■ CLINICAL ■

Health System Correlates of Receipt of Radiation Therapy After Breast-Conserving Surgery: A Study of Low-Income Medicaid-Enrolled Women

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Objective: To describe patient and healthcare system correlates of receipt of recommended care in North Carolina (NC) as indicated by receipt of adjuvant radiation therapy (RT) after breast-conserving surgery (BCS).

Study Design: Retrospective cohort study.

Methods: Subjects were 344 women diagnosed as having primary breast cancer in 1998 and 1999, who were classified as being alive at least 12 months after treatment with BCS. Medicaid claims were used to supplement central cancer registry (CCR) data about adjuvant RT, and hospital medical record verification was performed when no RT was documented. Health system characteristics (size and volume) were obtained from existing databases.

Results: Of 344 NC women enrolled in Medicaid and treated with BCS, one third did not receive RT. The following patient and health system characteristics were associated with lack of receipt of adjuvant RT after BCS: older age (≥65 years), residing in a low–population density county, receiving BCS at a smaller hospital, and living in a county classified as a whole-county specialist scarcity area.

Conclusions: Some low-income women do not access RT following BCS, placing them at risk for worse outcomes than those associated with standard mastectomy. We identify geographic isolation and scarcity of healthcare specialists as possible leverage points for interventions.

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For author information and disclosures, see end of text.

Breast cancer is one of the most frequently occurring diseases among women[1] and is expected to account for almost 49,000 deaths in the United States in 2007.[2] Decades of clinical trial research have established treatments that minimize risk of recurrence,[1] extend survival, and improve quality of life. To achieve maximum potential benefit of treatment, the National Cancer Institute[3] and the National Comprehensive Cancer Network[4] endorse that all women diagnosed as having breast cancer have access to care that is timely and is based on current professional guidelines. For breast cancer, the National Institutes of Health 1990 Consensus Conference[5] recommended breast-conserving surgery (BCS) plus radiation therapy (RT) as a safe and effective alternative to mastectomy for most women with stage I and stage II breast cancer based on evidence from the National Surgical Adjuvant Breast Project protocol[6,7] and other prospective randomized trials. These studies proved that, among women with node-positive or node-negative breast cancer, BCS followed by adjuvant RT resulted in the same breast cancer–related survival rates as those associated with mastectomy. More recently, evidence shows that receipt of RT after BCS is associated with improved survival.[8-10] Using data from the National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) registry, Vinh-Hung and colleagues[11] found a 34% increase in mortality among patients treated with BCS without RT, and Clark and colleagues[12] in a 2005 meta-analysis of 15 trials reported, the mortality effect remained, albeit smaller (8.9%) than that observed in registry data. The effect of RT on survival among low-income women is especially important to consider because they are at greater risk of having late-stage tumors at the time of diagnosis and may be especially vulnerable to an increased risk of local recurrence with subsequently larger tumors.[13,14]

The choice between BCS plus RT and mastectomy for stage I and stage II tumors depends on individual circumstances, personal preference, and provider recommendation. However, potential barriers to adjuvant RT with BCS faced by the patient may include an appreciable time burden (normally 5 days per week for 6 weeks), which may be logistically difficult and costly if the patient lives a long distance from a treatment facility.[15] Radiation therapy may also cause undesirable effects,

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including swelling, fatigue, pain, skin pigmentation, and fibrosis of the breast, and a patient treated with BCS might reweigh her preference to receive this required treatment. There is a substantial body of evidence indicating that some women treated with BCS do not receive RT.[10,11,16-21] For example, Young and colleagues[18] reported that only 60% of Pennsylvania Medicaid-insured patients with breast cancer undergoing BCS received RT in 1990, although National Institutes of Health[5] recommendations for RT and BCS were only emerging at this time. Roetzheim et al[22] found that only 67.9% of patients with breast cancer enrolled in Florida's Medicaid program received RT after BCS. In these studies, the reasons for omitting RT after BCS were hypothesized to include physician- and patient-led considerations such as patient refusal[21,23] and barriers to access such as distance to the nearest RT facility.[15] Healthcare system features may be important in assisting patients in weighing the "best" surgical approach based on patient preference and counseling about decision making. Because RT is not a surgical service, it requires patient referral and follow-up processes across providers and perhaps institutions. The latter functions may be challenging within fragmented healthcare systems.[21,24,25]

