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Research Report

Racial disparities in receipt of radiation and brachytherapy in cervical cancer patients: Do they exist in a SEER-Medicare population?

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ABSTRACT

Objectives: To evaluate if race is associated with disparities in receipt of radiation (RT) and outcomes for Medicare patients with cervical cancer who are candidates for primary radiation-chemotherapy.
Methods: This SEER-Medicare retrospective study included White and Black patients with stage IB1 through IVA squamous cell carcinoma or adenocarcinoma diagnosed 2000–2017 who were candidates for primary radiation-chemotherapy. Receipt of treatment by race and associated cancer specific (CSS) and overall survival (OS) outcomes were analyzed using frequency distributions, chi squared, log rank, multivariable Cox proportional-hazards models, and multivariable logistic models.
Results: 1038 patients (84.9 % White and 15.1 % Black) were included. 825 (79.5 %) received RT, and 601 (57.9 %) received brachytherapy (BT). Blacks were more likely to undergo RT than Whites (86.0 % vs. 78.3 %, $p = 0.028$) and had similar rates of BT (58.0 % vs. 57.9 %, $p = 0.986$). Median RT duration was 64.0 days (IQR 52.0, 75.0), and 276 (33.5 %) completed treatment in $\leq$ 56 days, with no differences by race ($p = 0.488$, 0.303, respectively). BT was more frequently provided at larger hospitals, National Cancer Institute-designated cancer centers, and teaching hospitals. When adjusted for covariates, no significant differences in RT, BT, or RT duration by race were identified. Median unadjusted OS was 3.58 years (95 % CI 2.92, 4.42) for White patients and 2.50 years (95 % CI 2.0, 5.25) for Black patients, with no differences in OS (HR 0.93, 95 % CI 0.75, 1.13) or CSS (HR 1.13, 95 %CI 0.86, 1.43).
Conclusions: Black Medicare patients with cervical cancer had greater receipt of RT than White patients, similar rates of BT, and no difference in survival.

1. Introduction

Cervical cancer is the fourth most common cancer and the fourth leading cause of cancer death among women worldwide (Sung et al., 2021). Though incidence has decreased significantly since the introduction of routine screening, there remain significant sociodemographic disparities in incidence, treatment, and mortality. Cervical cancer represents one of the largest mortality gaps by race of any cancer (Sung et al., 2021; Lawrence et al., 2022; Doll, 2018). Black women have the highest overall mortality rates and lowest 5-year survival among all cervical cancer subtypes and stages (Cohen et al., 2023). Moreover, the mortality rate of cervical cancer in the US is two-fold higher among patients residing in high-poverty versus low-poverty counties (Siegel et al., 2019). These disparities are complex and multifactorial, and contributing factors include differences in receipt of recommended cervical cancer screening, health insurance, access to cancer care, and racism at the systemic and individual levels (Sheeran et al., 2013; Jones, 2000; McDaniel et al., 2021).

Primary radiation therapy (RT) consisting of external beam radiation therapy (EBRT) with brachytherapy is recommended by the National

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Comprehensive Cancer Network's clinical practice guidelines in oncology as first-line therapy for advanced, locally advanced, and some early-stage cervical cancer confined to the pelvis (Koh et al., 2019). They also recommend the use of a chemo-sensitizing agent, like cisplatin, with radiation and a total RT duration ≤ 56 days (Koh et al., 2019; Song et al., 2013). Prior studies have reported racial and insurance-based disparities in the receipt of primary RT and brachytherapy (BT) for patients with cervical cancer. Black patients have been shown to receive suboptimal treatment, including less receipt of BT, and have poorer survival outcomes (Alimena et al., 2019). Uninsured and publicly insured patients present with more advanced cancer, receive less optimal treatment and have worse cancer-specific (CSS) and overall survival (OS) (Churilla et al., 2016).

It remains unclear what underlying factors contribute to these racial disparities in cervical cancer treatment and survival and whether uniform insurance coverage would mitigate these differences. This study, therefore, aimed to evaluate if race is associated with differences in receipt of RT and BT, RT duration, CSS, and OS in a population of uniformly insured Medicare patients with cervical cancer who were candidates for primary radiation-chemotherapy.

