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original contributions

Socioeconomic and Racial Determinants of Brachytherapy Utilization for Cervical Cancer: Concerns for Widening Disparities

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QUESTION ASKED: What factors are associated with declining brachytherapy (BT) utilization for cervical cancer (CC) and are racial and socioeconomic inequities in survival outcomes related to BT utilization?

SUMMARY ANSWER: Increasing age, Black or unknown race, Medicaid or no insurance, and increasing American Joint Committee on Cancer (AJCC) stage were associated with decreased BT utilization. Significant racial survival differences were noted between Black and White patients; however, these differences were eliminated when our comparison was restricted to patients who received both external beam radiation therapy (EBRT) and BT, suggesting that BT can independently correct racially driven survival inequities.

WHAT WE DID: We analyzed 7,266 patients with stage I-IV CC from the SEER database diagnosed between 2007 and 2015. Demographic and disease characteristics were examined for their association with BT use. Overall survival (OS) and disease-specific survival (DSS) were compared between patients who received EBRT alone versus EBRT and BT. Finally, we examined the impact of BT use on racial driven survival differences noted on our multivariate analysis.

WHAT WE FOUND: More than 47% of patients did not receive BT as a component of their treatment. Increasing age, Black or unknown race, Medicaid or no insurance, and increasing AJCC stage were associated with decreased BT utilization. EBRT + BT demonstrated superior OS and DSS compared with EBRT alone, with the 5-year OS of 58.8% versus 40.5% and the 5-year DSS of 67.0% versus 51.8%, respectively ($P < .0001$). On multivariate logistic regression analysis, Medicaid versus private insurance (hazard ratio [HR], 1.14; 95% CI, 1.04 to 1.25; $P = .007$), Black versus White race (HR, 1.13; 95% CI, 1.02 to 1.26; $P < .001$), and increasing AJCC stage ($P < .001$) were associated with inferior DSS-specific survival, whereas the use of EBRT + BT versus EBRT alone (HR, 0.61; 95% CI, 0.56 to 0.66; $P < .001$) and Other versus White race (HR, 0.84; 95% CI, 0.72 to 0.98; $P < .001$) was associated with improved DSS. When comparing racial survival differences, the 5-year OS was 44.2% versus 50.9% ($P < .0001$) and the 5-year DSS was 55.6% versus 60.5% ($P < .0001$) for Black and White patients, respectively. Importantly, the racial survival disparities resolved when examining patients who received combined EBRT + BT, with the 5-year OS of 57.3% versus 58.5% ($P = .24$) and the 5-year DSS of 66.3% versus 66.6% ($P = .53$) for Black and White patients, respectively.

BIAS, CONFOUNDING FACTORS, REAL-LIFE IMPLICATIONS: BT is a vital component of standard-of-care therapy for locally advanced CC. Despite its benefits, BT utilization has been declining. CC exhibits notable racial inequities in terms of survival outcomes because of a number of factors including screening rates, vaccination use, and access to appropriate care. Our work confirms notable inequities in terms of utilization of BT for Black and minority women, as well as those with lower insurance status, which unfortunately is directly associated with inferior oncologic outcomes. Importantly, when the use of BT is corrected for, racially driven survival differences no longer exist (Fig). This highlights the importance of BT in the management of CC and demonstrates the need to address access-of-care issues that minority and economically disadvantaged women face.

ASSOCIATED CONTENT

Appendix

Author affiliations and disclosures are available with the complete article at ascopubs.org/journal/op.

Accepted on July 6, 2021 and published at ascopubs.org/journal/op on September 22, 2021: Full-length article available online at DOI https://doi.org/10.1200/OP.21.00291

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abstract

PURPOSE Cervical cancer (CC) disproportionately affects minorities who have higher incidence and mortality rates. Standard of care for locally advanced CC involves a multimodality approach including brachytherapy (BT), which independently improves oncologic outcomes. Here, we examine the impact of insurance status and race on BT utilization with the SEER database.

MATERIALS AND METHODS In total, 7,266 patients with stage I-IV CC diagnosed from 2007 to 2015 were included. BT utilization, overall survival (OS), and disease-specific survival (DSS) were compared.