Previous work demonstrated that approximately one third of Medicaid-enrolled patients with breast cancer in North Carolina (NC) who underwent BCS did not have RT listed in Medicaid claims or in consolidated central cancer registry (CCR) data.[10,13] In the present study, we examine geographic and healthcare facility correlates of receipt of adjuvant RT among all Medicaid-enrolled women treated with BCS in 1998 and 1999 to identify potential areas for quality-of-care improvement.

METHODS

Study Population

Data for this study originated from NC Medicaid claims files and from 1998 and 1999 NC CCR data which were linked by patient identifiers (name, date of birth, and Social Security number) to produce an analytic file. To perform this dataset linkage, a probabilistic match routine was run against the Medicaid eligibility file based on 2 matching strings (1 for each round of matching). The first string consisted of a Social Security number and the first 3 characters of the first name (3 characters of the first name to prevent mismatching a wife's cancer record with hear husband's Medicaid record). Nonmatches were passed to a second string consisting of the first 5 characters of the last name, first 3 characters of the first name, date of birth, and county of residence. During the process of the linkage, we assessed nonmatched cases that were closely linked on a case-by-case basis, but the overall success of the linkage was not assessed.

Institutional review board and state agency approval was obtained to conduct this study and included all CCR and Medicaid data along with stringent data protection and patient privacy protection procedures. Subjects eligible for inclusion in this study were all female cases listed in the CCR with a diagnosis of nonmetastatic primary breast cancer (ie, in situ, local, or regional) in 1998 or 1999, who were classified as being alive at least 12 months after treatment with BCS. The latter was determined by the absence of a death record notification within the Social Security Administration's Death Master File (DMF) in a search conducted in 2000. Eligibility also required evidence of enrollment in NC Medicaid at the time of diagnosis listed in the CCR and during the period of 1 to 3 months before the exact date of diagnosis. The sample size in the study years allowed a between-group difference of 10% (25% vs 35%) at $\alpha = 0.05$ in the proportions with RT omitted following BCS. The time frame was selected to allow survival outcomes to be observed.

Health system characteristics were determined from CCR facility codes for the location of surgery. Hospital size and patient volume of the surgery facility were determined using a 2005 listing from the American Hospital Directory[26] that pertained to all patient stays. We classified NC counties as areas of specialist physician shortage in 2003, based on Centers for Medicare & Medicaid Services lists[27,28] as those having the lowest specialty care ratios of Medicare beneficiaries to active physicians in a rural census county. Specialist shortage area designations exclude primary care physicians, including general practice, family practice, internal medicine, and obstetrics/gynecology.

NC CCR

North Carolina mandates its CCR to collect data on pretreatment and the first course of treatment of all cancer sites in all patients diagnosed within the state. A network of local and regional hospital registries submits selected diagnosis and treatment data to the CCR following uniform standards established by the North American Association of Central Cancer Registries.[29] Consolidated cancer registry data were obtained for all pathologically confirmed cases of single primary female breast cancer in the CCR (codes C500 to C509) as diagnosed in 1998 and 1999. Other registry data included in this study were summary stage (in situ, localized, regional, or regional to lymph nodes); node status; estrogen receptor status (positive or negative); tumor size (pathologic size in centimeters, clinical size in centimeters, and when neoadjuvant therapy was given); surgery of the primary site (none, extended radical mastectomy, radical mastectomy, modified radical mastectomy, total mastectomy, or partial mastectomy); scope of regional lymph node surgery (none, sentinel nodes removed, or regional nodes removed); number of regional lymph nodes removed; RT administered (mode given, none, administered but not documented, or not known); and disposition of chemotherapy (none, single agent, multiple agents, or unknown). These data were linked to the NC Medicaid files for diagnosis year to identify Medicaid-enrolled patients at 3 months before the index date of cancer diagnosis. Because RT may be missed or not updated in some registries, we used Medicaid claims as a second source of evidence that RT was given and verified a final determination of no RT by hospital medical record review.

