Original Article

National Sociodemographic Disparities in the Treatment of High-Risk Prostate Cancer: Do Academic Cancer Centers Perform Better Than Community Cancer Centers?

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BACKGROUND: Most major cancer organizations seek to reduce sociodemographic disparities in high-risk cancers partly by increasing access to theoretically high-quality, academic-oriented cancer care. The objective of this study was to determine whether academic centers have less sociodemographic treatment disparities than community centers using high-risk prostate cancer as a test case. **METHODS:** The National Cancer Data Base was used to identify 138,019 patients who were diagnosed with nonmetastatic, high-risk prostate cancer from 2004 to 2012. Multivariable logistic analysis was used to identify independent determinants of definitive therapy. The Gray test and multivariable Cox regression were used to analyze the timing of therapy. All analyses were stratified by academic versus community cancer center. **RESULTS:** Compared with white or privately insured patients, black, Hispanic, and uninsured patients with prostate cancer were less likely to receive definitive therapy at both community centers (adjusted odds ratio: 0.60 [95% confidence interval (CI), 0.56-0.64], 0.69 [95% CI, 0.61-0.78], and 0.25 [95% CI, 0.22-0.30], respectively) and academic cancer centers (adjusted odds ratio: 0.50 [95% CI, 0.46-0.54], 0.56 [95% CI, 0.50-0.64], and 0.31 [95% CI, 0.28-0.36], respectively). Among patients who received definitive therapy, black, Hispanic, and uninsured patients were more likely to experience treatment delays at both community centers ($\geq$15, $\geq$10, and $\geq$19 days, respectively; all Gray $P<.001$) and academic centers ($\geq$19, $\geq$11, and $\geq$18 days, respectively); treatment delays were observed among the aforementioned groups even after multivariable Cox regression analysis ($P<.001$ for all adjusted hazard ratios). **CONCLUSIONS:** Nationally, academic cancer centers demonstrate similarly high rates of sociodemographic disparities in cancer treatment patterns as community cancer centers. Making community centers conform to academic center standards may not necessarily reduce treatment disparities. ***Cancer*** **2016;122:3371-7.** © *2016 American Cancer Society.*

KEYWORDS: academic center, community center, disparities, National Cancer Data Base, patterns of care, prostatic neoplasm.

INTRODUCTION

In 2015, there were 220,800 new cases of prostate cancer and 27,500 deaths from prostate cancer in the United States alone, making prostate cancer the most common noncutaneous cancer among men in the United States.[1] Reducing sociodemographic disparities in high-risk cancers has been a major goal of the American Cancer Society and other major cancer organizations for the last 2 decades.[2-4] Despite this goal and evidence that minority black men suffer poorer prostate cancer outcomes, there have been persistent sociodemographic disparities in the management of prostate cancer without significant changes in these patterns of care over the last decade.[5-9] Disparities in cancer care certainly present a barrier to mitigating disparities in cancer outcome, although it is unclear whether reducing disparities in care patterns would actually translate to better cancer outcomes. Differences in quality of care may contribute to observed disparities in treatment patterns and outcomes; and, theoretically, equal access to high-quality academic centers could act to reduce or neutralize the burden of disparities of high-risk cancers.[3,7] Although it has not been established that there are quality differences between the academic and community settings, 1 of the major objectives of the National Cancer Institute's Community Oncology