RESULTS Overall, 3,832 (52.7%) received combined external beam radiation therapy (EBRT) + BT, whereas 3,434 (47.3%) received EBRT alone. On multivariate logistic regression analysis, increasing age (OR, 0.98; 95% CI, 0.98 to 0.99; $P < .001$); Medicaid (OR, 0.80; 95% CI, 0.72 to 0.88; $P < .001$), uninsured (OR, 0.67; 95% CI, 0.56 to 0.80; $P < .001$), and unknown versus private insurance (OR, 0.61; 95% CI, 0.43 to 0.86; $P < .001$); Black (OR, 0.68; 95% CI, 0.60 to 0.77; $P < .001$) and unknown versus White race (OR, 0.30; 95% CI, 0.13 to 0.77; $P = .047$); and American Joint Committee on Cancer stage II (OR, 1.07; 95% CI, 0.93 to 1.24; $P = .36$), stage III (OR, 0.82; 95% CI, 0.71 to 0.94; $P = .006$), stage IV (OR, 0.30; 95% CI, 0.23 to 0.40; $P < .001$), and unknown stage versus stage I (OR, 0.36; 95% CI, 0.28 to 0.45; $P < .001$) were associated with decreased BT utilization. When comparing racial survival differences, the 5-year OS was 44.2% versus 50.9% ($P < .0001$) and the 5-year DSS was 55.6% versus 60.5% ($P < .0001$) for Black and White patients, respectively. Importantly, the racial survival disparities resolved when examining patients who received combined EBRT + BT, with the 5-year OS of 57.3% versus 58.5% ($P = .24$) and the 5-year DSS of 66.3% versus 66.6% ($P = .53$) for Black and White patients, respectively.

CONCLUSION This work demonstrates notable inequities in BT utilization for CC that particularly affects patients of lower insurance status and Black race, which translates into inferior oncologic outcomes. Importantly, the use of BT was able to overcome racial survival differences, thus highlighting its essential value.

JCO Oncol Pract 17:e1958-e1967. © 2021 by American Society of Clinical Oncology

INTRODUCTION

Cervical cancer (CC) is the fourth most common cancer and the second leading cause of cancer mortality among middle-age women in the United States.[1,2] Most patients present with locally advanced disease for which the standard of care includes multimodality therapy with platinum-based chemotherapy and a combination of external beam radiation therapy (EBRT) and a brachytherapy (BT) boost.[3] BT is a specialized procedure entailing the direct placement of radiation into the tumor, resulting in high intratumoral dose to affect local tumor control while sparing normal surrounding organs to minimize toxicity. The addition of BT improves oncologic outcomes, including overall survival (OS).[4-7] Professional societies, including the American Brachytherapy Society, American Society of Therapeutic Radiation Oncology, the Society of Gynecologic Oncology, and the National Comprehensive Cancer Network, recommend BT as an essential component of care for locally advanced CC.[8-10]

Because of its unique epidemiology, CC represents an ideal disease to evaluate inequalities in cancer care. CC is a highly preventable disease given the efficacy of vaccine administration and screening protocols for prevention and detection.[11-14] Despite such benefits, evidence suggests that these preventative measures

Author affiliations and support information (if applicable) appear at the end of this article.

Accepted on July 6, 2021 and published at ascopubs.org/journal/op on September 22, 2021: DOI https://doi.org/10.1200/OP.21.00291

might have exacerbated existing socioeconomic and racial disparities. In particular, rates of vaccination and screening are significantly lower among Black women who accordingly have an increased incidence of advanced-stage disease and CC mortality rates.[15-18] Furthermore, women residing in the southern United States and those of lower socioeconomic status have lower vaccination rates, higher incidence, and marked inferior outcomes.[19-24]

Despite its profound benefits, BT utilization has declined in the United States with approximately 50% of patients receiving standard-of-care therapy with chemotherapy, EBRT, and BT.[6,25-27] Although a highly effective form of treatment, BT requires increased training, expertise, and effort, but reimbursement for BT has been suggested to be inadequate, thus fueling the decreased utilization.[28] With the looming changes in reimbursement for radiation services with the initiation of the Radiation Oncology Alternative Payment Model (RO-APM) in January 2022, there are increasing concerns regarding this issue and how these changes will affect BT practice patterns and patient care accordingly. Furthermore, these reimbursement issues may further widen the disparity in BT utilization and partially explain the inferior outcomes noted in specific patient populations.[29-32] As a result, we sought to evaluate the impact of socioeconomic and demographic factors on BT utilization and CC outcomes in the SEER.