NC Medicaid

To qualify for NC Medicaid and for full Medicaid coverage for the treatment of breast cancer, an adult woman generally must have an annual income of less than 180% below the federal poverty level and must have 1 of the following characteristics: she must be 65 years or older, blind or disabled according to Social Security standards, pregnant, or the parent or caretaker relative of a child who is younger than 19 years. A woman aged 18 to 64 years with breast cancer who is not eligible for Medicaid but who has no creditable medical insurance coverage may be eligible under the breast and cervical cancer Medicaid program. To qualify for this program, she must be enrolled and screened for breast or cervical cancer through the Breast and Cervical Cancer Control Program that is administered by the Division of Public Health of the NC Department of Health and Human Services. Full NC Medicaid coverage includes full payment of all medically prescribed cancer treatment at rates negotiated by the Centers for Medicare & Medicaid Services. For persons enrolled in Medicaid with dual Medicare insurance (eg, for those legally blind or disabled or those ≥65 years), NC Medicaid pays the deductible and the coinsurance.

The study claims database included all paid NC Medicaid claims and crossover claims that originated under fee-for-service plans. For the period of study, almost all NC Medicaid was under fee for service, with only 1 small managed care organization in Mecklenberg County that covered approximately 10,000 lives (men, women, and children). During 1998 and 1999, paid Medicare claims were "crossed over" to the NC Medicaid claims processing contractor by tape and were listed in the study database regardless of the source of reimbursement. We used the date of cancer diagnosis and the NC Medicaid eligibility file to determine continuous eligibility; for our sample, we selected all patients who were enrolled at least 1 month before the date of diagnosis and who had 12 months of continuous enrollment in NC Medicaid. This procedure ensured that the cancer care of study subjects could be observed in our dataset.

Data Linkage

Medicaid claims and consolidated cancer registry data were merged at the NC registry facility using a probabilistic match algorithm based on 2 matching strings (Social Security number and the first 3 characters of the first name to prevent mismatching a patient's cancer record with her husband's Medicaid record). Nonmatches were passed to a second match string consisting of the first 5 characters of the last name, first 3 characters of the first name, date of birth, and county of residence. A crosswalk coding file was created to relate standard cancer collection and reporting codes of the National Program of Cancer Registries to standard administrative claims codes adopted by the Centers for Medicare & Medicaid Services for reimbursement of allowable healthcare charges. This resource was developed in consultation with medical claims coding experts, cancer care providers (oncologists and cancer surgeons), and cancer registry staff. The selected codes were refined by performing a cross-check of services listed in the consolidated cancer registry data but not in Medicaid claims and by reviewing claim codes for proxy information (eg, RT studies as a proxy for RT services or anesthesia services for total or radical mastectomy). The final crosswalk file was designed to allow matching within the procedure class (eg, mastectomy vs BCS), as well as less precisely on overall procedure category (eg, breast-focused surgery, chemotherapy, and RT). For BCS, the Medicaid claims codes included *Current Procedural Terminology* (*CPT*) codes 19160, 19162, 19120, and 19125 and *International Classification of Diseases*, *Ninth Revision, Clinical Modification* (*ICD-9-CM*) procedure codes 85.21, 85.23, and 85.22. For CCR codes, BCS was recorded as presence of the following: partial mastectomy not otherwise specified, less than total mastectomy not otherwise specified, nipple resection, lumpectomy or excisional biopsy, reexcision of biopsy site, wedge resection, quadrantectomy, segmental mastectomy, or tylectomy. For RT, the Medicaid codes included *CPT* codes 77401 to 77499, 77750 to 77799, 77261 to 77399, 77750 to 77799, 77600 to 77620, RC330, RC333, G0178, and G0174 and *ICD-9* procedure codes 92.21 to 92.29. The CCR RT information included beam RT, radioactive implants, radioisotopes, combinations, and RT not otherwise specified.