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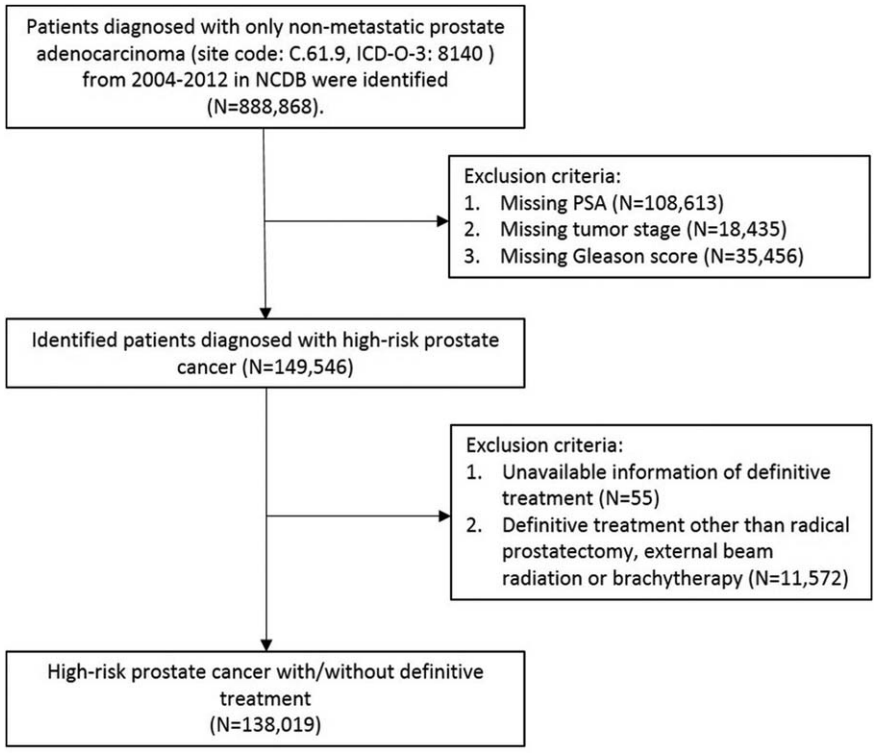

Figure 1. The study selection criteria are illustrated. ICD-O-3 indicates *International Classification of Diseases for Oncology, 3rd edition*; NCDB, National Cancer Data Base; PSA, prostate-specific antigen.

Research Program (NCORP) is to reduce cancer disparities by increasing uptake of effective, research-oriented cancer care and practices into routine community care.[4,10]

Herein, we used the National Cancer Data Base (NCDB), which is recognized as the largest national cancer database in the United States (in terms of number of cases collected),[11] to evaluate national disparities in the management patterns of a high-risk cancer as stratified by hospital type: community versus academic cancer center. In doing so, we sought to determine whether national racial and sociodemographic disparities in treatment patterns of high-risk prostate cancer differ between academic versus community cancer centers.

MATERIALS AND METHODS

Study Population

Our study population was derived from the NCDB,[11] which was created by the joint effort of the Commission on Cancer (CoC) and the American Cancer Society. The NCDB is a nationwide, hospital-based database that captures 70% of newly diagnosed cancers in the United States (all patients are diagnosed and treated at CoC-accredited cancer programs). Patients diagnosed with nonmetastatic, high-risk prostate cancer (with at least 1 high-risk factor: prostate-specific antigen [PSA] $>$ 20 ng/mL, or Gleason score 8-10, or clinical tumor classification $\geq$cT3a)[12] from 2004 through 2012 were identified from the database for study purposes. We restricted our study population to only 1 cancer diagnosis: prostatic adenocarcinoma. We excluded patients with unknown tumor classification, Gleason score, or PSA level and patients without available definitive treatment information. Selection criteria for the study are displayed in Figure 1. The institutional review board of our facility approved this study.

Statistical Analysis

Descriptive statistics were used to present the baseline characteristics. Categorical variables were assessed with the chi-square test, and continuous variables were compared using the Student *t* test or the Mann-Whiney *U* test, as appropriate. Receipt of definitive therapy was defined as receipt of either radical prostatectomy or radiation therapy plus androgen-deprivation therapy, as defined by the NCDB (notably, there is no time limit to when first-course treatment is captured, although most