2. Methods

This was a retrospective cohort study using the SEER-Medicare database. This database links patient demographic and tumor-specific data collected by SEER cancer registries to longitudinal healthcare claims for Medicare enrollees. Data included diagnoses from 2000 through 2017 and Medicare claims data from 1999 through 2019. We included White and Black patients with stage IB1 through IVA squamous cell or adenocarcinoma diagnosed on pathology. Our analysis was limited to Black and White patients because patients of other or unknown races comprised less than 5 %.

We collected demographic data, including race, comorbidities, median household income of the census tract, age at diagnosis, state, region, and diagnosing hospital factors. Not all states are available in the database. Available states were classified into the following regions according to the US Census Bureau geographic divisions: Northeast (Connecticut, New Jersey), Midwest (Iowa, Michigan), South (Georgia, Kentucky, Louisiana), and West (California, New Mexico, Utah, Washington) (U.S. Census Bureau, 2024). Diagnosing hospital factors included National Cancer Institute (NCI) designation status, whether the hospital was a teaching hospital, and hospital size (by quartiles of total beds: <250, 250–349, 350–549, ≥550). We also collected county-level data, including population density, as defined by the largest urban center within that county. Counties with largest urban center population over 250,000 were considered urban, those less than 2,500 were considered rural, and those in between were considered suburban. We collected cancer data, including histology, Fédération Internationale de Gynécologie et d'Obstétrique (FIGO) stage, grade, tumor size, and treatment modalities. To ensure conformity within the cohort, FIGO staging for cases diagnosed before 2009 was re-classified into the FIGO 2009 staging system using SEER extent of disease tumor-specific information. At the time this study was conducted, available cases were diagnosed up to 2017. Thus, staging assigned by SEER-Medicare and utilized for this analysis was maintained as pre-FIGO 2018. We excluded patients with more than one primary cancer, who were from New York, Massachusetts, or Idaho (given incomplete pathologic and demographic data from these states), those enrolled in Medicare for end-stage renal disease, with health maintenance organization (HMO) co-insurance, or lack of continuous Medicare Part A or B coverage for 12 months prior and six months after diagnosis, who received a hysterectomy before RT, who were diagnosed on autopsy or death certificate, or whose diagnosis date differed from pathology claim date by more than two months.

Primary outcomes were receipt of RT and BT, RT duration, and estimated 5-year cancer-specific and overall survival, stratified by race. We performed descriptive analyses with chi-squared tests on demographic and cancer variables. Survival curves were estimated using the Kaplan-Meier method. Log rank tests were used to compare survival differences. Multivariable Cox regression models were used to compare adjusted relative hazard ratios of survival and their 95 % confidence intervals. All statistical tests were two-sided. We considered a p-value less than 0.05 to be statistically significant. Data were analyzed using SAS v9.4 (SAS Institute, Cary, NC). This study was reviewed and deemed exempt by the University of Pennsylvania IRB.

3. Results

3.1. Demographics

1,038 patients were included, 84.9 % of whom were White and 15.1 % of whom were Black. The median age at diagnosis was 74 years (Interquartile Range [IQR] 68, 80). There was a relatively even distribution of geographic regions, with 28.2 % of patients being from the Northeast, 30.9 % from the South, and 26.3 % from the West. The smallest region represented was the Midwest, with 14.6 % of patients. The majority of patients resided in large metropolitan areas, with 80.6 % of patients from a metropolitan county and only 2.5 % from a rural county. Over half of patients resided in census tracts with a median income less than $55,000. (Table 1).

When analyzed by race, differences were noted in geographic region, with 48.4 % of Black patients and 27.8 % of White patients residing in the South, versus 10.8 % of Black patients and 29.1 % of White patients residing in the West ($p < 0.001$). There were also differences in population density, with 88.5 % of Black patients and 79.2 % of White patients residing in large metropolitan areas ($p = 0.023$). Finally, census tract median household income differed, with 56.7 % of Black patients and 26.3 % of White patients residing in areas with median income<

Table 1
Overall demographics.