Data Quality Review

To estimate the accuracy of the archived consolidated cancer registry RT data, we performed hospital record audits when there was a lack of agreement between cancer registry and Medicaid claims data for RT among 288 patients with BCS who were continuously enrolled in Medicaid for ~12 months following the date of diagnosis. The latter enrollment requirement ensured that Medicaid claims would be present during the treatment period pertinent to the review of registry data. The audit process included accessing updated consolidated cancer registry files for new treatment field entries and field notes to capture additional details not included in standard data releases. Patients with multiple source documents (cases reported by >1 facility) were placed on reconcile hold for side-by-side review of cases, including codes and text. For records in which updated information was not present, or if the discrepancy between data sources persisted after reviewing updated information, staff from the hospital registry office were contacted to provide supplemental information. This included reviewing the original file and following up with physician notes and freestanding RT facilities to clarify if a procedure or treatment was given. Only notes documented in the registry or medical records were reported back to the registry staff. Edits and recodes resulting from this review were used to recalculate percentage agreement per cancer care service category. Based on the results of this quality review, which showed high specificity and sensitivity of the study's adjuvant RT data (results presented herein), the entire sample of 344 patients listed as having BCS was included in this study, using Medicaid claims for RT to substitute for registry data that showed that RT was not planned or administered or that the treatment status was unknown.

Statistical Analysis

The primary study outcome is receipt of RT as recorded in the NC CCR or as supplemented by Medicaid claims data when registry data indicated no status or unknown status. Using *P* values from the test of proportions, descriptive analyses were performed on the distribution of receipt of adjuvant RT by patient characteristics. Adjusting for model covariates, multivariate logistic regression analysis of correlates was performed to determine unique predictors. The covariates used for adjustment were chosen based on risk factors in population studies[13,14,24,25,30] and on hypotheses about health system variables that may influence care, considering patient-level variables (eg, age, race/ethnicity, and residence) and comorbidity and healthcare system–level variables (eg, hospital size, volume, and physician supply). The covariates included the following: (1) Patient demographics, including age in years and race/ethnicity (white, black, or other). (2) Patient residence in a metropolitan or nonmetropolitan county based on codes defined by Butler and Beale[31] or in a county characterized as being a whole-county specialist physician scarcity area. (3) Patient risk for poor prognosis was assessed using a modified Deyo-Charlson index[32] that uses 5-digit *ICD-9-CM* diagnosis codes to calculate the risk for hospital mortality. This adaptation of the Charlson Comorbidity Index is calculated using a reduced set of diagnoses and new weights that improve prediction of inhospital mortality. (4) Clinical characteristics indicating disease severity or prognosis, including tumor size, summary stage (in situ, localized, or regional), and number of lymph nodes removed as recorded in the CCR. (5) Last, health system characteristics such as patient volume defined as the number of Medicaid-insured patients with breast cancer treated by the registry reporting facility in 1998, whether the reporting hospital had a certified cancer registrar office (indicating dedicated resources to cancer care), and hospital size defined by the number of staffed beds (large or medium if >112 or small if ≤112). Patient residence status was noted as being in an assisted-living facility at the time of cancer diagnosis and was based on the presence of Medicaid or crossover Medicare claims for nursing home stay, home health services, or skilled nursing facility care.

