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Do Rural Patients with Early-Stage Prostate Cancer Gain Access to All Treatment Choices?

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by

Laura-Mae Baldwin, MD, MPH

C. Holly A. Andrilla, MS

Michael P. Porter, MD, MS

Roger A. Rosenblatt, MD, MPH, MFR

Shilpen Patel, MD

Mark P. Doescher, MD, MSPH

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WWAMI RURAL HEALTH RESEARCH CENTER

UNIVERSITY OF WASHINGTON
SCHOOL OF MEDICINE
DEPARTMENT OF FAMILY MEDICINE

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ABOUT THE CENTER

The WWAMI Rural Health Research Center (RHRC) is one of six centers supported by the Federal Office of Rural Health Policy (FORHP), a component of the Health Resources and Services Administration (HRSA). The major focus of the RHRC is to perform policy-oriented research on issues related to rural health care and the rural health professional workforce. Specific interests of the RHRC include the adequacy of the supply and education of rural health care professionals, and the availability and quality of health care for rural populations, with particular emphasis on access to high-quality care for vulnerable and minority rural populations.

The WWAMI Rural Health Research Center is based in the Department of Family Medicine at the University of Washington School of Medicine, and has close working relationships with the WWAMI Center for Health Workforce Studies, state offices of rural health, and the other health science schools at the University, as well as with other major universities in the five WWAMI states: Washington, Wyoming, Alaska, Montana, and Idaho. The University of Washington has over 30 years of experience as part of a decentralized educational research and service consortium involving the WWAMI states, and the activities of the RHRC are particularly focused on the needs and challenges in these states.

The Rural Health Final Report Series is a means of distributing prepublication articles and other working papers to colleagues in the field. Your comments on these papers are welcome, and should be addressed directly to the authors. Questions about the WWAMI Rural Health Research Center should be addressed to:

Eric H. Larson, Ph.D., Director
Davis G. Patterson, Ph.D., Deputy Director
WWAMI Rural Health Research Center
Department of Family Medicine
School of Medicine
University of Washington
Box 354982
Seattle, WA 98195-4982
E-mail: rhrc@fammed.washington.edu
WWW: http://depts.washington.edu/uwrhrc/

ABOUT THE AUTHORS

LAURA-MAE BALDWIN, MD, MPH, is a Professor in the Department of Family Medicine and a Senior Investigator at the WWAMI Rural Health Research Center, University of Washington School of Medicine.

C. HOLLY A. ANDRILLA, MS, is a Biostatistician for the WWAMI Rural Health Research Center, Department of Family Medicine, University of Washington School of Medicine.

MICHAEL P. PORTER, MD, MS, is an Associate Professor in the Department of Urology, University of Washington School of Medicine.

ROGER A. ROSENBLATT, MD, MPH, MFR, is a Professor and the Vice Chair in the Department of Family Medicine, University of Washington School of Medicine.

SHILPEN PATEL, MD, is an Assistant Professor in the Department of Radiation Oncology, University of Washington School of Medicine.

MARK P. DOESCHER, MD, MSPH, was the Director of the WWAMI Rural Health Research Center and an Associate Professor in the Department of Family Medicine, University of Washington School of Medicine, at the time of this study.

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Do Rural Patients with Early-Stage Prostate Cancer Gain Access to All Treatment Choices?

LAURA-MAE BALDWIN, MD, MPH
C. HOLLY A. ANDRILLA, MS
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ROGER A. ROSENBLATT, MD, MPH, MFR
SHILPEN PATEL, MD
MARK P. DOESCHER, MD, MSPH

EXECUTIVE SUMMARY

BACKGROUND

Due to a scarcity of local cancer specialists and long distances to some cancer care facilities such as radiation treatment centers, rural residents may have more limited local cancer treatment choices. Many cancers, such as early-stage prostate cancer, have multiple, equally effective treatment options, yet the treatments have very different rates of complications. Optimal care allows early-stage prostate cancer patients to choose from among these treatment options after careful consideration of their risks and benefits. Definitive treatments for early-stage prostate cancer (localized treatments with curative intent) include surgery—radical prostatectomy—or one of three types of radiation therapy: one-time prostatic implantation of radioactive pellets (brachytherapy), five to eight weeks of external beam radiation, or a combination of the two.

