, gender, marital status, health insurance, tumor stage, tumor size, tumor grade, tumor site, comorbidity score, year of diagnosis, and SEER registries; Model-3 adjusted for chemotherapy, radiation therapy, antihypertensive therapy, and antidiabetic therapy in addition to factors in Model-2.