Does Patient Rurality Predict Quality Colon Cancer Care?
A Population Based Study

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Abstract

Introduction:
Over fifty million people reside in rural America. However, the impact of patient rurality on colon cancer care has been incompletely characterized. We hypothesize that patient rurality impacts colon cancer care quality measures.

Methods:
Using the 1996-2008 California Cancer Registry, we identified 123,129 patients with stage 0-IV colon cancer. Rural residence was established based on the patient's rural or urban medical service study area designation. Baseline characteristics were compared by rurality status. Controlling for covariates, multivariate regression models were used to examine the impact of rurality on stage in the entire cohort, adequate lymphadenectomy in stage I-III disease and receipt of chemotherapy for stage III disease. Cox proportional hazards modeling was used to examine the impact of rurality on survival in the entire cohort.

Results:
Of all patients diagnosed with colon cancer, 18,735 (15%) resided in rural areas. Rural residence was associated with white or American Indian race and later stage. Controlling for covariates, our multivariate models demonstrate that rurality was associated with later stage of diagnosis, inadequate lymphadenectomy in stage I-III disease and inadequate receipt of chemotherapy for stage III disease. In addition, rurality was associated with worse cancer specific survival.

Conclusions: A significant portion of patients treated for colon cancer live in rural areas. Yet, rural residence is associated with later stage, poor adherence to quality measures and poorer survival. Future quality improvement measures should specifically target rural patients to ensure both that structure of care is optimal and that appropriate processes of care are followed.

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INTRODUCTION:

Approximately one in five Americans lives in a rural area[1]. Rural surgical patients are served by approximately 20% of the nation's general surgeons who represent the second most common type of physician in rural America[2]. Furthermore, nearly 40% of hospitals are considered rural hospitals[3]. Efforts to improve medical care for rural Americans are important, as this group is subject to higher rates of poverty and higher mortality relative to their urban counterparts[4].

Additionally, the travel required for comprehensive cancer care complicates treatment of patients from rural communities[3]. Prior research has demonstrated that patients living in rural areas are less likely to receive recommended cancer screenings[5,6] and that these screening deficits have been shown to adversely impact colon cancer detection[7]. Furthermore, colon cancer tends to be diagnosed at later stages in rural patients[8–10]. We have previously explored the impact of the location of treatment on outcomes, specifically demonstrating that treatment at a rural hospital did not confer worse surgical mortality, except for in patients with complex cancers[11]. However, an effective appraisal of quality cancer care should more broadly consider the structures, processes and outcomes of cancer care[12]. While colon cancer represents the third most common cancer in the US, investigation into the impact of rural residence across the entire continuum of colon cancer care has been sparse.

Our study therefore sought to examine the impact of patient rurality on quality colon cancer care. We hypothesized that patient rurality is associated with the following colon cancer care quality measures: stage at diagnosis, adequacy of lymphadenectomy at surgery, receipt of chemotherapy, and cancer-specific death. Our findings will help inform research-driven interventions to improve surgical cancer care for rural Americans.

METHODS

Data Source

The California Cancer Registry is one of the largest and most diverse population-based cancer registries in the United States[13]. All new cancer diagnoses are required by law to be reported to this registry; consequently case reporting is estimated to be 98% complete[14]. Data are collected from California's ten regional registries, encompassing the state's fifty-eight counties and are abstracted according to established statewide standards[15].

Case Selection

Our cohort included patients with tumors of the colon as designated by ICD-O-3 site code. We excluded patients with tumors located in the rectum, anal canal or appendix. Patients younger than age 18 or older than 94 were also excluded (n=3081). Although case data were available beginning in 1988, complete reporting of patient rurality was not available until after 1995. Therefore, we limited our analysis to patients diagnosed between 1996 and 2008.