This study compares rates of receipt of these definitive treatments overall, and of the different treatment options between early-stage prostate cancer patients living in urban and four levels of rural counties. This study also reports urban-rural variation in receipt of definitive treatment across 10 states nationally.

STUDY DESIGN

This cross-sectional study used 2004-2006 Surveillance Epidemiology and End Results (SEER) cancer registry data from 303 rural and 165 urban counties in 10 states (California, Connecticut, Georgia, Hawaii, Iowa, Kentucky, Louisiana, New Mexico, Utah, Washington) representing all four U.S. regions. These data represent all of the SEER registry areas that include a general population of cancer patients in both rural and urban counties. The study population included rural and urban early-stage prostate cancer patients who were categorized as most likely to benefit from definitive treatment. Patients most likely to benefit were defined as those ages 40-74 years with prostate specific antigen (PSA) levels of 20 or less and a Gleason score of less than 8. Patients were categorized by their Federal Information Processing Standard (FIPS) county codes into urban and four levels of rural residence based on the size of the county's largest town and adjacency to urban areas using Urban Influence Codes (UICs): (1) *adjacent rural:* counties that are geographically adjacent to a metropolitan area (UICs 3-7), (2) *nonadjacent micropolitan:* counties that are not adjacent to a metropolitan area and whose largest town/urban cluster has 10,000 to 49,999 residents (UIC 8), (3) *small rural:* counties that are adjacent to a micropolitan area and whose largest town has less than 10,000 residents (UIC 9, 10), and (4) *remote small rural:* counties that are not

adjacent to a micropolitan area and whose largest town has less than 10,000 residents (UIC 11, 12). Availability of urologists and radiation oncologists in each residence county during the study years was obtained from the Area Resource File (ARF, 2007 release). Rates of different types of treatment for early-stage prostate cancer were calculated among men living in urban and different types of rural counties, adjusting for patient, cancer, and environmental characteristics such as state that differed between urban and rural counties.

FINDINGS

Of the 51,982 early-stage prostate cancer patients in this study, 45,964 (88%) lived in an urban and 6,018 (12%) in one of four types of rural counties. Rural prostate cancer patients were the oldest and had the highest rates of being white, non-Hispanic. Rural prostate cancer patients were most likely to have missing information on the size of the tumor (T2NOS disease), higher levels of the prostate cancer marker called prostate specific antigen (PSA) prior to biopsy (over 10 to 20), and a higher Gleason grading score suggesting more aggressive disease (Gleason score = 7).

The majority of rural early-stage prostate cancer patients did not have a radiation oncologist practicing in their county. The availability of urologists varied across rural places, with patients living in nonadjacent micropolitan counties (81.3%) most likely and those living in small rural counties (10.5%) least likely to have had a urologist practicing in their counties. With the exception of patients living in nonadjacent micropolitan places, most rural patients had neither a urologist nor a radiation oncologist practicing in their counties.

Over 80 percent of early-stage prostate cancer patients in the 10 study states received definitive treatment regardless of their rural or urban residence location, with the highest rates found in metropolitan counties (87.1%) and remote small rural counties (87.0%). Overall, the most common treatment for both rural and urban residents was radical prostatectomy (48.3%).

There was substantial variation in receipt of definitive treatment between rural and urban early-stage prostate cancer patients within several states and between rural early-stage prostate cancer patients across states. For example, some types of rural counties in Louisiana, New Mexico, and Georgia had adjusted definitive treatment rates that were more than 5 percentage points below the overall 10-state adjusted rate of 86.8 percent, and had significantly lower adjusted definitive treatment rates than urban counties in the same states.

