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Social Determinants of Appropriate Treatment for Muscle-Invasive Bladder Cancer

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Abstract

Background: Racial disparities in guideline-based, appropriate treatment (ApT) may be a significant driving force for differences in survival for people with non-metastatic muscle invasive bladder cancer (MIBC). We hypothesize that receipt of ApT is influenced by factors such as race and socioeconomic status, irrespective of neighborhood-level differences in healthcare, variations in practice patterns and clinical characteristics of patients with non-metastatic MIBC.

Methods: Within NCDB, we identified individuals diagnosed with MIBC between 2004 and 2013. Multivariable logistic regression and mixed effects modelling was used to examine predictors of ApT, clustered within institutions.

Results: 51,350 individuals with clinically staged non-metastatic, lymph node negative MIBC. Black individuals comprised 6.4% of the cohort. Mean age was 72.6 years (SD 11.6) with a male predominance (71.4%). Less than half received ApT (42.6%). Fewer black individuals received ApT compared white individuals (37% vs 43%, p<.001). When clustered by institution, the odds of ApT were 21% lower for black individuals (OR 0.79, 95% CI 0.73–0.87) compared to white individuals with non-metastatic MIBC. When restricted to higher volume centers with more diverse populations, black individuals had 25% lower odds of ApT (OR 0.75, 95% CI 0.61–0.91, p<0.01), compared to white counterparts.

Conclusions: Racial disparities in treatment persisted after accounting for various clinical factors and social determinants of health. Future efforts should focus on addressing racial bias to improve disparities in bladder cancer treatment.

Impact: If we are not delivering evidence-based care due to these biases (after accounting for access and biology), then it is expected that patients will experience inferior outcomes.

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Keywords

Social Determinants of Health; Urinary Bladder Neoplasms; Cohort Studies; United States; African Continental Ancestry Group; Socioeconomic Factors

INTRODUCTION

In 2018 there will be an estimated 81,190 new cases of malignancy of the urinary bladder with one-third of patients presenting with localized disease and one-fifth dying from bladder cancer[1]. Nearly half (48%) of black patients are diagnosed with localized or regional disease with a lower five-year survival rate of 64% compared to 77% for all races. Racial differences in stage at diagnosis, treatments utilized, and delays in treatment may be contributing to observed racial-disparities in bladder cancer outcomes. [2]

Guidelines from the American Urological Association [3] and the European Association of Urology[4] serve to propose what is considered best practice or appropriate treatment (ApT) for individuals with non-metastatic muscle-invasive bladder cancer (MIBC). For muscle-invasive disease, radical cystectomy (RC) with or without neoadjuvant chemotherapy remains the gold standard while tri-modal therapy remains an option for patients who wish to preserve the bladder or are unfit for cystectomy. These guidelines serve to standardize appropriate treatment to optimize outcomes such as cancer-specific survival. Non-clinical factors such as race, and socioeconomic status (SES), and access to care continue to hinder delivery of ApT although the extent of their impact is not completely understood.

Using the bladder cancer dataset of the National Cancer Database (NCDB), a a nationwide, facility-based, comprehensive clinical surveillance resource oncology data set that currently captures 70% of all newly diagnosed malignancies in the US annually from more than 1,500 Commission-on-Cancer accredited centers[5], we use a contextual approach to evaluate the influence of race on receipt of ApT for patients with non-metastatic MIBC. We hypothesize that rates of ApT are influenced by factors such as race and SES, irrespective of neighborhood-level differences in healthcare, variations in practice patterns, and clinical characteristics of patients with non-metastatic MIBC.

MATERIALS AND METHODS

Within NCDB, we identified 362,091 individuals diagnosed with bladder cancer between January 1, 2004 and December 31, 2013. The National Cancer Database, established in 1989, is a joint project of the American Cancer Society and the Commission on Cancer of the American College of Surgeons. The American College of Surgeons has executed a Business Associate Agreement that includes a data use agreement with each of its Commission on Cancer accredited hospitals. De-identified data on cancer staging and outcomes is included within the dataset. Those with non-muscle invasive bladder cancer, clinical evidence of metastasis, and/or nodal disease on clinical staging were excluded. The final cohort was comprised of 51,350 individuals diagnosed with non-metastatic MIBC (cT2–3Nx/oMx/o) disease. This project received exempt status from the institutional review board as this study involves the study of existing de-identified data that is publicly available.