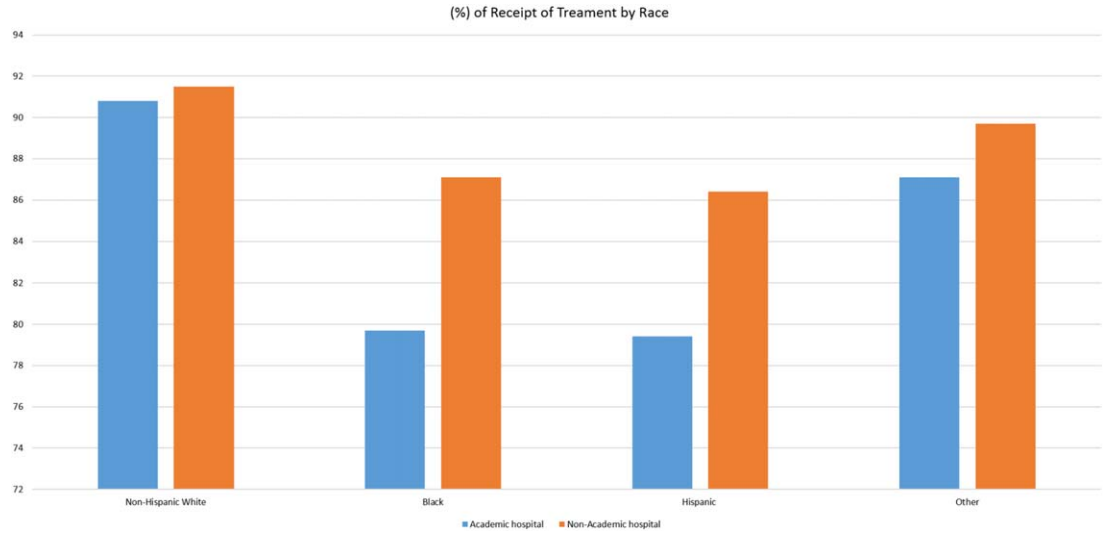

Figure 2. The rate of definitive therapy (with either radical prostatectomy or radiation therapy plus androgen-deprivation therapy) is illustrated stratified by race (N = 138,019).

first-course treatment in the NCDB is received within 1year of diagnosis, which was the case in our study population). We used multivariable logistic regression to identify the independent predictors for receipt of treatment. Univariable cumulative incidence functions were used to illustrate the timing of definitive therapy stratified by race and hospital type. Multivariable Cox regression was applied to determine adjusted hazard ratios for the time to receipt of definitive treatment. For the sensitivity analysis, all aforementioned analyses were repeated stratified by age group (ages ≤ 70 years and >70 years).

Demographic covariates that were assessed in the multivariable regression analyses included age, race, insurance status, residence type, distance to the reporting hospital, household income, and the percentage of education level less than high school for each patient's area of residence; clinical variables included Charlson-Deyo comorbidity score (0, 1, ≥ 2), tumor classification, PSA level, Gleason score, and hospital setting (academic vs nonacademic). Distance to the reporting hospital was categorized into tertiles (first tertile, ≤ 6.7 miles; second tertile, 6.7-20.4 miles; third tertile, >20.4 miles). Household income and the percentage of education level less than high school for each patient's area of residence were based on 2012 American Community Survey data, and residence type was based on the 2003 US Department of Agriculture Economic Research Service. All statistical analyses were performed using the software package SAS version 9.4. (SAS Institute Inc., Cary, NC). For all analyses, 2-sided P values $< .05$ were considered statistically significant.

RESULTS

Baseline Patient Characteristics

Definitive therapy rates for high-risk prostate cancer were 87.8% at academic cancer centers and 90.6% at community cancer centers. White patients had similarly high rates of definitive therapy at both academic and community centers (90.8% and 91.5%, respectively), whereas black and Hispanic patients who were treated at academic hospitals received definitive therapy 79.7% and 79.4% of the time, respectively, versus 87.1% and 86.4%, respectively, at community centers ($P < .001$) (Fig. 2). Patients who received treatment at academic centers were younger, more racially diverse, and more likely to come from metropolitan areas compared with those who received treatment at community cancer centers (all $P < .001$) (Table 1). All clinical characteristics, including PSA, Gleason score, T-classification, and Charlson comorbidity score, were clinically similarly yet differed statistically between patients who received treatment at academic versus community cancer centers.