CONCLUSIONS

The majority of rural and urban early-stage prostate cancer patients in all 10 study states were receiving definitive treatment, even though many lived in counties without a radiation oncologist or urologist. A WWAMI Rural Health Research Center study demonstrated that isolated small rural colorectal cancer patients most frequently traveled to urban places for cancer care, suggesting that the high rates of definitive prostate cancer treatment for men living in remote small rural places may reflect their receipt of care in urban areas. Although overall there were no substantial disparities in the types of treatment received by rural and urban patients, there were a few rural areas in Louisiana and New Mexico with especially low rates of definitive treatment for early-stage prostate cancer.

IMPLICATIONS FOR POLICY, DELIVERY, OR PRACTICE

This research demonstrates that overall, rural early-stage prostate cancer patients were able to access the full range of prostate cancer treatment options. However, further study is needed to identify both the burdens that travel for treatment place on rural early-stage prostate cancer patients, as well as the availability of local evaluation and treatment in rural areas because of itinerant cancer specialists. States with rural areas that had lower definitive treatment rates should explore the patient, social support, and health care system factors that may contribute to these rates.

Do Rural Patients with Early-Stage Prostate Cancer Gain Access to All Treatment Choices?

LAURA-MAE BALDWIN, MD, MPH
C. HOLLY A. ANDRILLA, MS
MICHAEL P. PORTER, MD
ROGER A. ROSENBLATT, MD, MPH, MFR
SHILPEN PATEL, MD
MARK P. DOESCHER, MD, MSPH

INTRODUCTION

BACKGROUND

Cancer, the second most common cause of death in the United States, can require an intensive and complex course of treatment from specialist physicians. Over the past decade, cancer care has come under scrutiny, and the Institute of Medicine (IOM) has called for measures to increase the quality of cancer care.[1] Improving cancer care quality is inherently difficult in rural areas, however, due to the paucity of cancer care specialists, as well as cancer diagnostic and therapeutic services.[2] Prior research has demonstrated geographic barriers that rural cancer patients experience; about a third of colorectal cancer patients in small and isolated small rural areas travel over 50 miles to medical and radiation oncologists' offices.[3]

Ensuring high-quality care is a particular challenge for rural patients with cancers for which there are multiple treatment options. Early-stage prostate cancer, for example, has several equally effective treatment options,[4] yet the treatments have very different rates of complications.[5] Definitive treatments (localized treatments with curative intent) for early-stage prostate cancer include surgery—radical prostatectomy—or one of three types of radiation therapy: one-time prostatic implantation of radioactive pellets (brachytherapy), five to eight weeks of external beam radiation, or a combination of the two. Radical prostatectomy is associated with more urinary incontinence and sexual dysfunction than external beam radiation therapy,[6,7] whereas radiation therapy is associated with more bowel dysfunction than prostatectomy.[5] Brachytherapy is associated with higher initial risk of urinary retention and urinary urgency and urge incontinence compared to external beam radiation, but over time these differences resolve. Both forms of radiation therapy are associated with similar sexual and bowel side effects.[8] Optimal care allows early-stage prostate cancer patients to choose from among these treatment options after careful consideration of their risks and benefits. However, due to a scarcity of local cancer specialists and long distances to some cancer care facilities such as radiation treatment centers,[3,9] rural residents have more limited local cancer treatment choices. Research examining the treatments received by early-stage prostate cancer patients living in rural areas is needed to determine whether they access the full range of treatment alternatives.

PURPOSE

To compare rates of receipt of definitive treatment overall, and of the different treatment options between early-stage prostate cancer patients living in urban and rural counties; and to examine urban-rural variation in receipt of definitive early-stage prostate cancer treatment across 10 states nationally.

METHODS

DATA SOURCES

This study used the 2004-2006 Surveillance Epidemiology and End Results (SEER) Limited-Use Data from eight state-based cancer registries (California, Connecticut, Hawaii, Iowa, Kentucky, Louisiana, New Mexico, Utah) and three county-based cancer registries (Atlanta, rural Georgia, Seattle/Puget