Patient Rurality and Other Demographic Measures

Rural residence was established based on the designation assigned to the patient's medical service study area by the California Office of Statewide Health Planning and

Development (OSHPD)[16]. Counties are subdivided in the state into multiple medical service study areas, each of which are classified by the OSHPD as rural, urban, or frontier. Due to the small number of frontier-residing patients, frontier medical service study areas were also considered rural for the purposes of our study.

Age was categorized into the following groups: 18-35, 36-50, 51-65, 66-80, and 81-94. Payers were grouped by similar payment sources. Surgical treatment was grouped into the following four categories: None, local therapy (polypectomy, laser, cautery), limited resection and colectomy.

Colon Cancer Care Quality Measures

We chose four colon cancer care quality measures to assess quality at multiple places in the cancer care continuum. First, we examined stage at diagnosis. This is a crucial quality measure of cancer care as it reflects the penetration of screening and outreach efforts. We assigned AJCC 7th edition TNM-stage and overall stage to each patient based on tumor extension, nodal positivity, and metastasis as reported by the California Cancer Registry. Stage was then dichotomized into low stage (Tis, I, II) and high stage (III, IV) for regression analysis.

For stage I - stage III patients who underwent surgical resection, we examined the adequacy of lymphadenectomy. An adequate lymphadenectomy was defined as recovery of more than 12 lymph nodes as specified by several specialty organizations[17]. Patients with missing nodal evaluation or number of nodes were excluded from analysis.

For stage III patients under 80 who underwent surgery, we compared receipt of chemotherapy for rural and urban patients. CCR reports whether patients received, refused or had a contraindication to chemotherapy. Patients were considered to have received chemotherapy if CCR designated them as such. This quality measure was selected as chemotherapy for stage III disease has been clearly shown to improve patient survival[18]..

Finally, cancer-specific death was assessed as our composite and final quality measure.

Bivariate Analysis

Our four quality measures as well as patient- and tumor-related factors (age, gender, marital status, race, insurance status, tumor stage, and tumor grade) were compared by rural versus urban patient residence using chi squared analysis.

Adjusted Analysis

We first used multivariate regression to identify patient and tumor factors associated with rural residence. Multivariate logistic regression models were then constructed to examine the impact of rurality on the selected colon cancer care quality measures including stage at diagnosis, adequate lymphadenectomy and receipt of chemotherapy. We excluded from the models any cases lacking data needed to construct any response variables: 20,825 were excluded from the regression model for stage due to unknown stage at diagnosis, 3075 excluded from the lymphadenectomy regression model due to unknown number of lymph nodes harvested, and 3689 excluded from the chemotherapy regression model due to unknown chemotherapy status.

Next, Cox proportional hazards models were created to examine the impact of rurality on cancer-specific death in the entire cohort, adjusting for stage, surgery, grade, age, lymphadenectomy, sex, race, marital status, insurance status, and year of diagnosis. A separate proportional hazards model was constructed to examine the impact of rurality on stage III patients and their cancer-specific survival to reflect chemotherapy guidelines. This model was adjusted for chemotherapy, surgery, grade, age, lymphadenectomy, sex, race, marital status, insurance status, and year of diagnosis. For both analyses, time to death was directly reported by the CCR along with cause of death. Patients who had a non cancer related death or an unknown cause of death were censored. Ties were handled using the Breslow method.

Interaction testing and sensitivity analyses were conducted to ensure that observed results were not due to our modeling decisions. The University of Minnesota Institutional Review board reviewed this study (HSC# 1202E10466) and deemed it exempt from further review. All regressions were performed using SAS 9.2 (Cary, NC).

RESULTS:

Our cohort consisted of 123,129 patients. Of these, 18,735 (15.2%) resided in rural areas. Results from unadjusted analyses showed rural patients differed by age, gender, marital status, race/ethnicity, adequate lymphadenectomy for stage I-III disease and receipt of chemotherapy for stage III disease. Stage and receipt of surgery did not vary by patient rurality on unadjusted analysis (see Table 1).