Definitions

The reported histologic type was attributed to the most invasive surgical procedure the patient underwent during the study interval. Histology was classified urothelial carcinoma or variant. Race was defined as white, black or other based upon self-report during initial recruitment for NCDB. Charlson comorbidity index (CCI) was used as a measure of overall health based on scores of zero, one, or two or greater. Education was defined as the percentage of people within the specific zip code that were without a high school diploma using the following categories: greater than 21%, 13–20.9%, 7–12.9% and less than seven percent. Household income was reported as a categorical variable corresponding to the percentage of people within the specific zip code in each pre-specific income range: less than $38,000, %38,000–47,999, $48,000–62,999 or greater than $63,000. Data for neighborhood-level factors such as education and household income were obtained at time of diagnosis. City type (Metropolitan, Urban, Rural) was defined by county population sizes according to the patient's residence. Institution type such as Community Cancer Program, Academic/Research Program, Comprehensive Community Cancer Program was defined by the Cancer Accreditation program. ApT was defined as a including one or more of the following modalities: RC, neoadjuvant chemotherapy with RC, RC with adjuvant chemotherapy, and/or chemoradiation.

Summary statistics and Univariate analyses

Descriptive statistics of the study cohort were generated to report demographic, clinical and pathologic characteristics of the cohort. Means and standard deviations (SD) were used for parametric continuous variables. Median and interquartile ranges were used for nonparametric continuous variables. Frequency tables were used for categorical variables. Violin plots were created to visualize the distributions of reported case volume and reported proportion of black patients within patient population, stratified by institution type.

Univariate analyses by race were used to identify differences in clinical and pathologic data. ANOVA analysis was used to compare means of continuous variables with a normal distribution. Kruskal-Wallis test was used to compare continuous variables that are not normally distributed. Chi square test was used compare categorical variables. Statistical significance level was set at 0.05.

Regression models

Multivariable logistic regression modelling was used to identify factors associated with increased odds of ApT. Clinically relevant and demographic individual-level variables such as age, clinical T stage, histology, gender, interval from diagnosis to treatment, and insurance status were included. Variables characterizing the social environment, reported within NCDB as covariates clustered by zip-code, included the "great circle" distance to nearest hospital, education level, average household income, and institution type (community, academic, etc). Variables significant on univariable analyses were included in the models. The regression models adjusted for individual-level and zip code-level covariates. The potential interaction between race and type of hospital was explored with inclusion of the interaction term in the initial logistic regression model. Given the concern bladder cancer risk is not uniform across races and genders, sensitivity analyses including

factorial interaction terms were generated for potential race-gender, and race-comorbidity interactions. These were then tested in the regression models and found not to be statistically significant. These terms were thus excluded from the final regression models.

Additional sensitivity analyses were performed to examine the impact of the interaction between insurance and race on ApT by stratifying individuals into three insurance subgroups: uninsured/unknown, private, or government-funded. Multivariable logistic regression analyses adjusting for the same clinically relevant and demographic variables used in the main regression models were then performed within each subgroup.

A mixed effects logistic regression model was used to assess within-institution variance in rates of ApT. Within NCDB, each institution is identified by a unique identification number. This institution identification number was used to cluster patients by where they received treatment. The institution was used as the random effect to adjust for variation in practice patterns, resource availability and other differences between facilities that were not discretely measured. This approach allowed us to account for unmeasured health-related factors within neighborhoods which may influence regional/geographic differences in care. Subset analyses restricted to facilities that reported more than 10 bladder cancer cases and whose patient cohorts contained more 10 black patients were conducted to examine how the observed associations may differ in higher volume centers with reporting more diverse patient populations.

Results were interpreted for both clinical and statistical significance. Odds ratios (OR) were presented with 95% confidence intervals (CI) and p values. Statistical significance level was set at 0.05. Statistical analyses were performed using STATA 14.2 (StataCorp, College Station, TX).