RESULTS

Sample

There were 12,037 cases of primary breast cancer identified in the NC CCR; of these, 331 cases lacked sufficient information to attempt a record match and were excluded. A match in Medicaid was made for 1413 cases, with 851 cases listed with a single tumor. Included in the analytic sample were all patients in the diagnosis years who had received BCS with stage and tumor size confirmed by pathologic examination. Excluded were 19 patients for whom both BCS and mastectomy were found in claims or registry information and 18 patients who were listed in the Social Security Administration's DMF as having died within 12 months of the diagnosis date of breast cancer.

Data Quality

Of 288 patients with BCS having continuous Medicaid eligibility, 33 (11.5%) showed lack of agreement between Medicaid claims and the CCR about having any receipt of adjuvant RT within 1 year following diagnosis. Review of hospital registrar information demonstrated that 94% of these discrepant cases had no registry RT information when Medicaid RT claims were present; 2 cases had no RT claims when the CCR indicated that RT was given. Based on data obtained from rereview and updated fields as the gold standard, the sensitivity of the original CCR RT data was 84%, and the specificity was 100%. Medicaid claims RT information had a sensitivity of 95% and a specificity of 93%. The combined CCR–Medicaid claims dataset had a sensitivity of 97% and a specificity of 98% when information indicating adjuvant RT was unilaterally accepted from either source. In a logistic model, predictors (*P* <.05) of the odds of having matching RT information in the 1-year period between data sources were the following: having cancer treatment provided by more than 1 medical facility, being treated at a facility with a hospital registrar, and having fewer days until RT after surgery (data not shown). Based on these results, for all 344 cases we took the approach of using CCR data as the primary source of RT data and used Medicaid data to classify the RT status of CCR patients for whom RT was missing, not given, or unknown.

Characteristics of the study population are given in Table 1. The mean age was 62.4 years (age range, 23-102 years), with 46.2% being 65 years or older; 49.1% were listed as being of nonwhite race/ethnicity, with 47.0% listed as being of black race/ethnicity. Most subjects (68.3%) had localized disease; approximately 11.0% and 20.6% had in situ and regional disease, respectively. None of the patients were listed as having unstaged disease. More than half (61.3%) had a tumor size of less than 2 cm, and 19.5% had 1 or more lymph nodes removed.

Correlates of the receipt of RT are given in Table 2. Women at highest risk of not receiving RT were those who were 65 years or older, those with in situ disease versus localized or regional disease, those residing in an assisted-living facility, those who had received their BCS procedure in a smaller hospital, those who had received their BCS procedure in a hospital with larger patient volume, and those whose address was in an NC county characterized as being a specialist shortage area.

In the multivariate model with all covariates, independent predictors (P <.05) of the omission of RT following BCS were the following: age of 65 years or older, residence in an assisted-living facility, and residence in a metropolitan county (Table 3). Metropolitan county residence status and hospital size were found to statistically interact such that women who resided in nonmetropolitan counties and who were surgically treated in small hospitals had the highest likelihood of not receiving RT. This relationship is summarized in the Figure, showing that approximately 37% of women with both nonmetropolitan county residence status and surgery performed at a small hospital received RT versus 72% to 75% of women in the other 3 interaction groups.

DISCUSSION

The results of the present study indicate that, after adjusting for all model covariates, women managed with BCS are at higher risk of not receiving adjuvant RT if they are 65 years or older, were surgically treated at small hospitals, or reside

Table 1. Characteristics of 344 Medicaid-Enrolled Women With Breast Cancer Who Did vs Did Not Receive Radiation Therapy After Breast-Conserving Surgery