Multivariate Analysis of Demographic Factors Associated with Patient Rurality:

Non-Hispanic Black, Hispanic, or Asian/Pacific Islanders were less likely to live in rural areas compared to non-Hispanic whites (see Table 2). However, American Indian patients were the most likely to live in rural areas (American Indian vs Non-Hispanic Whites OR 3.406; 95% CI 2.744-4.227). Furthermore, rural patients were less likely to have private insurance (OR 0.720; 95% CI 0.624-0.830).

Multivariate Analysis of Colon Cancer Quality Measures

After adjusting for covariates, patients living in rural areas were more likely to be diagnosed at later stages (III or IV) compared to their urban counterparts (OR 1.04; 95% CI 1.001-1.075, $p=0.043$). The uninsured were also likely to be diagnosed at later stages as well (see Table 3). Interaction testing revealed no significant interaction between rurality and age. However, an interaction was identified between rurality and race, reflecting varying effects of rurality on late stage at diagnosis by race. Therefore, we stratified our models by race to examine the effect of rurality on this measure within each race group. We then observed that late stage at diagnosis was statistically significantly associated with rurality for only non-Hispanic whites and American Indians (see Table 7).

Rural patients with stage I-III disease were less likely to receive adequate nodal evaluation than were their urban counterparts (OR 0.81; 95% CI 0.78-0.84; $p<0.001$).

Older patients, males, non-Hispanic Blacks, Asian Pacific Islanders were also less likely to receive an adequate lymphadenectomy (Table 4).

As for receipt of adjuvant systemic chemotherapy for stage III colon cancer, rural patients were less likely to receive adjuvant chemotherapy (OR 0.86; 95% CI 0.80-0.93, $p<0.001$). Males, non-Hispanic blacks, Hispanics, and the elderly were also less likely to receive adjuvant chemotherapy (Table 5). During interaction analysis, there was no significant interaction between rurality and age. However, an interaction was identified between rurality and race ($p=0.045$). Therefore, we again stratified our models by race to independently look at the effect of rurality on chemotherapy use within each race group, finding this effect was statistically significant for non-Hispanic whites only (see Table 8). During sensitivity analysis, our results did not change when excluding patients for whom chemotherapy was contraindicated or patients who died.

Proportional Hazards Regression of Cancer-Specific Mortality

We found that patients living in rural areas had a 4% higher risk of death from their cancer compared with patients living in urban areas (HR 1.04, 95% CI 1.01-1.07; $p=0.016$) even after adjustment for stage and other patient, tumor and treatment factors. In addition, non-Hispanic blacks had higher risk of cancer-specific death than their non-Hispanic white counterparts while Asian/Pacific Islanders and Hispanics appeared to have lower risk (Table 6).

Similarly, in our analysis of specifically stage III patients, which included chemotherapy as a covariate, patient rurality predicted higher cancer-specific mortality (HR 1.08; 95% CI 1.02-1.14; $p=0.01$). Receiving no adjuvant chemotherapy predicted higher mortality as well (HR 1.24; 95% CI 1.19-1.30; $p<0.001$). No race-rurality or age-rurality interactions were found in our proportional hazards models.

DISCUSSION:

In this large, diverse, population-based study of 123,126 colon cancer patients in the state of California, we found that rural patients were more likely to be diagnosed at late stage and less likely to receive adequate lymphadenectomies or receive chemotherapy for stage III disease. In addition, rural residence conferred worse cancer-specific mortality. To our knowledge, this study is the first to examine the impact of patient rurality across the entire continuum of colon cancer care at the population level.

The literature regarding the stage of diagnosis for rural colon cancer patients is mixed. Consistent with our hypothesis, some researchers have found later stage cancer diagnoses for rural compared to urban patients using the Nebraska Cancer registry[5]. However, other studies have found no difference in colon cancer stage at diagnosis[7] or even earlier stage at diagnosis among rural patients[19]. It is important to note that these studies defined patient rurality by county of residence only, while our study utilized subdivisions of each county of residence.