MATERIALS AND METHODS

Patient Population and Data Selection

The National Cancer Institute SEER program is one of the largest national cancer databases (NCDBs) that collects and publishes clinical and survival data of approximately 30% of the patients with cancer treated in the United States.[33] Patients included in this analysis were those with a diagnosis of American Joint Committee on Cancer (AJCC) stage I-IV CC between 2007 and 2015 who received radiation therapy without any surgery to their primary site (N = 7,266). All histology types were available with squamous cell carcinoma (79.2%), adenocarcinoma (9.0%), and adenosquamous subtypes (2.7%) representing the majority of patients. Patients who received only BT were excluded from this cohort. Treatment groups were divided into patients who received EBRT alone (n = 3,832) versus those who received EBRT + BT (n = 3,434).

Statistical Analysis

Data procurement was conducted using SEER*stat software (version 8.3.8).[34] Descriptive statistics were used to summarize patient characteristics. Chi-square and Student *t*-tests were used to test for differences between categorical variable and continuous variables between treatment groups.[35] OS and disease-specific survival (DSS) distributions were estimated by the Kaplan-Meier method, with DSS being measured from the date of diagnosis to the date of death or last known follow-up. Differences in survival were assessed using the log-rank test.[36] A Cox proportional hazards analysis of the DSS was performed using the Cox proportional hazards model to compare outcomes between treatment groups.[37] Multivariate logistic regression analysis was performed to assess for independent determinants of BT utilization. Both these models were constructed in the forward step. Variables present in the multivariate model included age at diagnosis, radiation treatment type (EBRT alone *v* EBRT + BT), race or ethnicity, stage at diagnosis, and insurance status. Statistical analysis was performed using JMP 15.0.0 statistical software (SAS Institute Inc, Cary, NC).[38]

Ethics

This study was exempt from review of the institutional review boards, as the data used are publicly available anonymized data that are compliant with the Health Insurance Portability and Accountability Act.

RESULTS

Patient Characteristics

Three thousand eight hundred thirty-two (52.7%) patients received combined EBRT + BT, whereas 3,434 (47.3%) patients received EBRT alone. Table 1 depicts the differences in patient characteristics. Notably, patients treated

TABLE 1. Patient and Treatment Characteristics

Variable	BT + EBRT	EBRT	*P*
Age at diagnosis, years			.007
Mean (SD)	52.8 (14.0)	56.3 (15.7)	
Median (IQR)	52 (42.3-62)	55 (45-67)	
Race, No. (%)			.0011
White	2,848 (74.3)	2,376 (69.2)	
Black	550 (14.4)	685 (20.0)	
Others[a]	426 (11.1)	354 (10.3)	
Unknown	8 (0.2)	19 (0.6)	
AJCC stage, No. (%)			< .001
I	636 (16.6)	476 (13.9)	
II	1,369 (35.7)	987 (28.7)	
III	1,602 (35.7)	1,432 (41.7)	
IV	92 (2.4)	239 (7.0)	
Unknown	133 (3.5)	300 (8.7)	
Insurance, No. (%)			.0355
Medicaid	1,380 (36.0)	1,295 (37.7)	
Private	2086 (54.4)	1721 (50.1)	
Uninsured	307 (8.0)	333 (9.7)	
Unknown	59 (1.5)	85 (2.5)	

Abbreviations: AJCC, American Joint Committee on Cancer; BT, brachytherapy; EBRT, external beam radiation therapy; IQR, interquartile range; SD, standard deviation.

[a]Includes American Indian or AK Native and Asian or Pacific Islander.

with EBRT alone were more likely to be of older age (median 56.3 *v* 52.8 years; $P \leq .0001$), have stage IV (7% *v* 2.4%; $P \leq .0001$), or be unknown stage disease (8.7% *v* 3.5%; $P \leq .0001$) and be of Black race (20% *v* 14.4%; $P \leq .0001$).