	Overall (n, %)	White (n, %)	Black (n, %)	P-value
Overall population	1038	881 (84.9)	157 (15.1)	
Age at diagnosis (Mean, SD)	74.1 (9.1)	74.4 (8.8)	72.3 (10.2)	0.021
Region:				0<.0001
Northeast	293 (28.2 %)	248 (28.2)	45 (28.7)	
Midwest	151 (14.6 %)	132 (15.0)	19 (12.1)	
South	321 (30.9 %)	245 (27.8)	76 (48.4)	
West	273 (26.3 %)	256 (29.1)	17 (10.8)	
Metro	837 (80.6 %)	>710 (>80.6)	>128 (>81.5)	0.023
Urban	175 (16.9 %)	160 (18.2)	15 (9.6)	
Rural (population < 2,500)	**	**	**	
Median household income:				0<.0001
< $40,000	320 (30.9 %)	231 (26.3)	89 (56.7)	
$40,000 to <$55,000	269 (26.0 %)	237 (27.0)	32 (20.4)	
$55,000 50 <$75,000	236 (22.8 %)	214 (24.4)	22 (14.0)	
≥ $75,000	211 (20.4 %)	197 (22.4)	14 (8.9)	

Table 1 Social demographic factors for SEER-Medicare patients with cervical cancer who underwent primary radiation chemotherapy. **Cell count suppressed due to CMS cell-suppression policy data use agreement.

$40,000 ($p < 0.001$). (Table 1).

Years of diagnosis were equally represented across the study period, with 35.7 % of patients diagnosed between 2000–2005, 32.8 % diagnosed in 2006–2011, and 31.5 % diagnosed in 2012–2017. Cancer stages were relatively evenly distributed, with 27.4 % having stage I cancer, 32.7 % having stage II, and 34.6 % having stage III. Only 5.4 % of patients had stage IV cancer. Most patients (76.9 %) had squamous cell carcinoma, with the remaining 23.1 % having adenocarcinoma. Relatively few (16.9 %) underwent lymph node dissection (LND). Only 49.8 % received cisplatin treatment within six months of diagnosis. Most patients (88.8 %) received care at a hospital that was not NCI-designated. 67.0 % received care at a teaching hospital.

3.2. Clinical data

Table 2 shows clinical data by race. Black patients were more likely (86.6 %) than White patients (75.1 %) to have squamous cell histology ($p = 0.002$) and were less likely (10.9 % vs. 17.9 % of White patients) to have undergone LND ($p = 0.031$). Stage of cancer at diagnosis and receipt of cisplatin did not differ by race. There was no difference in overall (HR 0.93, 95 % CI 0.75, 1.14) or cancer-specific survival (HR 1.13, 95 % CI 0.86, 1.43) by race (Fig. 1).

3.3. Treatment data – Any RT

Nearly 80 % of the cohort received any RT (Table 3). When analyzed by race, Black patients were more likely (86 %) than White patients (78.3 %) to have received any RT ($p = 0.028$). In a multivariable model adjusted for age, LND, stage, cisplatin treatment, NCI status, and hospital size, there was no different in RT receipt by race ($p = 0.341$).

Cancer covariates associated with receiving any RT included squamous cell histology, not undergoing LND, cancer grade, stage, and cisplatin treatment. (Supplement Table S1) Demographic covariates associated with the receipt of any RT included being from a region other than the West, with over 80 % of patients from other regions receiving RT compared to 72.2 % from the West ($p = 0.007$), and hospital size, with patients diagnosed at larger hospitals being more likely (85.4 %) to receive RT ($p = 0.009$). Receipt of radiation therapy differed by state, with patients residing in Washington and New Mexico receiving the least radiation (65.8 % and 68.2 %, respectively) and patients residing in New Jersey, Iowa, and Louisiana receiving the most (84.3 %, 86.0 %, and 86.4 %, respectively) ($p = 0.004$) (Fig. 2a). There were no differences in receipt of RT by population density ($p = 0.794$), median household income ($p = 0.514$), hospital NCI status ($p = 0.415$), teaching hospital designation ($p = 0.352$), or year of diagnosis ($p = 0.952$).