RESULTS

The study cohort was comprised of 51,350 individuals with clinically staged non-metastatic, lymph node negative MIBC, representing patients treated at 1,268 unique facilities. The mean age was 72.6 years (SD 11.6) with a male predominance (71.4%). The majority of patients were healthy (CCI of zero, 68.6%) with fairly even distributions in terms of neighborhood-level household income and education levels. Table 1 shows demographic and clinical characteristics for the overall cohort and cohort stratified by race. The majority used Medicare as their primary insurance provider (67.6%) and lived in metropolitan counties (79.3%). Most were seen at either comprehensive community centers (46.1%) or academic facilities (34.9%) (Supplemental Figure 1a). ApT was more frequently reported at academic facilities (45.3%) followed by comprehensive community centers (39.7%). ApT was reported in less than ten percent of cases in community cancer centers (8.64%), integrated network centers (6.1%), and other facilities (0.25%, $p<0.001$). Overall, less than half of patients received ApT (42.6%). Supplementary Table S1 shows the treatments received by patients for the entire cohort and stratified by race.

Overall, black individuals comprised 6.4% of the cohort. Females comprised a higher percentage of black patients (43.7%) than white patients (27.5%, $p<.001$). Black individuals

were generally poorer than white individuals, lived in areas with a household income less than $38,000 per year (45.6% vs 16.5%, p<.001) and lower proportions of individuals with a high school education (37.3% for black vs 15.3%, p<.001). Medicare was the most common insurance provider across all race groups. Black individuals lived closer to their healthcare institution (5.7 miles vs 10 miles, p<.001) and were more often treated at academic facilities (44% vs 33.8%, p<.001) compared to white individuals (Supplemental Figure 1b). A smaller proportion of black individuals received ApT compared to their counterparts (37% vs 43%, p<.001).

Using a multivariable logistic regression model, socioeconomic factors such as increasing neighborhood-level household income, education level and good health (CCI 1 or less) were associated with increased odds of ApT (Table 2). Medicare was associated with greatest odds of ApT (OR 1.54, 95% CI 1.34–1.76, p<.001) followed by private insurance (OR 1.27, 95% CI 1.11–1.45, p=<.001) compared to being uninsured. Academic institutions were associated with the highest odds of ApT (OR 2.56, 95% CI 2.39–2.73, p<.001), followed by Integrated Cancer Networks (OR 1.55, 95% CI 1.41–1.70, p=<.001) compared to community hospitals. Women had 12% lower odds of ApT compared to men (OR 0.88, 95% CI 0.84–0.96, p<.001). Higher CCI was associated with lower odds of ApT (CCI 2+, OR 0.90, 95% CI 0.84–0.96, p=0.03) compared to a CCI score of zero. Black individuals had 28% lower odds of ApT (OR 0.72, 95% CI 0.67–0.79, p<.001) compared to white individuals. In a subset analysis of higher volume centers with more diverse patient populations, black race was associated with further reduced odds of ApT (OR 0.63, 95% CI 0.52–0.76, p<0.001) compared to white individuals after adjusting for clinical, demographic, pathologic, and social environment factors. Of individuals uninsured or with unknown insurance status, race was not significantly associated with receipt of ApT (p=0.5). Black individuals with private insurance had 27% lower odds of ApT compared to white individuals (OR 0.73, 95% CI 0.62–0.87, p<0.001). Black individuals with government funded insurance such as Medicaid or Medicare had 32% lower odds of ApT compared to white counterparts (OR 0.68, 95% CI 0.62–0.76, p<0.001).