Our work found the largest rural-urban disparity in lymphadenectomy, where rural patients had 20% lower odds of having an adequate number of lymph nodes examined (OR 0.81; 95% CI 0.78-0.84). Evaluation of 12 or more lymph nodes has been shown to improve overall survival after colectomy for cancer[17]. We posit, as other authors have, that the adequacy of lymphadenectomy depends on the interplay between multiple structural elements of the patient's care: the surgeon's specialty, the pathologist, case volume, and even the setting of care. As such, adequate lymphadenectomy can be seen as a surrogate marker of appropriate structures of care. With our study, we could not directly comment on the structural factors that may have contributed to the suboptimal number of lymph nodes examined in rural patients, but this finding should be further investigated.

Our results are in agreement with others who have found differing rates of chemotherapy among rural patients. Previous work has shown that rural patients have more difficulty than their urban counterparts in accessing chemotherapy due to geographic and infrastructure barriers[20]. Although two studies[21,22] have recently found no impact of rurality on chemotherapy use in colon cancer patients, both studies used cases linked to Medicare claims and therefore limited their entire study cohort to elderly patients.

The current analysis has several positive attributes in addition to the fundamental strength of its population-based design. First, because cancer reporting is mandatory in California, we were able to study nearly all colon cancers diagnosed in that state during the study period. Second, because of California's diverse population, our study results are generalizable to a broader population than studies based on more ethnically homogeneous registries. Third, we were able to assess key quality-care metrics of structures, processes and outcomes. Finally, with the unique use of designations by medical service study area, we were able to classify patient rurality at a level more detailed than just by county of residence.

Our study has several limitations related to the California Cancer Registry. First, we could not account for socioeconomic status from the registry, although we were able to adjust for insurance status. We neither had access to information regarding treatment location, nor how far rural patients travelled for their care. Furthermore we were not able to adjust for hospital case volume, surgeon specialty, or surgeon case volume. Finally, we did not have information on patient comorbidities, emergent versus elective surgical case status or postoperative complications, which potentially could impact receipt of chemotherapy.

Our results highlight the importance of identifying the barriers to healthcare for the rural population. Caring for rural patients will likely become increasingly challenging as the increasing centralization of care may increase financial pressures on both rural hospitals and rural providers. Rural patients may not be able to find quality care close to home and may travel increasing distances as these trends continue to evolve.

With more than 50 million people living in rural America, the striking impact of rural residence on the continuum of cancer care cannot be ignored. Future studies should investigate how rural patient outcomes are affected by treatment location, provider volume, provider specialty, hospital volume, and other structures of care. In addition, research should be directed toward linking the rurality of the patient and the rurality of the treating facility. Furthermore, as more and more surgical graduates are choosing sub-specialization and urban practice[2], resources should be devoted to bolstering the rural surgical workforce. Methods should be investigated which could improve care for rural patients, and key stakeholders should reward treating this critical population in an effective manner.

CONCLUSION:

A significant portion of patients treated for colon cancer live in rural areas. In this study, using the largest population-based state registry in the United States, rural residence was associated with later stage at diagnosis, inadequate lymphadenectomy, failure to receive chemotherapy, and worse cancer-specific mortality.

Future quality improvement measures should specifically target rural patients in order to improve outcomes in this vulnerable population by ensuring that adequate structures of care are present and that appropriate processes of care are followed.