Characteristic	Overall (N = 344)	Radiation Therapy (n = 242)	No Radiation Therapy (n = 102)	*P*
Demographic				
Age, mean (SD), y	62.4 (15.7)	69.3 (18.1)	59.4 (13.7)	—
Age ≥65 y at the time of diagnosis, %	46.2	38.4	64.7	<.001
Nonwhite race/ethnicity, %	49.1	49.6	48.0	.79
Clinical				
Stage, %				.04
In situ	11.0	8.7	16.7	
Localized	68.3	68.2	68.6	
Regional	20.6	23.1	14.7	
Tumor size, cm				.06
0 to <1	23.8	25.2	20.6	
1 to <2	37.5	40.5	30.3	
2 to <5	35.2	31.8	43.1	
≥5	3.5	2.5	5.9	
Confirmed estrogen-receptor positive, %	43.9	45.9	39.2	.28
Positive lymph nodes, %	19.5	23.1	10.8	<.001
Chemotherapy, %	34.0	40.9	17.7	<.001
Comorbidity				
Charlson Comorbidity Index, mean (SD)	1.32 (1.73)	1.16 (1.60)	1.71 (1.95)	.01
Disability status, %	39.9	48.7	23.1	<.001
Healthcare costs, mean (SD), $	51,420 (115,960)	45,500 (118,600)	65,460 (108,710)	.15

Table 2. Correlates of Underuse of Radiation Therapy Following Breast-Conserving Surgery

Variable	Total, No. (%) (N = 344)	% Radiation Therapy (n = 242)	% No Radiation Therapy (n = 102)	*P*
Age at the time of diagnosis, y				
≥65	159 (46.2)	58.5	41.5	<.001
<65	185 (53.8)	80.5	19.5	
Race/ethnicity				
White	175 (50.9)	69.7	30.3	.79
Other	169 (49.1)	71.0	29.0	
Stage				
In situ	38 (11.0)	55.3	44.7	.04
Localized	235 (68.3)	70.2	29.8	
Regional	71 (20.6)	78.9	21.1	
Charlson Comorbidity Index, excluding cancer diagnosis				
0	166 (48.3)	75.9	24.1	.09
1	52 (15.1)	65.4	34.6	
2	126 (36.6)	65.1	34.9	
Patient county of residence				
Nonmetropolitan	116 (33.7)	64.7	35.3	.10
Metropolitan	228 (66.3)	73.3	26.8	
Assisted-living facility				
Yes	80 (23.3)	52.5	47.5	.001
No	264 (76.7)	75.8	24.2	
Hospital size				
Large or medium	302 (87.8)	72.5	27.5	.02
Small	42 (12.2)	54.8	45.2	
Surgery hospital volume				
High or medium, >5000 patient discharges	301 (87.5)	72.4	27.6	.03
Low	43 (12.5)	55.8	44.2	
Specialist shortage county[a]				
Yes	31 (9.1)	54.8	45.2	.047
No	310 (90.9)	71.9	28.1	

[a]Three (n = 3) patients were listed without address of residence.