BT Utilization

On univariate logistic regression analysis, private insurance status, lower AJCC stage, younger age, and White race were associated with increased likelihood of BT utilization. On multivariate logistic regression analysis (Table 2), increasing age at diagnosis (OR, 0.98; 95% CI, 0.98 to 0.99; $P < .001$); Medicaid (OR, 0.80; 95% CI, 0.72 to 0.88; $P < .001$), uninsured (OR, 0.67; 95% CI, 0.56 to 0.80; $P < .001$), and unknown insurance status versus private insurance (OR, 0.61; 95% CI, 0.43 to 0.86; $P < .001$); Black (OR, 0.68; 95% CI, 0.60 to 0.77; $P < .001$) and unknown versus White race (OR, 0.30; 95% CI, 0.13 to 0.77; $P = .047$); and AJCC stage II versus 1 (OR, 1.07; 95% CI, 0.93 to 1.24; $P = .36$), stage III versus 1 (OR, 0.82; 95% CI, 0.71 to 0.94; $P = .006$), stage IV versus 1 (OR, 0.30; 95% CI, 0.23 to 0.40; $P < .001$), and unknown stage versus stage 1 (OR, 0.36; 95% CI, 0.28 to 0.45; $P < .001$) were associated with decreased BT utilization.

Survival Outcomes

OS and DSS outcomes are displayed in Figure 1. BT + EBRT demonstrated superior OS compared with EBRT alone, with the 5-year OS of 58.8% versus 40.5%, respectively ($P < .0001$). Additionally, BT + EBRT was associated with improved DSS compared with EBRT alone, with the 5-year DSS of 67.0% versus 51.8%, respectively ($P < .0001$).

Univariate Cox proportional hazards analysis demonstrated that Medicaid insurance status, higher disease stage, and Black race are associated with poorer DSS. On multivariate Cox proportional hazards analysis (Appendix Table A1, online only), Medicaid vs private insurance (hazard ratio [HR], 1.14; 95% CI, 1.04 to 1.25; $P = .007$), Black versus White race (HR, 1.13; 95% CI, 1.02 to 1.26; $P < .001$), and increasing AJCC stage ($P < .001$) were associated with inferior DSS-specific survival, whereas the use of EBRT + BT versus EBRT alone (HR, 0.61; 95% CI, 0.56 to 0.66; $P < .001$) and Other versus White race (HR, 0.84; 95% CI, 0.72 to 0.98; $P < .001$) was associated with improved DSS.

Despite Black race being a strong correlative factor for inferior OS and DSS in our cohort, a secondary survival analysis conducted in patients who received only standard-of-care therapy with combined EBRT + BT negated this racially driven survival difference (Fig 2). When comparing Black and White patients in our entire cohort, the 5-year OS was 44.2% versus 50.9% ($P < .0001$) and the 5-year DSS was 55.6% versus 60.5% ($P < .0001$) for Black and White patients, respectively. When examining only patients who received combined EBRT + BT, these racial disparities were attenuated with the 5-year OS of 57.3% versus 58.5% ($P = .24$) and the 5-year DSS of 66.3% versus 66.6% ($P = .53$) for Black and White patients, respectively.

TABLE 2. Multivariate Logistic Regression Analysis for Determinants of BT + EBRT Receipt Compared With EBRT Alone

Variable	OR (95% CI)	P
Age at diagnosis, years	0.98 (0.979 to 0.985)	< .0001
Insurance status		
Private insurance	1.00 (Ref)	
Medicaid	0.80 (0.72 to 0.88)	< .0001
Uninsured	0.67 (0.57 to 0.80)	< .0001
Unknown	0.61 (0.43 to 0.86)	.0052
AJCC stage		
I	1.00 (Ref)	
II	1.07 (0.93 to 1.24)	.36
III	0.82 (0.71 to 0.94)	.006
IV	0.30 (0.23 to 0.40)	< .0001
Unknown	0.36 (0.28 to 0.45)	< .0001
Race		
White	1.00 (Ref)	
Black	0.68 (0.60 to 0.77)	< .0001
Others[a]	1.05 (0.90 to 1.23)	.54
Unknown	0.30 (0.13 to 0.69)	.005

Abbreviations: AJCC, American Joint Committee on Cancer; BT, brachytherapy; EBRT, external beam radiation therapy; OR, odds ratio; ref, reference.

[a]Includes American Indian or AK Native and Asian or Pacific Islander.