Table 2
Clinical Data by Race.

	White (n, %)	Black (n, %)	P-value
Stage:			0.497
I	247 (28.0)	37 (23.6)	
II	289 (32.8)	50 (31.9)	
III	300 (34.1)	59 (37.6)	
IV	45 (5.1)	11 (7.0)	
Histology:			0.002
Squamous cell carcinoma	662 (75.1)	136 (86.6)	
Adenocarcinoma	219 (24.9)	21 (13.4)	
Lymph node dissection:			0.031
Yes	158 (17.9 %)	17 (10.9)	
No	723 (82.1 %)	139 (89.1)	
Receipt of cisplatin:			0.755
Yes	437 (49.6)	80 (51.0)	
No	444 (50.4)	77 (49.0)	

Table 2 Cervical cancer related pathology and treatment factors.

3.4. Treatment data – BT

Only 57.9 % of patients received BT, with no difference by race. In a multivariable model adjusted for age, stage, LND, receipt cisplatin, and hospital size, there remained no difference in BT receipt by race ($p = 0.151$). Cancer covariates associated with the receipt of BT were younger age at diagnosis, squamous cell histology, not having received LND, having stage II cancer, and receiving cisplatin treatment. (Supplement Table S2) There was no difference by grade ($p = 0.433$). Demographic covariates associated with receipt of BT included residing in the Midwest or South (with 62.3 % and 62.0 % receiving BT, respectively, versus 57.3 % of patients residing in the Northeast and 51.3 % residing in the West; $p = 0.040$) and receiving care from a hospital that is an NCI designated cancer center (68.5 % of patients at hospitals with comprehensive designation and 74.1 % of patients at hospitals with a clinical designation, versus 56.5 % of patients at non-NCI designated hospitals; $p = 0.020$), a teaching hospital (61 %, versus 52.6 % at non-teaching hospitals; $p = 0.010$), and with a larger total number of beds (64 % of those at hospitals with more than 550 beds, versus 49.1 % of those at hospitals with fewer than 250 beds; $p = 0.002$). Receipt of BT also differed by state, with patients residing in Washington (39.5 %) and New Mexico (45.5 %) receiving the least BT and patients residing in Louisiana (67.8 %) and Iowa (68.8 %) receiving the most ($p = 0.052$) (Fig. 2b). There was no difference in receipt of BT by metro, urban, or rural ($p = 0.516$), median household income ($p = 0.330$), or year of diagnosis ($p = 0.247$).

3.5. Treatment data – RT duration

Among patients who received any RT, only 33.5 % had a treatment duration ≤ 56 days. Median RT duration was 64.0 days (IQR 50.0, 75.0) for White patients and 63.0 days (IQR 53.0, 77.0) for Black patients ($p = 0.488$). There was no difference by race. In a multivariable model adjusted for age, year of diagnosis, stage, LND, cisplatin treatment, region, urban vs. rural environment, and NCI status, there remained no difference by race ($p = 0.752$).

Factors associated with RT duration ≤ 56 days included year of diagnosis (38.9 % of those diagnosed from 2000 to 2005 versus 28 % of those diagnosed from 2006 to 2011 and 33 % of those diagnosed from 2012 to 2017; $p = 0.024$), age at diagnosis (47.5 % of those over 80 versus 29.9 % of those from 70 to 79 and 24.8 % of those less than 70; $p < 0.001$), stage IV cancer (58.1 % versus 31.7 % of Stage I, 30.4 % with Stage II, and 34.0 % with Stage III; $p = 0.004$), and not having received cisplatin treatment (47.2 % versus 24.8 % of those who did receive cisplatin; $p < 0.001$). (Supplement Table S3) RT duration also differed by state, with patients residing in New Mexico the least likely (13.3 % and patients in Utah the most likely (68.4 %) to finish treatment in ≤ 56 days ($p = 0.002$) (Fig. 2c). There was no difference in RT duration by histology ($p = 0.693$), LND ($p = 0.596$), or grade ($p = 0.588$), region ($p = 0.065$), metro, urban, or rural ($p = 0.110$), median household income ($p = 0.948$), hospital NCI status ($p = 0.282$), teaching hospital designation ($p = 0.669$), or hospital bed size ($p = 0.063$).