Table 1 Patient and Tumor Factors, by Patient Residence

Factors	Rural	Urban	χ^2 p-value
Age			
18-35	163 (0.9%)	1093 (1.1%)	<0.0001
36-50	1297 (6.9%)	8351 (8.0%)	
51-65	4525 (24.2%)	26002 (24.9%)	
66-80	8539 (45.6%)	45386 (43.5%)	
80+	4211 (22.5%)	23562 (22.6%)	
Sex			
Male	9607 (51.3%)	50871 (48.7%)	<0.0001
Female	9128 (48.7%)	53523 (51.3%)	
Marital Status			
Single	1678 (9.0%)	12456 (11.9%)	<0.0001
Married	11194 (59.8%)	57927 (55.5%)	
Separated/Divorced/Widowed	5472 (29.2%)	30937 (29.6%)	
Unknown	391 (2.1%)	3074 (2.9%)	
Race/ethnicity			
Non-Hispanic White	15429 (82.4%)	69905 (67.0%)	<0.0001
Non-Hispanic Black	456 (2.4%)	8609 (8.3%)	
Hispanic	2108 (11.3%)	13361 (12.8%)	
Asian/Pacific Islander	485 (2.6%)	11552 (11.1%)	
Non-Hispanic American Indian	155 (0.8%)	190 (0.2%)	
Unknown	102 (0.5%)	777 (0.7%)	
Insurance Status			
Non Insured	238 (1.3%)	1720 (1.7%)	0.0007
Insured	18108 (96.7%)	100559 (96.3%)	
Unknown	389 (2.1%)	2115 (2.0%)	
Tumor Grade			
Low	13227 (70.6%)	72181 (69.1%)	0.0003
High	3227 (17.2%)	18975 (18.2%)	
Unknown	2281 (12.2%)	13238 (12.7)	
Tumor Stage			
Tis	297 (1.6%)	1781 (1.7%)	0.11
I	3507 (18.7%)	18853 (18.1%)	
II	5206 (27.8%)	29376 (28.1%)	
III	4386(23.4%)	24258 (23.2%)	
IV	2251 (12.0%)	12389 (11.9%)	
Unknown	3088 (16.5%)	17737 (17.0%)	
Surgery (Stage I-III)			
None	31 (0.2%)	190 (0.3%)	0.08
Local Polypectomy/Laser/Cautery	25 (0.2%)	191 (0.3%)	
Limited Resection	5088 (38.9%)	28803 (39.8%)	
Colectomy	7950 (60.7%)	43254 (59.7%)	
Nodal Evaluation (Stage I-III)			
<12 Nodes	2943 (26.4%)	17198 (28.7%)	<0.0001
>12 Nodes	8220 (73.6%)	42776 (71.3%)	
Chemo (Stage III)			
Indicated, Not Given	1494 (43.2%)	7419 (39.3%)	<0.0001
Indicated, Given	1961 (56.8%)	11445 (60.7%)	

Table 2 Multivariable Logistic Regression Predicting Rurality (n=123129, c=0.658)

Factor	Adjusted OR*	95% CI	p-value
Age			
18-35 vs 66-80	1.261	1.059 - 1.500	0.009
36-50 vs 66-80	1.240	1.156 - 1.330	<0.001
51-65 vs 66-80	1.243	1.118 - 1.301	<0.001
80+ vs 66-80	0.876	0.840-0.913	<0.001
Gender			
Male vs Female	1.070	1.035-1.106	<0.001
Marital Status			
Married vs Single	1.467	1.386-1.553	<0.001
Divorced/Separated/Widowed vs Single	1.301	1.223-1.384	<0.001
Unknown vs Single	1.007	0.891-1.138	0.907
Race			
Non-Hispanic Blacks vs Non-Hispanic White	0.245	0.223-0.270	<0.001
Hispanic vs Non-Hispanic White	0.701	0.666-0.737	<0.001
Asian/Pacific Islander vs Non-Hispanic White	0.180	0.164-0.197	<0.001
American Indian vs Non-Hispanic White	3.406	2.744-4.227	<0.001
Unknown vs Non-Hispanic White	0.666	0.537-0.825	<0.001
Payer			
Private Insurance Vs Uninsured	0.720	0.624-0.830	0.002
Medicaid/Tricare/Indian Health vs Uninsured	1.551	1.098-1.496	<0.001
Unknown Insurance vs Uninsured	1.288	1.343-1.791	0.002