Sociodemographic Disparities in Receipt of Prostate Cancer Stratified by Treatment Facility Type

After robust multivariable adjustment for clinical and sociodemographic factors, compared with white or privately insured patients, black, Hispanic, and uninsured patients were less likely to receive definitive therapy at both community cancer centers (adjusted odds ratio [AOR]: 0.60 [95% confidence interval (CI), 0.56-0.64], 0.69 [95% CI, 0.61-0.78], and 0.25 [95% CI, 0.22-

TABLE 1. Patient Baseline Characteristics by Hospital Type

Characteristic	No. of Patients (%)		*P*
	Academic Cancer Center, N = 50,319	Community Cancer Center, N = 87,700	
Treatment status			
Received definitive treatment	44,179 (87.8)	79,416 (90.6)	< .0001
No treatment	6122 (12.2)	8284 (9.5)	
Age, y: Mean [95% CI]	65.4 [65.3-65.4]	67.2 [67.1-67.3]	< .0001
Race			< .0001
Non-Hispanic white	34,957 (69.5)	68,384 (78)	
Black	9697 (19.3)	12,429 (14.2)	
Hispanic	2258 (4.5)	3356 (3.8)	
Other	2162 (4.3)	2420 (2.8)	
Unknown	1245 (2.5)	1111 (1.3)	
PSA: Median/IQR, ng/mL	12.6/28.7	13.7/29.8	< .0001
Gleason score			< .0001
≤6	6125 (12.2)	12,706 (14.5)	
7	11,514 (22.9)	19,052 (21.7)	
8-10	32,680 (65)	55,942 (63.8)	
Tumor classification			< .0001
T1	24,427 (48.5)	41,119 (46.9)	
T2	16,867 (33.5)	32,088 (36.6)	
T3	8476 (16.8)	13,490 (15.4)	
T4	549 (1.1)	1003 (1.1)	
Charlson score			< .0001
0	43,239 (85.9)	73,839 (84.2)	
1	6079 (12.1)	11,733 (13.4)	
≥2	1001 (2)	2128 (2.4)	
Insurance status			< .0001
None	1655 (3.3)	1471 (1.7)	
Private	22,670 (45.1)	34,305 (39.1	
Medicaid	1907 (3.8)	2067 (2.4)	
Medicare	21,774 (43.3)	47,146 (53.8)	
Other government	1080 (2.2)	1535 (1.8)	
Unknown	1233 (2.5)	1176 (1.3)	
Distance to facility			< .0001
First tertile: ≤ 6.7 miles	15,917 (31.6)	34,950 (39.9)	
Second tertile: 6.7-20.4 miles	15,294 (30.4)	30,377 (34.6)	
Third tertile: > 20.4 miles	19,108 (38)	22,373 (25.5)	
Median household income[a]			< .0001
<$38,000	8740 (17.4)	15,610 (17.8)	
$38,000-$47,999	9806 (19.5)	22,067 (25.2)	
$48,000-$62,999	12,192 (24.2)	23,856 (27.2)	
≥$63,000	18,859 (37.5)	24,737 (28.2)	
Unknown	722 (1.4)	1430 (1.6)	
Percentage with less than a high school education			< .0001
≥21%	8317 (16.5)	14,628 (16.7)	
13%-20.9%	11,708 (23.3)	22,581 (25.8)	
7%-12.9%	14,979 (29.8)	28,866 (32.9)	
<7%	14,627 (29.1)	20,249 (23.1)	
Unknown	688 (1.4)	1376 (1.6)	
Residence type			< .0001
Metropolitan	42,527 (84.6)	65,000 (74.1)	
Urban	5596 (11.1)	17,062 (19.5)	
Rural	679 (1.4)	2725 (3.1)	
Unknown	1497 (3)	2913 (3.3)	

Abbreviations: CI, confidence interval; IQR, interquartile range; PSA, prostate-specific antigen.
[a] Percentages may not sum to 100% because of rounding.