Sound) in two other states. These data represent all of the SEER registry areas that include a general population of cancer patients in both rural and urban counties. These SEER registries include 303 rural and 165 urban counties. SEER data provided detailed information on cancer histology, type, stage, extent of disease, and initial treatment (e.g., surgery, radiation); Federal Information Processing Standard (FIPS) county codes; and demographic characteristics (e.g., age, sex, race/ethnicity). The Area Resource File (ARF)[10] identified whether there was a radiation oncologist or a urologist in each county. The U.S. Department of Agriculture 2004 Economic Research Service (ERS) County Typology codes identified counties that were low education (25% or more of residents 25-64 years old had neither a high school diploma nor a General Equivalency Diploma [GED] in 2000), low employment (less than 65% of residents 21-64 years old were employed in 2000), and persistent poverty (20% or more of residents were poor as measured by the 1970, 1980, 1990, and 2000 censuses).[11]

STUDY POPULATION

The SEER data included 149,822 individuals ages 18 years and older at the time of a first diagnosis with prostate cancer. Of these, 18,637 men who had had a previous cancer of another type and 1,109 men whose prostate cancer diagnosis was made on death certificate or at autopsy were excluded. Our analysis was restricted to the 112,863 typical prostate cancer cases with early-stage disease. These cases included tumor categories T1c, T2a, T2b, T2c, and T2NOS, and one of the following typical morphology codes (combines histologic type and behavior code from the *International Classification of Diseases for Oncology, Third Edition*): 8000.3, 8140.3, 8255.3, 8480.3, 8481.3, and 8570.3.[12,13] Additional exclusions were patients who were either missing information on radiation and/or surgery treatment or the type of radiation or surgery was not specified (n = 3,043), since this was our primary outcome of interest. Also excluded were those patients with metastatic disease and those who received radioisotope treatment, since that may be an indicator for metastatic disease (n = 2,729). Finally, patients who were most likely to benefit from definitive treatment were retained in the study sample[14]: those less than 75 years of age because there is no clear evidence that treating older men has an impact on their overall survival, and those with a Gleason score less than 8 and a prostate specific antigen (PSA) level of 20 or less because they are least likely to have either metastatic disease that is not clinically evident or disease outside the prostate gland at the time of treatment. The Gleason grading score indicates the level of aggressiveness of the tumor (lower scores are representative of less-aggressive tumors). The PSA test is a prostate cancer tumor marker. Higher serum PSA levels are associated with more aggressive tumors, higher tumor volume, and higher risk of disease recurrence and progression after treatment. After exclusion and inclusion criteria were invoked, our study sample included 51,982 patients.

STUDY VARIABLES

Outcome Variable: Our outcome of interest was receipt of definitive therapy (localized treatment with curative intent), defined as radical prostatectomy, external beam radiation, brachytherapy, or a combination of external beam radiation and other radiation. The SEER data include the first course of treatment received by each individual. When a patient received more than one type of treatment, SEER data indicate which treatment was provided first.

Independent Variables of Interest: The primary independent variable was residence location of each cancer patient. Each patient's county of residence was classified as metropolitan (urban) or one of four types of non-metropolitan (rural) as defined by the Office of Management and Budget.[11] Urban influence codes (UICs)[11] linked to residence county FIPS codes were used to subdivide the non-metropolitan counties into the four rural subgroups: (1) *adjacent rural*: counties geographically adjacent to a metropolitan area (UICs 3-7), (2) *nonadjacent micropolitan*: counties that are not adjacent to a metropolitan area and whose largest town/urban cluster has 10,000 to 49,999 residents (UIC 8), (3) *small rural*: counties that are adjacent to a micropolitan area and whose largest town has less than 10,000 residents (UIC 9, 10), and (4) *remote small rural*: counties that are not adjacent to a micropolitan area and whose largest town has less than 10,000 residents (UIC 11, 12).

Additional county-level contextual variables included whether the county was designated as persistent poverty, low employment, or low education, and whether there was an available radiation oncologist and/or urologist in the year of diagnosis. The availability of a radiation oncologist and/or urologist in a county in each study year was defined by the Area Resource File,[10] which uses the physicians' preferred professional mailing address from the American Medical Association Physician Masterfile and the American Osteopathic Association, and does not include additional satellite locations.

Control Variables: A number of factors could influence the relationship between whether an individual lived in an urban or rural location and the prostate cancer treatment he received. These include patient sociodemographics (age, sex, marital status, and race/ethnicity), and state, which represents regional practice variation.