Table 3 **Logistic Regression Predicting Late Stage at Diagnosis* (n=102304; c=0.564)**

Factor	Adjusted OR*	95% CI	p-value
Rurality			
Rural vs. Urban Residence	1.037	1.001-1.075	0.043
Age			
18-35 vs 66-80	1.781	1.572 - 2.018	<0.001
36-50 vs 66-80	1.652	1.569 - 1.740	<0.001
51-65 vs 66-80	1.269	1.226 - 1.314	<0.001
80+ vs 66-80	0.887	0.858 - 0.917	<0.001
Gender			
Male vs Female	0.959	0.934-0.985	0.002
Marital Status			
Married vs Single	0.980	0.940-1.021	0.332
Divorced/Separated/Widowed vs Single	1.002	0.958-1.049	0.916
Unknown vs Single	0.861	0.776-0.954	0.004
Race			
Non-Hispanic Blacks vs Non-Hispanic White	1.201	1.143-1.262	<0.001
Hispanic vs Non-Hispanic White	1.055	1.015-1.097	0.007
Asian/Pacific Islander vs Non-Hispanic White	1.202	1.152-1.256	<0.001
American Indian vs Non-Hispanic White	1.145	0.911-1.438	0.247
Payer			
Private Insurance Vs Uninsured	0.832	0.750 - 0.922	0.001
Medicaid/Tricare/Indian Health vs Uninsured	1.032	0.921- 1.156	0.591
Unknown Insurance vs Uninsured	1.363	1.181 - 1.574	<0.001

*after adjusting for sex, age, race, marital status, payer/insurance status, and year of diagnosis

Table 4 Logistic Regression Predicting Adequate Lymphadenectomy for Stage I-III Disease* (n=85905; c=0.638)

Factor	Adjusted OR*	95% CI	p-value
Rurality			
Rural vs. Urban Residence	0.808	0.777-0.840	<0.001
Age			
18-35 vs 66-80	3.064	2.617-3.586	<0.001
36-50 vs 66-80	1.831	1.724-1.945	<0.001
51-65 vs 66-80	1.243	1.195-1.293	<0.001
80+ vs 66-80	0.931	1.195-1.293	<0.001
Gender			
Male vs Female	0.857	0.832-0.882	<0.001
Marital Status			
Married vs Single	1.015	0.968-1.064	0.542
Divorced/Separated/Widowed vs Single	0.987	0.938-1.039	0.608
Unknown vs Single	0.996	0.890-1.116	0.951
Race			
Non-Hispanic Blacks vs Non-Hispanic White	0.857	0.809-0.907	<0.001
Hispanic vs Non-Hispanic White	0.815	0.780-0.852	<0.001
Asian/Pacific Islander vs Non-Hispanic White	0.816	0.778-0.857	<0.001
American Indian vs Non-Hispanic White	0.916	0.712-1.179	0.496
Payer			
Private Insurance vs Uninsured	0.690	0.611-0.780	<0.001
Medicaid/Tricare/Indian Health vs Uninsured	0.813	0.710-0.930	0.003
Unknown Insurance vs Uninsured	0.735	0.621-0.869	<0.001

*after adjusting for sex, age, race, marital status, payer/insurance status, and year of diagnosis

Table 5 **Logistic Regression Predicting Receipt of Chemotherapy for Stage III Disease in Patients Younger than 80* (n=22319; c= 0.639)**