0.30], respectively; all $P < .001$) and academic cancer centers (AOR: 0.50 [95% CI, 0.46-0.54], 0.56 [95% CI, 0.50-0.64], and 0.31 [95% CI, 0.28-0.36], respectively; all $P < .001$) (Table 2).

Sociodemographic Disparities in the Timing of Treatment Stratified by Treatment Facility Type

The median time to receipt of definitive treatment among patients who ultimately received definitive therapy was 83

TABLE 2. Multivariable Logistic Regression Models for Receipt of Definitive Treatment by Hospital Type and Multivariable Cox Regression Models for the Time to Receipt of Definitive Treatment by Hospital Type, N = 138,019[a]

	Academic Cancer Center		Community Cancer Center	
Variable	AOR for Receipt of Definitive Therapy (95% CI)[b]	AHR for Time to Receipt of Definitive Therapy (95% CI)[b]	AOR for Receipt of Definitive Therapy (95% CI)[b]	AHR for Time to Receipt of Definitive Therapy (95% CI)[b]
Race				
Black	0.50 (0.46-0.54)	0.75 (0.73-0.77)	0.60 (0.56-0.64)	0.78 (0.76-0.80)
Hispanic	0.56 (0.50-0.64)	0.91 (0.86-0.96)	0.69 (0.61-0.78)	0.91 (0.87-0.95)
Other	0.86 (0.75-0.99)[c]	1.03 (0.98-1.08)	0.99 (0.85-1.14)	0.90 (0.85-0.94)
Non-Hispanic white	Ref	Ref	Ref	Ref
Insurance status				
None	0.31 (0.28-0.36)	0.75 (0.70-0.79)	0.25 (0.22-0.30)	0.77 (0.72-0.82)
Medicaid	0.47 (0.42-0.54)	0.79 (0.75-0.84)	0.41 (0.36-0.47)	0.75 (0.72-0.80)
Medicare	1.16 (1.07-1.25)	0.89 (0.87-0.92)	1.09 (1.02-1.17)	0.92 (0.90-0.94)
Other government	2.75 (2.03-3.73)	0.64 (0.60-0.69)	1.77 (1.36-2.31)	0.66 (0.62-0.70)
Private	Ref	Ref	Ref	Ref
Distance to facility				
Third tertile: > 20.4 miles	1.19 (1.10-1.30)	1.00 (0.98-1.03)	1.24 (1.15-1.33)	1.02 (0.99-1.04)
Second tertile: 6.7-20.4 miles	1.07 (0.99-1.16)[d]	0.99 (0.96-1.01)	1.07 (1.01-1.13)[e]	1.01 (0.99-1.03)
First tertile: ≤ 6.7 miles	Ref	Ref	Ref	Ref

Abbreviations: AOR, adjusted odds ratio; AHR, adjusted hazard ratio; CI, confidence interval; Ref, reference category.
[a] The model was adjusted for age, race, prostate-specific antigen level, Gleason score, T-classification, Charlson score, insurance status, distance to facility, facility location, household income, education level, and residence type.
[b] Unless indicated otherwise, for all CIs that do not include 1.0, $P < .001$.
[c] $P = .04$.
[d] $P = .06$.
[e] $P = .023$.

days after diagnosis, regardless of race or hospital setting. In academic centers, the median time to receipt of definitive treatment among white patients was 83 days versus 102 days for black patients and 94 days for Hispanic patients (Gray $P < .001$) (Fig. 3A). In community centers, the median time to receipt of definitive therapy among white patients was 77 days versus 92 days among black patients and 87 days among Hispanic patients (Gray $P < .001$) (Fig. 3B).