Using a mixed effects logistic regression model (Table 2), we examined predictors of ApT when clustered by institution. Age (per decade increase, OR 0.69, 95% CI 0.68–0.71, p<.001) and CCI score maintained their associations with ApT (CCI 2+ OR 0.90, 95% CI 0.84–0.97, p=0.004; CCI 1, OR 1.11 95% CI 1.06–1.16, p<0.001). Neighborhood-level education level (p>0.5 for all strata) and rural city type (p=0.2) were no longer associated with ApT. Female gender (OR 0.87, 95% CI 0.84–0.91, p<.001) remained associated with decreased odds of ApT compared to male gender (Table 2). When clustered by institution, the odds of ApT were 21% lower for black individuals (OR 0.79, 95% CI 0.73–0.87, p<.001) compared to white counterparts. In a subset analysis of higher volume centers with more diverse patient populations, odds of ApT were 25% lower for black individuals (OR 0.75, 95% CI 0.61–0.91, p<0.01) compared to white counterparts after adjusting for clinical, demographic, pathologic, and social environment factors.

DISCUSSION

Our study shows less than half (42.6%) of individuals received ApT, with the lowest percentage (37%) in black individuals. Black race was associated with decreased odds of ApT at the national and when clustered by institution, after adjusting clinical characteristics, and neighborhood-level variables, and within-institution variations in practice. Black patients had 21% lower odds of ApT compared to their white counterparts with the same disease characteristics treated in the same institution. And this disparity is widened further to 25% when the analysis is restricted to higher volume institutions and 32% when restricted to individuals with government-funding insurance such as Medicaid or MediCare. Our findings suggest the presence of implicit bias may influence who receives standard, established treatment despite adequate access to care.

Previous studies have demonstrated how racial bias impacts medical treatment, irrespective of clinical indications[6–8]. Additional factors within a patient's social environment, such as the type of hospital providing care[9], provider density[10] and the travel burden to the nearest hospital have also been shown to dictate care more than race or biological factors [11]. Our study showed that factors such as private or government-funded insurance was associated with increased odds of ApT. Yet even amongst those with private insurance or government-funded insurance, black patients remained at decreased odds of ApT compared to white counterparts. Interestingly, it was only amongst the uninsured that race was not significantly associated with ApT. Perhaps, the interaction of race with these social determinants of health drive outcomes more than race alone. Specifically, in patients with MIBC, studies of regional cohorts have reported that black individuals underwent RC less frequently, and received lower quality of care when RC was performed (low yield lymph node dissection, low volume hospital, no continent diversion, etc) implicating race as a significant driver of disparity.[12–15] Numerous studies have acknowledged the relationship between socioeconomic factors and outcomes[16,17] although these commonly limit the quantification of SES to individual-level characteristics such as education and insurance. Corcoran et al looked at institution-level characteristics and reported the impact of hospital type on quality measures (such as receipt of neoadjuvant chemotherapy, time to treatment, and lymph node yield) for 23,279 patients with muscle-invasive urothelial carcinoma [9]. They noted that receiving treatment at an academic hospital was associated with the greatest odds of meeting these quality measures. Relying solely on patient-level factors such as education and insurance or only institution-specific factors may underestimate and obscure of the true effect of an individual's combined social environment [18,19]. When accounting for as many social determinants of health as possible, our findings support race as a significant driver of treatment disparities in a nationwide, contemporary cohort, inclusive of all guideline-based treatments for patients with MIBC.

Weiner et al also looked at racial disparities in outcomes for patients with stage III-IV bladder cancer, noting that black patients were more likely to present with later stage disease (OR 1.51, 95% CI 1.44–1.59, $p<0.001$) and experience delays in treatment (18.4% vs 12.7%, $p<0.001$) compared to white patients. Black patients were less likely to undergo cystectomy compared to white patients (18.3% vs 26.9%, $p<.001$) and worse three-year survival rates (16.2% vs 21.5%, $p<0.001$). The authors postulate that while lower SES