Factor	Adjusted OR*	95% CI	p-value
Rurality			
Rural vs. Urban Residence	0.863	0.799-0.932	<0.001
Age			
18-35 vs 66-80	3.821	2.954-4.944	<0.001
36-50 vs 66-80	2.349	2.120-2.602	<0.001
51-65 vs 66-80	2.023	1.885-2.170	<0.001
Gender			
Male vs Female	0.891	0.842-0.943	<0.001
Marital Status			
Married vs Single	1.556	1.426-1.697	<0.001
Grade			
High vs Low	0.976	0.917-1.038	0.438
Unknown vs Low	0.942	0.774-1.147	0.552
Race			
Non-Hispanic Blacks vs Non-Hispanic White	0.892	0.804-0.990	0.032
Hispanic vs Non-Hispanic White	0.921	0.849-1.000	0.049
Asian/Pacific Islander vs Non-Hispanic White	1.005	0.920-1.098	0.912
American Indian vs Non-Hispanic White	0.897	0.584-1.379	0.621
Payer			
Private Insurance vs Uninsured	1.572	1.299-1.903	<0.001
Medicaid/Tricare/Indian Health vs Uninsured	1.241	1.005-1.532	0.044
Unknown Insurance vs Uninsured	1.692	1.291-2.216	<0.001

* - adjusted for sex, age, race, marital status, payer/insurance status, and year of diagnosis

Table 6 Cox Proportional Hazards Predicting Cancer-Specific Death* (n=123129)

Factor	Adjusted HR*	95% CI	p-value
Rurality			
Rural vs. Urban Residence	1.038	1.007-1.071	0.016
Age			
18-35 vs 66-80	0.576	0.512-0.648	<0.001
36-50 vs 66-80	0.653	0.623-0.685	<0.001
51-65 vs 66-80	0.741	0.718-0.764	<0.001
80+ vs 66-80	1.493	1.452-1.536	<0.001
Gender			
Male vs Female	1.122	1.096-1.148	<0.001
Marital Status			
Married vs Single	0.815	0.786-0.844	<0.001
Divorced/Widowed/Separated vs Single	0.956	0.920-0.994	0.023
Unknown vs Single	0.681	0.626-0.741	<0.001
Grade			
High vs Low	1.403	1.367-1.440	<0.001
Unknown vs Low	0.916	0.877-0,956	<0.001
Race			
Non-Hispanic Blacks vs Non-Hispanic White	1.156	1.111-1.204	<0.001
Hispanic vs Non-Hispanic White	0.954	0.921-0.988	0.008
Asian/Pacific Islander vs Non-Hispanic White	0.853	0.819-0.888	<0.001
American Indian vs Non-Hispanic White	1.123	0.926-1.362	0.239
Payer			
Private Insurance vs Uninsured	0.823	0.754-0.898	<0.001
Medicaid/Tricare/Indian Health vs Uninsured	1.013	0.921-1.115	0.784
Unknown Insurance vs Uninsured	1.093	0.978-1.222	0.116

*after adjusting for stage, surgery, grade, age, lymphadenectomy, sex, race, marital status, insurance status, and year of diagnosis

Table 7 Logistic Regression Predicting Late Stage at Diagnosis, stratified by race*

Race	Adjusted OR*	95% CI
Non-Hispanic White	1.040	1.000-1.082
Non-Hispanic Black	0.827	0.672-1.018
Hispanic	1.002	0.904-1.111
Asian/Pacific Islander	1.205	0.986-1.473
Non-Hispanic American Indian	1.884	1.081-3.282
Other/Unknown	1.673	0.686-4.81

*after adjusting for sex, age, marital status, payer/insurance status, and year of diagnosis

Table 8 Logistic Regression Predicting Chemotherapy in Stage III Disease, stratified by race*

Race	Adjusted OR*	95% CI
Non-Hispanic White	0.860	0.784-0.943
Non-Hispanic Black	0.858	0.558-1.320
Hispanic	1.129	0.898-1.421
Asian/Pacific Islander	1.146	0.743-1.767
Other/Unknown	5.965	0.227-156.78

* - adjusted for sex, age, marital status, payer/insurance status, and year of diagnosis

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