ANALYSIS

The analysis first included a description of the sociodemographic, cancer, and contextual characteristics of the study's cancer patients. Next, unadjusted rates of different types of treatment for early-stage prostate cancer were calculated among men living in urban and different types of rural counties. Logistic regression analysis was used to examine the relationship between residence location (urban and four rural categories) and receipt of definitive treatment, controlling for those variables that either improved the fit of the regression model or were significant predictors of definitive treatment themselves. These variables included sociodemographic characteristics (age, race, marital status), tumor category (T category), prostate specific antigen (PSA) level prior to biopsy, Gleason score, residence state, and county-level contextual characteristics (persistent poverty and low employment county only). General estimating equation methods were applied in all regression analyses to account for clustering of patients by county.[15] From these logistic models, adjusted rates of our study outcomes were calculated by urban-rural residence county category and by state.

RESULTS

Of the 51,982 early-stage prostate cancer patients in this study, 45,964 (88%) lived in an urban and 6,018 (12%) in one of four types of rural counties (Table 1). Most rural patients lived in counties adjacent to a metropolitan area ("adjacent rural"). Rural prostate cancer patients were the oldest and had the highest rates of being white, non-Hispanic, having T2NOS disease, higher PSA levels prior to biopsy (over 10 to 20), and a higher Gleason score (Gleason score = 7). More than half (58.8%) of urban patients were from California, which includes four SEER registries. Almost half (43.7%) of the rural patients were from Iowa and Kentucky. Other states with over 10 percent of the rural patients were California (14.4%) and Louisiana (13.7%).

The majority of rural early-stage prostate cancer patients did not have a radiation oncologist practicing in their county, especially in adjacent rural, small rural, and remote small rural counties (1.8% in small rural counties up to 43.7% in nonadjacent micropolitan counties, Table 2). The availability of urologists varied across rural places, with patients living in nonadjacent micropolitan counties most likely to have a urologist practicing in their counties (81.3%). Notably, 45.9 percent of patients living in remote small rural counties but only 10.5 percent of patients living in small rural counties had a urologist practicing in their counties. With the exception of patients living in nonadjacent micropolitan places, the majority of rural patients had neither a urologist nor a radiation oncologist practicing in their counties. The percentage of early-stage prostate cancer patients living in persistent poverty or low employment counties was highest among rural patients, particularly those living in small rural and remote small rural counties.

Over 80 percent of early-stage prostate cancer patients in this study received definitive treatment regardless of their rural or urban residence location, with the highest rates found in metropolitan counties (87.1%) and remote small rural counties (87.0%) (Table 2). The most common treatment for both rural and urban patients was radical prostatectomy (48.3%). Prostate cancer patients living in adjacent rural counties had the highest rates of brachytherapy (18.8%). Those living in remote small rural and nonadjacent micropolitan rural counties had the highest rates of external beam radiation (22.6% and 20.8%, respectively). The rates of no treatment were highest among early-stage prostate cancer patients living in nonadjacent micropolitan (16.6%) and small rural counties (16.3%).

Rates and patterns of receipt of definitive treatment for early-stage prostate cancer patients varied substantially within and across states. Some types of rural counties in Louisiana, New Mexico, and Georgia had adjusted definitive treatment rates that were more than 5 percentage points below the overall 10-state adjusted rate of 86.8 percent, and had significantly lower adjusted definitive treatment rates than urban counties in the same states (Figure 1). In other states such as California, Connecticut, Kentucky, and Utah, there was no difference in the rate of receipt of definitive treatment between patients living in rural and urban places. In Washington State's Seattle/Puget Sound SEER registry (13 counties in western Washington), patients living in a rural location had a significantly higher rate of definitive treatment than their urban counterparts.