portends more advanced stage disease as well as poorer outcomes this may not completely explain the observed racial disparities, [2] reaching a conclusion concordant with ours. Similar observations have been described across almost every discipline in medicine. Recently, Friedlander et al used NCDB to demonstrate significant racial differences in institution-level rates of definitive treatment for prostate cancer, suggesting that these differences contribute to mortality differences observed between white and black men. [20] In 1999 Shulman et al conducted a survey-based study of physicians using simulated patients with chest pain to evaluate predictors of receiving treatment. [7] Black race was associated with 40% lower odds of a physicians' recommendation for cardiac catheterization (p=0.02), irrespective of clinical characteristics. Two studies, nearly twenty years later, continued to examine the impact of physician bias in treatment disparities. [6,21] Hoffman et al showed that half (50%) of medical students and residents harbored false beliefs of race-based biological differences between white and black patients in a survey-based study of pain perception and management. The authors noted that those who harbored these false beliefs both rated black patients as feeling less pain and exhibited lower accuracy in recommendations for pain management. A separate retrospective study of patients with acute myelogenous leukemia in the California Cancer Registry demonstrated that black patients had 26% lower odds of receiving treatment (p=0.004) and 38% lower odds receiving stem cell transplantation (p=0.005) compared to white patients in adjusted logistic regression models. The authors further report an increased risk of overall mortality (HR 1.14 95% CI 1.04–1.25, p=0.004), which is reduced to baseline when adjusted for receipt of treatment (HR 1.09, 95% CI 0.85–0.98, p=0.05).

In our cohort we identify significant racial disparity in receipt of guidelines-based treatment for patients with MIBC after adjusting for demographic, clinical, pathologic and social environment-related factors. As observed in various diseases, this disparity may confer a disproportionate increase in mortality risk. In the current era of improving cancer outcomes and providing value-based care, addressing implicit bias may provide an opportunity to improve outcomes for patients with bladder cancer. Yet we must acknowledge that racial bias is one of various factors which influence if and when care is delivered. A significant history of disenfranchisement leading to social and economic inequality, deep rooted distrust in the medical system, patient understanding and preferences, lack of social support, a poor provider-patient relationship, and various cultural beliefs may further exacerbate these disparities by dissuading black individuals from seeking and accepting appropriate therapies. Without confronting these issues, the medical community loses the opportunity to better educate both patients and providers while fostering more trusting relationships between communities and healthcare systems in order to deliver high-quality, guidelines-based care to patients with bladder cancer. Merely improving access by mechanisms such as the Affordable Care Act does not address underlying, and likely more important, disparities in care. If we are not delivering evidence-based care due to biases (after accounting for access and biology), then it is expected that patients will experience inferior outcomes. Acknowledgement of this bias is critical and future efforts must face this reality head on, starting with physicians. Efforts to address implicit and explicit bias within medical practitioners should be expanded, along with efforts to increase culture competence, education, and diversity within our discipline.

Our study does have limitations which should be considered. The lower rates of ApT could be affected by several factors which were unmeasured in our study such as provider knowledge of the most current guidelines, barriers to care, marital status, lack of social support, poor patient understanding or patient-provider relationships, or patient preferences. Some variation in the rates of specific treatment modalities can be attributed to the individualized risk assessment for complications, which may lead some providers to recommend treatments incongruent with guidelines although each of these are taken into account in our composite outcome measure. As a population level study, we have limited granularity in our observations. Yet the strengths of this study are important. This provides a population-level assessment of adherence to guidelines-based treatment for our cohort. Our analysis takes into account differences in physician preferences in treatment modalities by using a broad definition of ApT and adjusting for histologic type. Using a hierarchical approach, we are able to take into account provider-level differences within each hospital and adjust for community-level SES factors. We restricted our study to patients seen and diagnosed with MIBC, thereby limiting the impact of potential bias due to patient mistrust with doctors and treatment variation due to cancer stage. With further investigation we can adjust the current paradigm and reduce health disparities in outcomes for patients with bladder cancer.

CONCLUSION

Our findings show that black patients with non-metastatic MIBC are less likely to receive appropriate, guideline-based treatment than white patients despite adjustment for various clinical factors and social determinants of health. Future efforts should focus on addressing bias to reduce disparities in bladder cancer outcomes.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1.