4. Discussion

In this national database of publicly insured cervical cancer patients who did not undergo hysterectomy, 79.5 % received any RT, 57.9 % received BT, and only 33.5 % of these completed RT in the recommended ≤ 56 days. Black patients received more RT than White patients and had similar rates of BT and RT duration.

Regional and state differences were seen in the receipt of RT, BT, and RT duration. Treatment receipt, especially the receipt of BT, differed by hospital factors, with NCI cancer centers, teaching hospitals, and larger hospitals more likely to provide standard-of-care treatment.

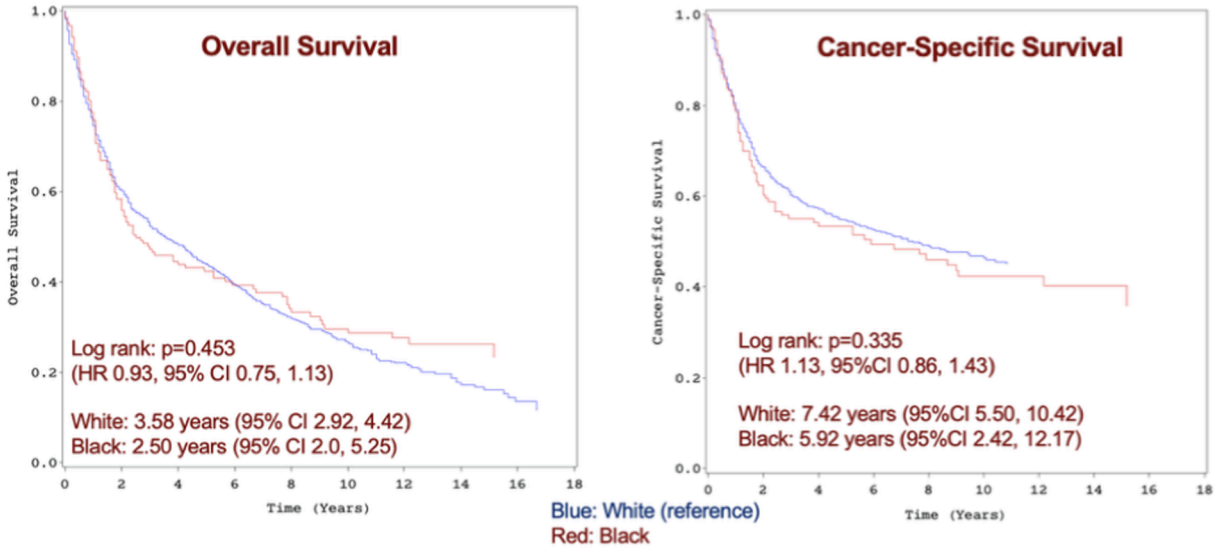

Fig. 1. Overall and Cancer-Specific Survival. Overall survival and Cancer Specific Survival did not differ by race in SEER-Medicare patients with cervical cancer undergoing primary radiation chemotherapy treatment.

Table 3
Primary Outcomes.

	White (n, %)	Black (n, %)	Total (n, %)	P-value
Any RT	690 (78.3)	135 (86.0)	825 (79.5)	0.028
BT	510 (57.9)	91 (58.0)	601 (57.9)	0.986
RT Duration ≤ 56 days*	236 (34.2)	40 (29.6)	276 (33.5)	0.303

Table 3 Receipt of primary radiation chemotherapy treatment in SEER-Medicare patients by race.

* Among patients who received any RT (n = 825).