Table 1. Early-Stage Prostate Cancer Patient Sociodemographic, Cancer, and Contextual Characteristics by Residence Location

Patient Characteristics	Urban, % (N = 45,964)	Adjacent Rural, % (N = 3,547)	Nonadjacent Micropolitan, % (N = 1,381)	Small Rural, % (N = 569)	Remote Small Rural, % (N = 521)	Total, % (N = 51,982)
Individual characteristics						
Age***						
40-49 years	4.3	3.1	2.8	3.9	1.5	4.2
50-59 years	29.2	26.1	27.1	23.7	29.0	28.9
60-69 years	47.6	50.0	46.3	51.1	47.8	47.8
70-74 years	18.9	20.9	23.8	21.3	21.7	19.2
Race***						
White non-Hispanic	71.4	86.7	84.0	94.3	95.8	73.3
Black non-Hispanic	11.7	9.5	2.9	4.4	2.1	11.1
AI/AN non-Hispanic	0.2	0.6	0.7	0.2	1.2	0.3
Asian non-Hispanic	5.6	0.3	7.1	0.2	0.2	5.1
Latino/Hispanic	11.0	2.8	5.2	0.9	0.8	10.0
Other non-Hispanic	0.2	0.1	0.0	0.0	0.0	0.2
Marital status***						
Married/partnered	79.2	81.5	79.6	82.8	83.0	79.4
Single/separated/divorced	18.1	14.6	16.7	13.8	14.2	17.8
Widowed	2.7	3.9	3.7	3.4	2.8	2.8
Cancer characteristics						
Prostate cancer T stage***						
T1c	62.5	59.5	59.1	56.6	58.0	62.1
T2a	6.5	5.8	6.7	5.3	6.1	6.4
T2b	1.8	1.9	2.2	2.3	2.9	1.9
T2c	9.5	9.2	9.2	10.0	10.9	9.5
T2NOS	19.7	23.7	22.9	25.8	22.1	20.1
PSA category***						
≤10	86.4	86.1	82.6	83.8	83.9	86.2
>10-20	13.6	13.9	17.4	16.2	16.1	13.8
Gleason score***						
≤6	60.3	58.4	55.2	59.9	53.7	59.9
7	39.7	41.6	44.8	40.1	46.3	40.1
Contextual characteristics						
State***						
California	58.8	17.4	10.8	1.2	17.5	53.6
Connecticut	6.5	6.3	0.0	0.0	0.0	6.2
Georgia	5.7	3.6	0.8	2.5	0.4	5.4
Hawaii	1.4	0.0	14.1	0.0	0.0	1.6
Iowa	2.9	18.5	21.3	40.6	21.7	5.0
Kentucky	3.9	15.5	26.9	41.3	34.0	6.0
Louisiana	5.4	20.9	1.8	6.7	3.8	6.3
New Mexico	2.6	5.0	12.6	4.6	4.6	3.1
Utah	4.3	4.9	2.8	3.2	11.1	4.3
Washington	8.5	7.9	8.8	0.0	6.9	8.4
Urologist and/or radiation oncologist in residence county***						
Neither	2.8	51.5	18.7	87.7	54.1	8.0
Urologist only	2.8	28.3	37.6	10.5	32.1	5.8
Radiation oncologist only	0.2	2.0	0.0	1.8	0.0	0.4
Both	94.2	18.2	43.7	0.0	13.8	85.8
Persistent poverty***	1.4	19.0	14.7	39.7	30.5	3.7
Low employment***	4.9	28.6	16.9	40.4	59.5	7.8
Low education***	22.2	22.8	19.3	37.8	37.8	22.5

The availability of a urologist and/or radiation oncologist in a county was defined by the Area Resource File (ARF) data from the year of diagnosis. The ARF uses the physicians' preferred professional mailing address from the American Medical Association Physician Masterfile and the American Osteopathic Association, and does not include additional satellite locations.