Demographic, neighborhood, and clinical characteristics of the cohort and stratified by race continued

Characteristic, n (%)		Entire Cohort n = 51,350	White n = 46,573	Black n = 3,261	Other n = 1,516	p
Age, years (mean, SD)		72.6 (11.6)	72.9 (11.5)	70.1 (12.5)	71.3 (12.1)	<.001
Gender	Male	36,679 (71.4)	33,754 (72.5)	1,836 (56.3)	1,089 (71.8)	<.001
	Female	14,671 (28.6)	12,819 (27.5)	1,425 (43.7)	427 (28.2)	
Charlson Comorbidity Index	0	35,225 (68.6)	31,941 (68.6)	2,165 (66.4)	1,119 (73.8)	<.001
	1	11,739 (22.9)	10,677 (22.9)	759 (23.3)	303 (20)	
	2+	4,386 (8.5)	3,955 (8.5)	337 (10.3)	94 (6.2)	
Annual household income *	<$38,000	9,379 (18.3)	7,702 (16.5)	1,486 (45.6)	191 (12.6)	<.001
	$38,000–47,999	12,683 (24.7)	11,636 (25)	746 (22.9)	301 (19.9)	
	$48,000–62,999	13,816 (26.9)	12,819 (27.5)	575 (17.6)	422 (27.8)	
	≥$63,000	15,472 (30.1)	14,416 (31)	454 (13.9)	602 (39.7)	
% without HS education *	>21%	8,634 (16.8)	7,127 (15.3)	1,216 (37.3)	291 (19.2)	<.001
	13–20.9%	13,169 (25.7)	11,652 (25)	1,174 (36)	343 (22.6)	
	7–12.9%	17,570 (34.2)	16,492 (35.4)	588 (18)	490 (32.3)	
	<7%	11,977 (23.3)	11,302 (24.3)	283 (8.7)	392 (25.9)	
Insurance status	Not Insured	1,139 (2.2)	943 (2)	145 (4.5)	51 (3.4)	<.001
	Private Insurance	12,568 (24.5)	11,424 (24.5)	750 (23)	394 (26)	
	Medicaid	1,681 (3.3)	1,285 (2.8)	262 (8)	134 (8.8)	
	Medicare	34,733 (67.6)	31,863 (68.4)	1,996 (61.2)	874 (57.7)	
	Other Government	465 (0.9)	408 (0.9)	37 (1.1)	20 (1.3)	
	Unknown/Not reported	764 (1.5)	650 (1.4)	71 (2.2)	43 (2.8)	
Miles to hospital, median (IQR)		9.5 (4.1–25.2)	10 (4.2–26.1)	5.7 (2.8–13.2)	8.7 (3.8–24.2)	<.001
	< 10 miles	25,752 (50.2)	22,753 (48.9)	2,194 (67.28)	805 (53.1)	<.001
	10–50 miles	18,085 (35.2)	16,814 (36.1)	781 (24)	490 (32.2)	
	> 50 miles	7,513 (14.6)	7,006 (15)	286 (8.8)	221 (14.6)	
Year of Diagnosis, median (IQR)		2009 (2006–2011)	2009 (2006–2011)	2009 (2006–2011)	2009 (2007–2011)	0.6
City Type	Metropolitan	40,729 (79.3)	36,559 (78.5)	2,875 (88.2)	1,295 (85.4)	<.001
	Urban	7,587 (14.8)	7,713 (15.4)	262 (8)	152 (10)	
	Rural	3,034 (5.9)	2,841 (6.1)	124 (3.8)	69 (4.6)	
Hospital Type	Community	6,308 (12.3)	5,772 (12.4)	376 (11.6)	160 (10.7)	<.001
	Comprehensive Community	23,573 (46.1)	21,913 (47.2)	1,185 (36.7)	475 (31.8)	
	Academic	17,834 (34.9)	15,675 (33.8)	1,424 (44.1)	735 (49.1)	
	Integrated Cancer Network	3,319 (6.5)	2,948 (6.4)	245 (7.6)	126 (8.4)	
	Other	83 (0.2)	81 (0.2)	2 (0.1)	0 (0)	
Histology present	Urothelial CA	46,003 (89.6)	41,884 (89.9)	2,809 (86.1)	1,350 (89.1)	<.001
	Variant	5,347 (10.4)	4,729 (10.2)	452 (13.9)	166 (11)	
Mean days from diagnosis to ApT		11.3 (25.5)	10.2 (30.4)	11.2 (28.2)	11.3 (25.5)	.03

Characteristic, n (%)		Entire Cohort n = 51,350	White n = 46,573	Black n = 3,261	Other n = 1,516	p
Appropriate treatment received	Yes	21,867 (42.6)	20,010 (43)	1,205 (37)	652 (43)	<.001

Year of diagnosis not shown

Abbreviations: HS, high school; CA, carcinoma; ApT, appropriate treatment

* variables based on neighborhood-level measures

Table 2.