DISCUSSION

Overall, this work adds to the existing body of literature demonstrating that Black women and those who are uninsured or have public insurance are significantly less likely to receive BT for the management of their CC despite this therapeutic modality being known as an independent predictor of improved DSS. From the current study, Black patients and individuals on Medicaid are demonstrated to have significantly worse OS and DSS. Significantly, we identified resolution of the racial survival disparities when comparing only patients who received BT as part of their treatment. Altogether, this work highlights the primary socioeconomic and racial disparities that exist in CC care, which may be directly reflective of the limited use of and/or access to vital BT services.

Similar findings have been reported by multiple studies.[29,30,39-41] The first report evaluating such disparities was completed by the University of Chicago.[39] This study noted a strong trend toward inferior 8-year cause-specific survival (CSS) in Black versus White patients (47.9 *v* 60.6%; $P = .10$) with low income ($P = .001$) and that the absence of BT ($P = .09$) is associated with worse survival in

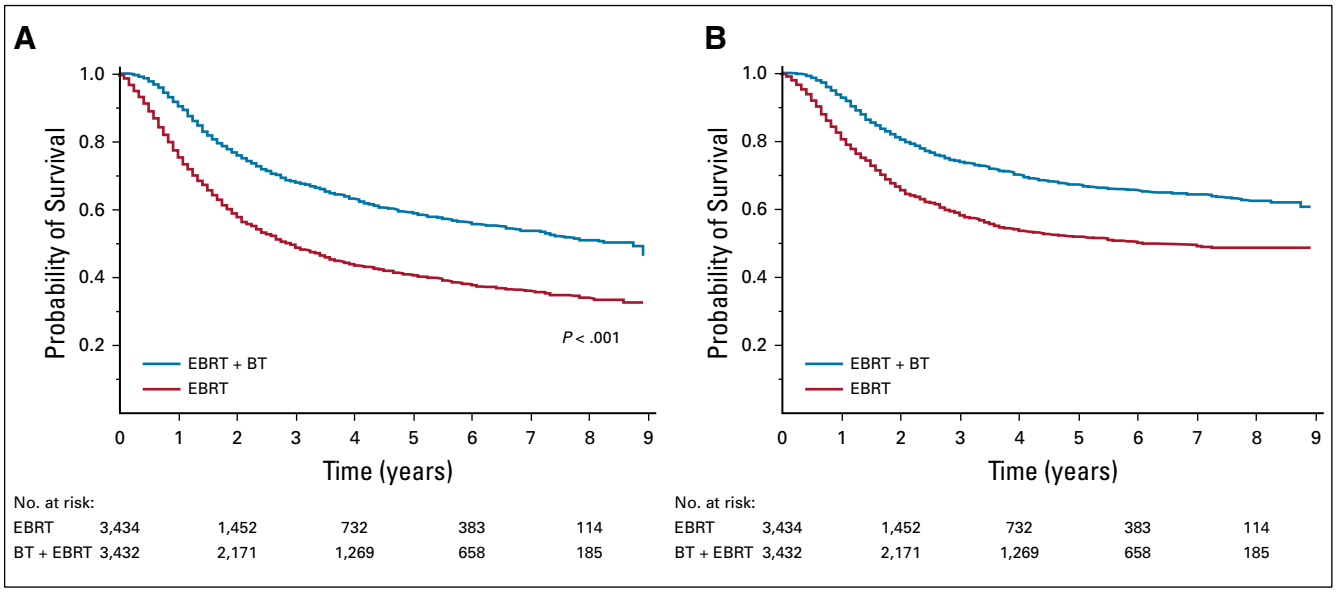

FIG 1. Kaplan-Meier survival curves comparing outcomes by radiation treatment modality in terms of (A) overall survival and (B) disease-specific survival.