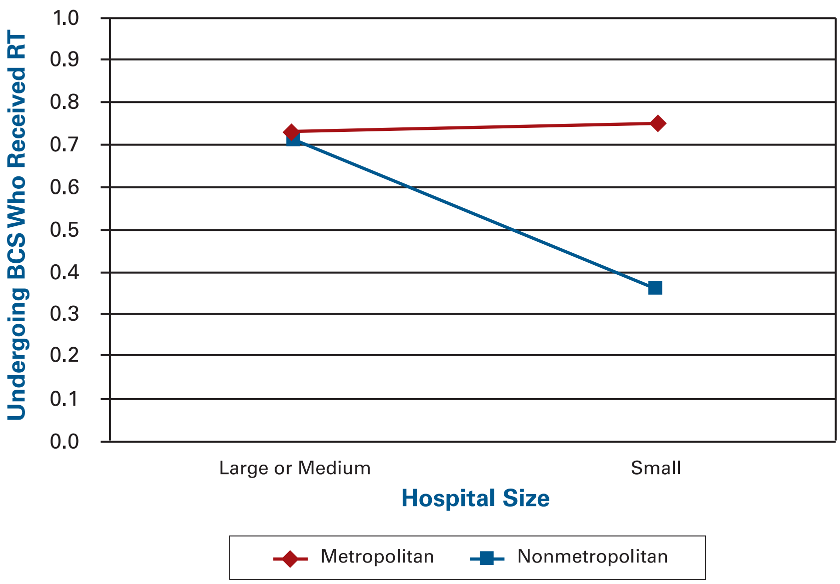
in group homes or assisted-living facilities. This builds on previous work[10,13] and on the larger literature about patterns of breast cancer care among underserved populations[18,21-24,33] by revealing that, like barriers to diagnostic follow-up of mammography,[34-36] barriers to the receipt of adjuvant RT following BCS are multilevel, including individual (age), residential location (rural), and healthcare system (hospital size and patient volume) inputs. This is important because it is well established that omission of RT increases the risk for tumor recurrences following BCS (1990 National Institutes of Health 1990 Consensus Conference[5]). Although randomized clinical trials have not found a benefit of increased survival with RT, recent population and cohort studies[8,10,11,37] show poorer longer-term survival for patients without RT. We hypothesize that the pattern of results for RT use found in this study reflects the larger issue of quality of care (eg, through care coordination processes among healthcare organizations) and a varying availability of resources focused on seamless comprehensive cancer care. The

Table 3. Variable Estimates of Logistic Regression Analysis Predicting Radiation Therapy in Patients Undergoing Breast-Conserving Surgery

Variable	β Level (SD)	Odds Ratio (95% Confidence Interval)
Intercept	0.07 (0.51)	—
Age ≥65 y at the time of diagnosis	–0.47 (0.13)[a]	0.39 (0.23-0.65)
Other race/ethnicity	–0.03 (0.13)	0.94 (0.57-1.57)
Charlson Comorbidity Index[b]		
1	–0.06 (0.23)	0.85 (0.40-1.80)
≥2	–0.03 (0.19)	0.88 (0.49-1.59)
Patient residence in		
Metropolitan county	0.47 (0.22)[c]	—
Assisted-living facility	–0.43 (0.15)[d]	0.42 (0.23-0.76)
Specialist shortage county	0.17 (0.64)	1.18 (0.34-4.17)
Hospital size, high Medicaid	0.31 (0.29)	—
Higher volume	0.36 (0.52)	1.43 (0.51-3.99)
Patient residence in metropolitan county–x–hospital size	–0.42 (0.22)[c]	—

[a] *P* <.001.
[b] Reference category, 0.
[c] *P* <.05.
[d] *P* <.01.

Figure. Interaction Graph Showing Unadjusted Proportions of Radiation Therapy (RT) in Patients Undergoing Breast-Conserving Surgery (BCS) by Metropolitan County Residence Status and by Hospital Size



cancer patient volumes typically have fewer resources dedicated specifically to the care coordination of patients with cancer than larger comprehensive cancer facilities, where an array of services across the continuum of cancer care can be integrated within a single information system or community region. However, future studies are needed to directly test this hypothesis and to suggest interventions to improve the rate of access to required treatment among low-income populations. For example, Bickell and colleagues[38] in a physician recall survey study of 119 women surgically treated for breast cancer 4 years earlier who did not receive standard adjuvant therapies found that adjuvant treatment was underused when surgical care was delivered at a municipal hospital and was associated with a pattern of referral to a clinic rather than to a specifically named oncologist. In addition, system failures were more common among Medicaid-enrolled patients than among Medicare-enrolled patients. Schrag et al[25] reported that enrollment in Medicaid is associated with greater fragmentation of hospital care among chronically ill New York City residents than enrollment in other insured groups. This suggests that Medicaid recipients are vulnerable to disjointed care or disruptions in care. Transportation, also a likely barrier in Medicaid populations, has been shown to influence the receipt of RT through association with the distance that a patient must travel to receive care.[15] Small hospitals in nonmetropolitan counties likely have fewer resources on site and may require their patients undergoing BCS to travel to other facilities for RT.