A large body of literature exists documenting the racial disparities in cervical cancer treatment and outcomes. Our results contradicting these previously published data were surprising and may be due to the uniformity of public insurance for patients in our cohort. These findings indicate the critical importance of health insurance on standard-of-care treatment in cervical cancer. Prior studies have found disparities in gynecologic cancer treatment by insurance coverage and socioeconomic status. For example, Doll et al. found that women dually enrolled in Medicare and Medicaid had over a thirty percent increased all-cause mortality after gynecologic cancer diagnosis than the non-dually enrolled Medicare population (Doll et al., 2015). Insurance coverage is a proxy for healthcare access, with publicly insured patients having more restricted access to providers and treatment elements. A large cross-sectional study of over 20,000 women with cervical cancer using the SEER database found that a larger proportion of women with private or Medicare insurance compared with women with Medicaid or no insurance received a diagnosis of early-stage cancer. The same study found that any health insurance coverage mediated more than half of racial disparities in diagnosis of advanced-stage cancer (Holt et al., 2023). These findings are consistent with our study and suggest that Medicare (as opposed to Medicaid) insurance is a protective factor against racial differences in care.

Our findings also point to state and regional differences in care. Prior studies have described geographical differences in gynecologic cancer care, with the South, Midwest, and West having fewer gynecologic oncologists and overall cancer centers than the Northeast (Alimena et al., 2022). Patients residing in the West were least likely to receive any RT and patients residing in rural Western states, like New Mexico, less likely to receive guideline-concordant care overall. These differences are likely due to the greater proportion of rural counties found in regions outside the Northeast and resulting geographic barriers to care. Over half of rural Americans need to travel over 60 miles to receive care from a gynecologic oncologist, compared to an average of 8 miles traveled by urban patients (Hung et al., 2020).Additionally, patients residing in the South have known higher cancer incidence and mortality and lower rates of screening and human papillomavirus (HPV) vaccination (Buskwofie et al., 2020; Yoo et al., 2017). Many of these differences have been thought to be partly due to variations in Medicaid expansion by state and attitudes towards vaccination. Still, neither of these factors would have impacted the patient population in this study, given that Medicare coverage is federally run. The majority of patients would not have received the HPV vaccination, given their age.

Our findings that receipt of guideline-concordant care was generally associated with larger hospital size and NCI designation align with existing data. Specifically, receipt of BT has been noted to differ greatly between treatment centers. Wright et al. found that patients with locally advanced cervical cancer treated at high-volume centers received more BT, though with no difference in survival outcomes (Wright et al., 2015). Other studies have found that locally advanced cervical cancer patients treated at higher-volume and academic centers were more likely to receive guideline-concordant therapy, including BT, and did have an associated survival benefit (Lin et al., 2014; Robin et al., 2016).

The strengths of this study include the fact that the SEER-Medicare database is a national registry merged with all Medicare claims and captures real-world practice. Additionally, the database uniquely allows for capturing a universally publicly insured population, which allows for analysis of racial disparities in a setting where insurance coverage is controlled. Limitations include that Medicare enrollees are limited to the older or disabled population. Additionally, the database lacks information regarding provider or patient treatment preference and additional social determinants of health (such as transportation or financial resources). Several states were omitted due to incomplete data. Finally, hospital factors were defined by diagnosing hospital as we were unable to identify treating hospital reliably.

In conclusion, we show that in this national database of publicly insured Medicare patients with cervical cancer, Black patients undergoing primary radiation therapy had greater receipt of RT compared to White patients and similar rates of BT and mean time to initiation of RT with no difference in survival. Our findings point to the critical importance of healthcare coverage and overall healthcare access in reducing racial disparities in cancer care. Further studies are needed to evaluate