Black patients.[39] A population-based study conducted from the California Cancer Registry included 4,783 patients with CC, of which 45% were treated with BT boost. This study reported BT to be an independent predictor of OS and CSS and noted Black race ($P = .0002$) and lower socioeconomic status ($P = .0263$) to be significantly associated with inferior CSS.[29] An NCDB analysis performed on 15,194 patients again confirmed the positive influence of BT on survival outcomes.[41] More importantly, this study emphasized notable racial disparities in quality of care as only 16.7% of Black women received standard-of-care treatment with chemotherapy, EBRT, and BT in comparison with 64.4% of White women.[41] A second NCDB study that included 16,116 women found that Black women had significantly worse all-cause mortality compared with White women (median 3.9 *v* 5.2 years; $P < .001$) and were also much less likely to receive treatment with BT (OR, 0.87; 95% CI, 0.79 to 0.96; $P = .007$).[30] Arguably, the most meaningful finding from this study was the fact that the survival detriment Black patients incurred was eliminated when limiting comparison to patients who received BT.[30] This concept supported by our manuscript suggests that BT utilization may be one of the primary drivers of the inferior survival outcomes found in Black and socioeconomically disadvantaged patients and therefore makes access to BT services a potential simple solution to a complex problem. With that being said, this finding was refuted in a larger NCDB analysis consisting of more than 25,000 patients with CC where the use of BT was not found to be a driver of race-based or insurance-based survival disparities.[42]

The decreased utilization of BT services for Black and socioeconomically marginalized patients is likely a multifactorial problem involving socioeconomic, environmental, cultural, and health system-based issues. First, a majority of evidence suggests that BT utilization for CC, in general, has been declining across the nation.[6,25-27] This itself is a result of several factors, including decreased training, a nonevidence-based movement toward noninvasive external beam boost options, and financial incentives favoring alternative radiation treatments.[43] Declining utilization of BT may stem from limited access in patients who are socioeconomically disadvantaged. Access has undoubtedly been shown to be significant barrier for Black and non-White minority patients to receive specialized cancer therapy. This includes decreased enrollment in clinical trials, less access to life-prolonging therapies, and decreased screening, resulting in advanced-stage disease and limited treatment options.[16,44] This finding was reported from a population-based study from the Maryland Cancer Registry that noted that Black patients frequently presented with more advanced-stage disease and were limited in their ability to receive surgical procedures for their care including BT ($P < .01$).[40] Furthermore, lack of equitable representation of Black physicians within oncology may alienate patients and accentuate a growing level of mistrust in the medical system among such communities.[44-46] Data suggest that despite the fact that Black individuals represent more than 13% of the US population, only 2% of oncologists are identified as being Black.[44] Consistent with our findings, several studies have shown that patients with public (Medicaid or Medicare) insurance or those who are uninsured have decreased access to BT.[30,42] Considering that Black and Hispanic patients have a disproportionately higher likelihood of having Medicaid or being uninsured, they may be restricted from obtaining resource-intensive or costly oncologic therapy such as BT.[47] Finally, broader cultural, historical, and political issues, encompassing education, personal finances, and lack of domestic or family support, may