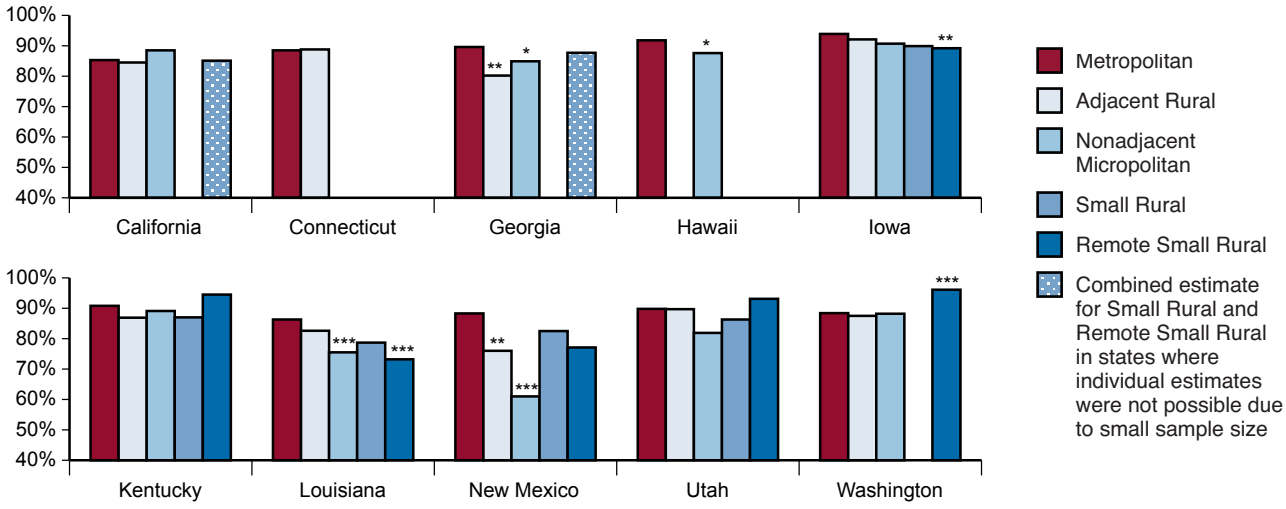
Overall chi-square: *$P \leq .05$, **$P \leq .01$, ***$P \leq .001$.

Table 2. Adjusted Rates of Different Treatments Received by Early-Stage Prostate Cancer Patients by Patient's County of Residence

	Urban, % (N = 45,964)	Adjacent Rural, % (N = 3,547)	Nonadjacent Micropolitan, % (N = 1,381)	Small Rural, % (N = 569)	Remote Small Rural, % (N = 521)	Total, % (N = 51,982)
Definitive treatment**	87.1	84.3	81.4	82.3	87.0	86.8
Radical prostatectomy	48.7	44.4	44.7	46.4	45.3	48.3
External beam radiation	18.6	16.9	20.8	17.9	22.6	18.6
Brachytherapy	15.6	18.8	14.5	17.2	14.6	15.8
Combination of external beam radiation and brachytherapy	4.2	4.2	2.8	2.5	4.8	4.2
Non-definitive treatment	1.4	2.8	2.2	1.9	1.0	1.6
No treatment*	11.4	12.6	16.6	16.3	12.4	11.6

Overall chi-square: *$P \leq .05$, **$P \leq .01$, ***$P \leq .001$.

Figure 1. Adjusted† Rate of Definitive Treatment by Residence State and Rural-Urban Categorization (N = 51,982)



*$P \leq .05$.
**$P \leq .01$.
***$P \leq .001$.

†Adjusted for age, race, marital status, stage, PSA level, Gleason score, residence in a low employment county (y/n), and residence in a persistent poverty county (y/n).

Significance tests compare adjusted definitive treatment rates in each type of rural county to the rate in urban counties in each state.

LIMITATIONS

SEER cancer registry data are limited in several ways. First, most rural early-stage prostate cancer patients in the SEER registries were concentrated in California, Iowa, Kentucky, Louisiana, New Mexico, and Utah. In addition, California accounted for 53.6 percent of the early-stage prostate cancer patients overall and the majority of all urban early-stage prostate cancer patients (58.8%). Practice patterns in those states could strongly influence our study findings.