Predictors of ApT using multivariable logistic regression and predictors of ApT within each facility using mixed effects logistic regression model

		Logistic Regression			Mixed Effects Logistic Regression		
Characteristic, n (%)		**OR**	**95% CI**	**p**	**OR**	**95% CI**	**p**
Age, years (per 10 year increase)		0.67	0.65–0.68	<.001	0.69	0.68–0.71	<.001
Gender	Male (ref)	-	-	-	-	-	-
	Female	0.88	0.84–0.96	<.001	0.87	0.84–0.91	<.001
Charlson Comorbidity Index	0 (ref)	-	-	-	-	-	-
	1	1.10	1.06–1.16	<.001	1.11	1.06–1.16	<.001
	2+	0.90	0.84–0.96	0.03	0.90	0.84–0.97	0.004
Annual household income *	<$38,000 (ref)	-	-	-	-	-	-
	$38,000–47,999	1.10	1.03–1.17	0.004	1.09	1.01–1.16	0.02
	$48,000–62,999	1.09	1.02–1.16	0.02	1.11	1.03–1.20	0.005
	≥$63,000	0.97	0.90–1.05	0.41	1.05	0.96–1.15	0.3
% without HS education *	>21% (ref)	-	-	-	-	-	-
	13–20.9%	1.05	0.99–1.12	0.12	1.01	0.94–1.09	0.7
	7–12.9%	1.09	1.02–1.17	0.01	1.02	0.94–1.10	0.7
	<7%	1.17	1.08–1.27	<.001	1.04	0.95–1.14	0.4
Race	White (ref)	-	-	-	-	-	-
	Black	0.72	0.67–0.79	<.001	0.79	0.73–0.87	<.001
	Other	0.91	0.81–1.02	0.11	0.92	0.81–1.04	0.2
Insurance status							
	Not Insured (ref)	-	-	-	-	-	-
	Private Insurance	1.27	1.11–1.45	<.001	1.15	1.00–1.32	0.04
	Medicaid	1.05	0.89–1.24	0.54	1.04	0.88–1.24	0.6
	Medicare	1.54	1.34–1.76	<.001	1.37	1.19–1.58	<.001
	Other Government	1.26	1.00–1.59	0.05	1.14	0.89–1.46	0.3
	Unknown/Not reported	1.02	0.83–1.26	0.83	0.96	0.77–1.20	0.7
Distance to hospital (per mile increase)		1.00	1.00–1.00	<.001	1.00	1.00–1.00	0.05
Days from diagnosis to ApT		1.00	1.00–1.00	<.001	1.00	1.00–1.00	0.02
City Type	Metropolitan (ref)	-	-	-	-	-	-
	Urban	1.13	1.07–1.20	<.001	1.08	1.01–1.15	0.03
	Rural	1.13	1.03–1.25	0.01	1.08	0.97–1.21	0.2
Hospital Type	Community (ref)	-	-	-	-	-	-
	Comprehensive Community	1.36	1.27–1.45	<.001	-	-	-
	Academic	2.56	2.39–2.73	<.001	-	-	-
	Integrated Cancer Network	1.55	1.41–1.70	<.001	-	-	-
	Other	3.64	2.28–5.81	<.001	-	-	-

		Logistic Regression			Mixed Effects Logistic Regression		
Characteristic, n (%)		**OR**	**95% CI**	**p**	**OR**	**95% CI**	**p**
Histology	Urothelial CA (ref)	-	-	-	-	-	-
	Variant	0.93	0.88–0.99	0.04	0.93	0.88–0.99	0.04

Adjusted for year of diagnosis.

Abbreviations: HS, high school; CA, carcinoma

* variables based on neighborhood-level measures