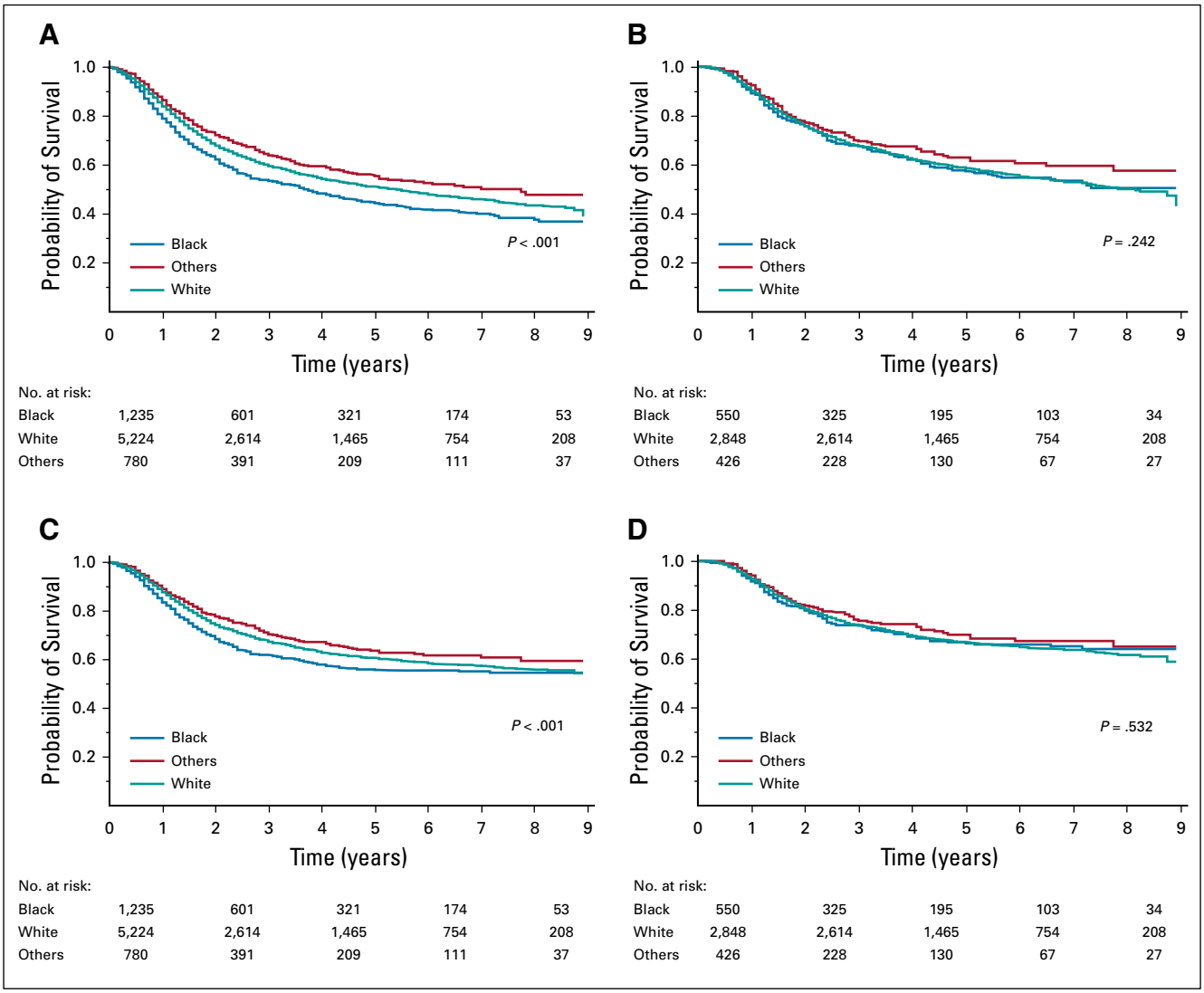

FIG 2. Kaplan-Meier survival curves comparing outcomes by race in terms of (A) OS in all patients, (B) OS in EBRT + BT patients, (C) DSS in all patients, and (D) DSS in EBRT + BT patients. BT, brachytherapy; DSS, disease-specific survival; EBRT, external beam radiation therapy; OS, overall survival.

disproportionately limit the access of specialized cancer therapy such as BT among patients in minority groups.[44,48,49]

Although there have been an increasing emphasis and awareness of racial and socioeconomic disparities within oncology, significant work is still needed to level the playing ground and provide high-quality value-based equitable and accessible cancer care nationally. Several studies have shown that patient navigation programs are promising avenues to reduce such disparities, resulting in increased adherence to cancer screening and early follow-up to minimize advanced disease presentation.[50,51] Increased research, as exemplified by the recent efforts of government programs, including the NCI Community Oncology Research Program and The National Cancer Institute Community Cancer Centers Program, can make great strides in identifying important disparities in oncology and aim to find effective solutions.[52,53] Expansion of Medicaid and insurance benefits such as the Affordable Care Act (ACA) has been shown to reduce disparities in cancer care, including improving access to cancer surgeries and screening programs.[54-56] Importantly, a recent NCDB analysis reported that BT rates have stabilized in recent years because of the implementation of the ACA and, in particular, positively affected patients with Medicaid or those who are uninsured.[57] Finally, aiming to build culturally competent cancer center, engaging minority community leaders, and encouraging minority physician recruitment in oncology can help breach significant cultural barriers, increase trust in medical providers, and expand access to necessary cancer services.[58-60]

One important looming event that may further affect BT practice patterns is the upcoming implementation of the RO-APM. The RO-APM represents an initiative from The Center for Medicare and Medicaid Services Innovation