The SEER Limited-Use Data used in this study include geographic identifiers at the county level only. Rural Urban Commuting Area (RUCA) codes, which can provide more precise measures of the level of rurality but require either ZIP codes or census tracts, could not be assigned to the prostate cancer patients. The SEER registry data also do not identify where patients receive their cancer care; thus this study is unable to determine the travel burden for rural prostate cancer patients. The SEER data include a limited number of individual-level and contextual variables. Other factors that could be associated with prostate cancer treatment, such as comorbidity, socioeconomic status, insurance status, and social support, were not available. For example, if rural patients had higher rates of comorbidity and preferentially chose either brachytherapy or external beam radiation treatment to avoid the risks of surgery, this study may overestimate the adjusted rates of these radiation treatments among rural men. The practice location of the urologists and radiation oncologists reflected their preferred professional mailing address from the American Medical Association Physician Masterfile and the American Osteopathic Association. These specialists' satellite locations were unavailable, which could underestimate the presence of these specialists in rural counties.

CONCLUSIONS

The majority of rural and urban early-stage prostate cancer patients in all 10 study states were receiving definitive treatment, even though many lived in counties without a radiation oncologist or urologist. A WWAMI Rural Health Research Center (RHRC) study demonstrated that isolated small rural colorectal cancer patients most frequently traveled to urban places for cancer care,[3] suggesting that the high rates of definitive prostate cancer treatment for men living in remote small rural places may reflect their receipt of care in urban areas. These findings suggest that in general, rural early-stage prostate cancer patients were able to gain access to the full range of prostate cancer treatment options that are available.

The majority of rural, early-stage prostate cancer patients had neither a urologist nor a radiation oncologist listed as practicing in their county. It is possible that some of these counties had itinerant urologists who offered radical prostatectomy in these rural locations. Alternately, these patients may have been required to travel to receive urologic care. Because radiation therapy requires facilities with specialized equipment, patients who chose radiation treatments for their prostate cancer but lived in rural counties without these services were required to travel for this care. Identifying and quantifying the burdens placed on rural patients who did travel for their treatments is an important area for further study, since prior research has shown that in rural areas, only about a third of rectal cancer patients live within 30 miles of a radiation oncologist.[3]

Although not the focus of this study, men with early-stage prostate cancer living in rural counties had the highest rates of tumor characteristics associated with unfavorable prognosis. There is very little literature examining rural-urban differences in staging at the time of prostate cancer diagnosis, and the findings are mixed. Some studies show that urban men are more likely than rural men to be diagnosed with later stage prostate cancer[16]; others show no difference.[17] Given the findings of this study, further analysis examining stage at diagnosis among all prostate cancer patients is warranted to determine whether men living in rural places are diagnosed with prostate cancer at later stages than men living in urban places.

Among rural early-stage prostate cancer patients, men living in remote small rural counties had the highest rates of definitive treatment. Prior research has demonstrated that isolated small rural colorectal cancer patients most frequently traveled to urban places for their cancer care.[3] Thus, it is likely that these high rates of definitive prostate cancer treatment for men living in remote small rural counties reflect their receipt of care in urban counties.

This study's state-based analyses helped identify geographic areas whose early-stage prostate cancer patients might require additional support to gain access to treatment services. Overall, there were no substantial disparities in the types of treatment received by patients living in urban and different types of rural counties. However, there were several rural areas in Louisiana and New Mexico with especially low rates of definitive treatment for early-stage prostate cancer, even after adjusting for demographic, cancer, and

contextual characteristics. Identification of these areas provides the opportunity to improve access to prostate cancer treatment for a subset of vulnerable rural men.

IMPLICATIONS FOR POLICY, DELIVERY, OR PRACTICE

This research demonstrates that overall, rural early-stage prostate cancer patients were able to access the full range of prostate cancer treatment options. However, further study is needed to identify both the burdens that travel for treatment place on rural early-stage prostate cancer patients, as well as the availability of local evaluation and treatment in rural areas because of itinerant cancer specialists. States with rural areas that had relatively low definitive treatment rates can use these data to explore the patient, social support, and health care system factors that may contribute to these lower treatment rates. In particular, cancer centers, advocacy groups such as the American Cancer Society, and others can use this study's results to identify needed services, such as transportation, for men in these geographic areas, and to plan outreach programs that allow them to receive optimal prostate cancer treatment.

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