Even after robust multivariable adjustments, black, Hispanic, and uninsured patients were still less likely to receive timely definitive therapy at both community (adjusted hazard ratio [AHR]: 0.78 [95% CI, 0.76-0.80], 0.91 [95% CI, 0.87-0.95], and 0.77 [95% CI, 0.72-0.82], respectively; all $P < .001$) and academic cancer centers (AHR: 0.75 [95% CI, 0.73-0.77], 0.91 [95% CI, 0.86-0.96], and 0.75 [95% CI, 0.70-0.79], respectively; all $P \leq .001$]) (Table 2).

Sensitivity Analysis

All aforementioned analyses, including both multivariable analyses for the receipt of definitive treatment and multivariable Cox models for the time to receipt of treatment, were repeated stratified by age (ages ≤ 70 and >70 years), and there were no differences in any of the findings according to age group.

DISCUSSION

We used the nation's largest cancer registry to evaluate contemporary national disparities in the management patterns of high-risk cancer as stratified by hospital type. Given the size and comprehensive nature of the NCDB, the patterns of care described in this study are likely the best available estimation and reflection of national disparities in high-risk prostate cancer patterns of care across academic and community cancer centers.

In this study, we observed that black and Hispanic patients had nearly one-half the odds of receiving definitive therapy relative to white patients across both community and academic cancer centers. Similarly, uninsured patients had nearly one-fourth the odds of receiving definitive therapy relative to privately insured patients across both community and academic cancer centers. Furthermore, black, Hispanic, and uninsured patients all were more likely to experience significant delays in receipt of treatment compared with white or privately insured

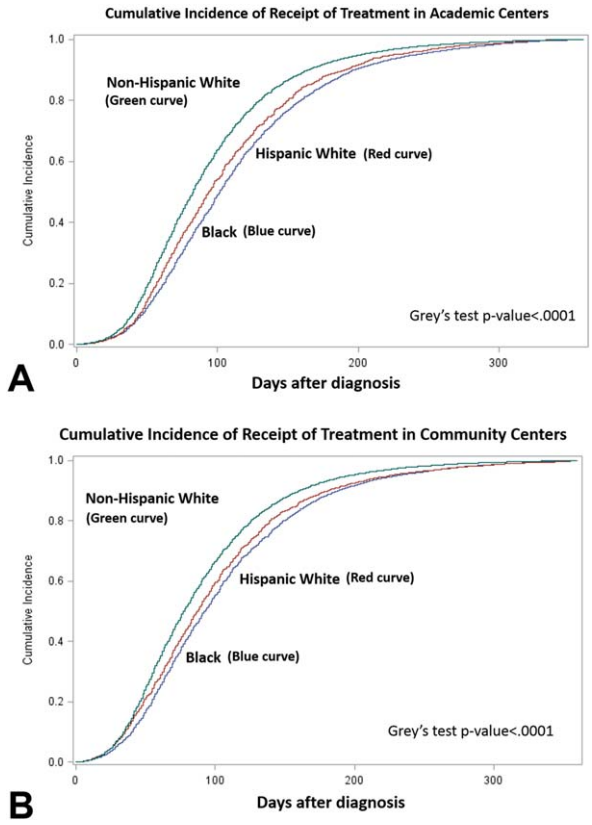

Figure 3. The cumulative incidence of receipt of definitive treatment is illustrated in (A) academic centers (N = 42,769) and (B) community centers (N = 76,792) stratified by race.

patients across both community and academic cancer centers.