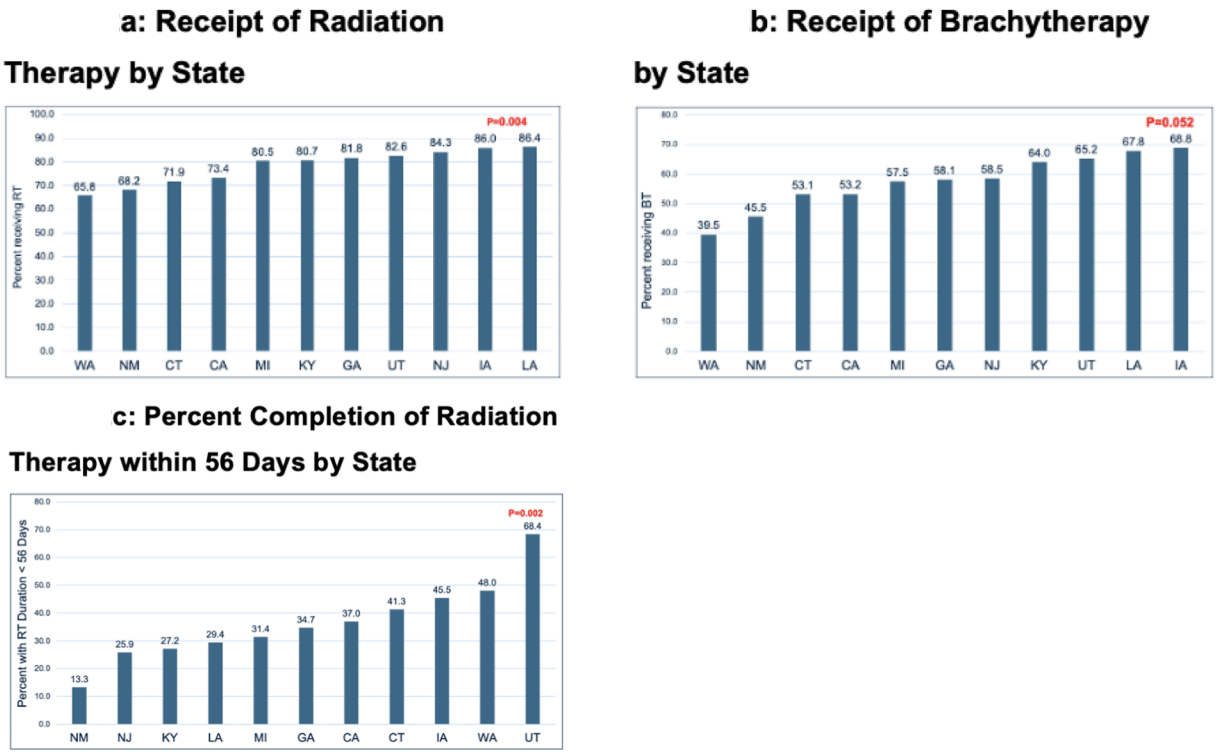

Fig. 2. State-based difference in receipt of radiation therapy, including brachytherapy, as well as duration of therapy (percent completion of radiation ≤ 56 days). S1. Cancer and demographic covariates associated with receipt of RT. S2. Cancer and demographic covariates associated with receipt of BT. S3. Cancer and demographic covariates associated with RT treatment duration ≤ 56 days.

public health interventions and policies that may increase insurance coverage and enrollment, thus mitigating disparities and improving women's cancer care outcomes.

Presentation

An earlier version of this study was presented as an oral presentation at the MAGOS 2022 Annual Conference (Nov 2022) in Nashville, TN, and as a poster at the SGO 2023 Annual Meeting on Women's Cancer (Feb 2023) in Tampa, FL.

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CRediT authorship contribution statement

Emily G. Gleason: Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Daniel Saris:** Writing – review & editing, Methodology, Investigation. **Elizabeth Tubridy:** Writing – review & editing, Methodology. **Colleen Brensinger:** Writing – review & editing, Methodology, Investigation, Formal analysis. **Emily M. Ko:** Writing – review & editing, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: [The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. Dr. Ko has institutional research support from Tesaro and Faeth, an Investigator research award from Winn-Bristow Myers Squibb, and Ovarian Cancer Research Alliance-GSK].

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.gore.2024.101505.

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