latter is a process that leads with patient education and assistance in decision making about the choice of surgery through the facilitation of a patient's navigation of postsurgical care and secondary preventive care. Smaller hospitals with lower

The association of age as a barrier to adjuvant RT following BCS reflects the larger controversy about optimal management of breast cancer in older women and is consistent with the reported underuse of RT in SEER data.[37] However, there is evidence that older women, despite having fewer survival years remaining, may benefit from RT alone[39] or in the context of hormonal therapy[40] by a reduction in risk for local disease recurrence. Finally, the finding that women listed in the Medicaid enrollment files as living in a group home or assisted-living facility were at risk for omission of RT after adjusting for all model covariates is intriguing and merits further study. Bradley et al[41] studied nursing home patients insured under Michigan Medicaid and found underuse of cancer services in this population. Patients in assisted-living facilities are likely frail and may be deemed likely to succumb to competing causes of death. However, these patients are not autonomous, and some may be subjected to lack of follow-up care through deficiencies in care coordination that may be present in some facilities.

Take-away Points

Omission of adjuvant radiation therapy (RT) after breast-conserving surgery leads to higher recurrence and mortality rates. One third of Medicaid-insured women with low socioeconomic status did not receive adjuvant RT.

- In a linked central cancer registry and North Carolina Medicaid claims database, we find that the following patient and health system characteristics are associated with lack of receipt of adjuvant RT: older age (≥65 years), residing in a low–population density county, receiving surgery at a smaller hospital, and living in a county classified as a whole-county specialist scarcity area.
- We propose that geographic isolation and scarcity of healthcare specialists are possible leverage points for interventions in this regard.

Certain limitations of this study deserve to be noted. We did not have a data source independent of hospital registrar data in this study (ie, independent reabstraction of medical record data); therefore, the extent of false-positive listings in the CCR or in claims could not be assessed. However, Cress et al[42] examined the correspondence of registry data to physician medical records and found 2% disagreement with registry information. Similarly, Malin et al[16] found that the medical record is generally positive when the registry says that no treatment was delivered. Another limitation is that our results pertain to cases of primary breast cancer identified in the NC CCR in 1998 and 1999 and might not be generalizable to systems in other states or to time frames that vary from ours in the degree of data completeness. The NC registry system has received "gold" and "silver" ratings on the quality of its 1998 and 1999 data by the North American Association of Central Cancer Registries based on case ascertainment and has received silver ratings based on case completeness. North Carolina Medicaid policy required crossing over of all Medicare claims to NC Medicaid for determination of coinsurance payment of deductibles and of noncovered charges associated with a treatment or procedure. States that do not require this level of detail will likely lack claims for the dually insured; therefore, Medicare data will be necessary to fill this gap. Finally, we did not obtain data from other insurance plans; therefore, we cannot conclude that Medicaid-enrolled patients treated with BCS are at a greater disadvantage than non–Medicaid-enrolled patients in accessing adjuvant RT. There is other evidence to suggest that Medicaid-enrolled patients are less likely to receive guideline-concordant therapy. In a study of SEER data, Harlan et al[43] found that among patients with cancer diagnosed from 1995 through 1999, non-Hispanic blacks with Medicaid coverage had significantly lower rates of guideline-concordant therapy compared with non-Hispanic blacks having Medicare coverage only, private insurance, or no insurance.

In conclusion, we find that factors related to geographic isolation and to scarcity of healthcare specialists are related to omission of adjuvant RT after BCS in this Medicaid population characterized by low-income status. Because RT is a key component of local definitive therapy for breast cancer, its omission may adversely affect survival outcomes. As such, this work provides potential target interventions to improve care among Medicaid-enrolled and low-income populations to help us work toward eliminating disparities in cancer outcomes.

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