Our study highlights the novel finding that academic cancer centers are not performing better than community cancer centers when it comes to disparities in cancer treatment patterns for high-risk cancers. Academic cancer centers, in fact, have strikingly similar rates of disparities in the treatment of minorities and uninsured patients with high-risk prostate cancer compared with community cancer centers. These results have major implications for ongoing efforts by many major national cancer organizations that seek to reduce or eliminate disparities in cancer treatment patterns and outcomes. Specifically, our results suggest that more will need to be done than simply increasing access to high-quality research-focused cancer centers, which is 1 of the major aims of the NCORP as a part of the National Cancer Institute's initiative to reduce cancer disparities.[4,10]

The finding that disparities exist across cancer care centers, regardless of academic versus community center structure, suggests that there may be something intrinsic about systemic, provider-level, or patient-level issues that may be interfering with treatment. It may be the case that the systems involved with cancer care are incredibly complex to navigate and that patients from more at-risk groups are more likely to receive later diagnoses, not receive proper treatment, or be lost to follow-up. It has been suggested and demonstrated that patient navigators may help to reduce cancer care disparities by helping those patients who are most at risk of receiving substandard care because of the complex systems of cancer care.[13,14] Alternatively, it is possible that there may be differences in treatment because of patient preferences, or even physician bias.[15,16]

Both community and academic centers need to identify and address the issues and processes that are leading to racial and sociodemographic differences in the treatment of high-risk cancers. Although this study may be the first and certainly the largest national study to demonstrate similar rates of disparity across community and academic centers, current national cancer registry studies are not able to comprehensively identify the processes that lead to the observed disparities. Researchers from the National Health Institute, however, have recently developed Cancer Care Delivery Research, which focuses on how systems, processes of care, delivery models, financing and reimbursement, available treatments, and both physician and patients attitudes, beliefs, and behaviors contribute to access to cancer care and cancer outcomes.[17] Cancer Care Delivery Research or a similar type of research should be implemented at both community and academic cancer centers to elucidate the factors that are leading to sociodemographic differences in the management of high-risk cancers. Once these factors are identified, interventions and programs can be tailored to address those factors in an effort to reduce disparities in the treatment and outcomes of cancer.

Our results must be viewed within the limitations of this study. The NCDB is a hospital-based cancer registry that only captures patients diagnosed and treated at CoC-accredited cancer programs and not from those that are not accredited by the CoC; therefore, our data may not reflect trends from smaller cancer centers. Nevertheless, the NCDB is recognized as the nation's largest cancer registry, capturing 70% of incident cancers, and as such represents 1 of the best databases with which to analyze national patterns of care in cancer treatment disparities. Furthermore, we were still able to capture disparities in the management of high-risk prostate cancer at both CoC-accredited academic and community cancer centers, and it should be expected that other non-CoC–accredited centers would have similar rates of disparities.

Despite the potential limitations, our study is the first NCDB report on national disparities in the treatment of a high-risk cancer stratified by hospital type. Nationally, academic cancer centers demonstrate similarly high rates of racial and sociodemographic disparities in cancer treatment patterns compared with community cancer centers. Making community centers conform to academic center standards may not necessarily reduce treatment disparities, and both academic and community cancer centers must work on identifying and addressing processes that lead to disparities in the treatment of aggressive cancers.

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CONFLICT OF INTEREST DISCLOSURES

James B. Yu reports funding from 21st Century Oncology outside the submitted work. Paul L. Nguyen reports consulting fees from Medivation/Astellas and Genome Dx outside the submitted work. Felix Y. Feng reports grants and consulting fees from Medivation/Astellas and Varian and consulting fees from Celgene and Genome Dx outside the submitted work.

AUTHOR CONTRIBUTIONS

All authors (**Brandon A. Mahal, Yu-Wei Chen, Vinayak Muralidhar, Amandeep R. Mahal, Toni K. Choueiri, Karen E. Hoffman, Jim C. Hu, Christopher J. Sweeney, James B. Yu, Felix Y. Feng, Simon P. Kim, Clair J. Beard, Neil E. Martin, Quoc-Dien Trinh**, and **Paul L. Nguyen)** participated in some way to the conception and design of this study and in the drafting and critical revision of the article. All authors also contributed to some aspect of the technical, administrative, or material support of this article. **Brandon A. Mahal, Yu-Wei Chen**, and **Paul L. Nguyen** had full access to all data in the study and take responsibility for the integrity of the data and accuracy of the data analysis.

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