Center to transform Medicare reimbursement from a fee-for-service model to an episode-based payment schema.[61] Although there have been several concerns with this payment model, one of the primary agreed-upon issues by professional societies has been the potential negative impact that this may have on BT services.[28,62]

This is especially pertinent for CC, considering that BT represents the most resource-intensive component of radiation therapy, accounting for 67% of total costs and requiring significantly more physician time.[63] The RO-APM largely disincentives BT use for CC from a financial perspective because of the additional provider time, the availability of less resource-intensive (albeit inferior) alternative options, and high-cost variability on the basis of radiation sources. This amplifies existing fears regarding declining BT utilization that, on the basis of the aforementioned data, will likely disproportionately disenfranchise Black and socioeconomically disadvantaged women. Considering this, we urge Center for Medicare and Medicaid Services to strongly consider implementing changes suggested by the American Brachytherapy Society to ensure equitable access to BT for all patients with CC.[28]

This analysis was subject to several inherent limitations of population database studies. Accuracy of data is a common concern of national registries; however, SEER has been found to have high-quality data and excellent accuracy in the assessment of radiation utilization.[64,65] Aside from survival outcomes, SEER lacks other relevant clinical end points including locoregional recurrence, patient-reported outcomes, and toxicity. Additionally, more granular socioeconomic and demographic data, as well as the presence of comorbidities, are lacking. With regard to radiation modality, information regarding dosing and palliative intent was unavailable. Although our data suggest that EBRT + BT offers improved DSS, it is important to note that staging differences between groups may be in part driving this difference. Despite these limitations, SEER is considered among the gold standard of population cancer databases because of its representation of 30% of cancer cases and high data accuracy and can thus provide a reasonable representation of general practice patterns and outcomes within the United States. Additionally, our study provides an important update of previous work but is now in the context of the ACA. This manuscript displays that despite efforts to increase insurance coverage with the ACA, racial disparities for CC continue to exist.

In conclusion, our work provides further support to a growing body of important literature that highlights disparities in access to essential BT services for Black and uninsured or Medicare patients. Such disparities unfortunately result in inferior oncologic outcomes for some patients. Importantly, we highlight several reasons for such disparities and suggest important changes that must be considered to increase access to BT and ensure equitable cancer care. Finally, we show that the use of BT can independently reverse racially driven survival differences, highlighting its fundamental importance for the management of locally advanced CC.

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Disclosures provided by the authors are available with this article at DOI https://doi.org/10.1200/OP.21.00291.

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AUTHORS' DISCLOSURES OF POTENTIAL CONFLICTS OF INTEREST

Socioeconomic and Racial Determinants of Brachytherapy Utilization for Cervical Cancer: Concerns for Widening Disparities

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Patents, Royalties, Other Intellectual Property: Software copyright for Python Programming Code for RO-APM Analysis

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Patents, Royalties, Other Intellectual Property: GYN applicator for brachytherapy, royalty received from license by Elekta

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Consulting or Advisory Role: Boston Scientific

No other potential conflicts of interest were reported.

APPENDIX

TABLE A1. Cox Proportional Hazards Model Assessing for Disease-Specific Survival

Variable	HR (95% CI)	*P*
Age of onset, years	1.004 (1.001 to 1.007)	.007
Insurance status		
Private insurance	1.00 (Ref)	
Medicaid	1.14 (1.04 to 1.25)	.005
Uninsured	1.13 (0.97 to 1.31)	.906
Unknown	1.09 (0.80 to 1.47)	.588
AJCC stage		
I	1.00 (Ref)	
II	1.42 (1.20 to 1.68)	< .0001
III	2.92 (2.49 to 3.42)	< .0001
IV	4.53 (3.66 to 5.60)	< .0001
Unknown	3.27 (2.67 to 4.01)	< .0001
Treatment		< .0001
EBRT	1.00 (Ref)	
BT + EBRT	0.61 (0.56 to 0.66)	
Race		
White	1.00 (Ref)	
African American	1.13 (1.02 to 1.26)	.023
Others[a]	0.84 (0.72 to 0.98)	.023
Unknown	0.14 (0.02 to 1.01)	.051

Abbreviations: AJCC, American Joint Committee on Cancer; BT, brachytherapy; EBRT, external beam radiation therapy; HR, hazard ratio.

[a]Includes American Indian or AK Native and Asian or Pacific Islander.