Published in final edited form as:

Women Health. 2015 ; 55(8): 975–995. doi:10.1080/03630242.2015.1061095.

Patterns of Care for Localized Breast Cancer in Oklahoma, 2003–2006

JANIS E. CAMPBELL, PhD,

Department of Biostatistics and Epidemiology, College of Public Health, University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, USA

AMANDA E. JANITZ, PhD,

Department of Biostatistics and Epidemiology, College of Public Health, University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, USA

SARA K. VESELY, PhD,

Department of Biostatistics and Epidemiology, College of Public Health, University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, USA

DANA LLOYD, MS, RHIA, CTR, and

Department of Health Information Management, Southwestern Oklahoma State University, Weatherford, Oklahoma, USA

ANNE PATE, PhD

School of Nursing and Allied Health Sciences, Southwestern Oklahoma State University, Weatherford, Oklahoma, USA

Abstract

Despite well-established clinical guidelines for breast cancer treatment, Standard of Care (SOC) is not universal in the U.S. The purpose of this study was to describe the extent to which patients receive guideline-based, stage-specific treatments for localized female breast cancer in Oklahoma. Data were obtained from the Oklahoma Central Cancer Registry for the period 2003–2006. We included localized, invasive female breast cancers and analyzed both treatment and demographic factors. We used the National Comprehensive Cancer Network (NCCN) treatment guidelines to determine SOC. Among women who received breast conserving surgery (BCS), we used logistic regression to evaluate factors related to SOC. In Oklahoma, 92 percent of the 4,177 localized breast cancer patients were treated with recognized SOC. In women aged ≥65 years with BCS, those ≥75 years had a lower adjusted odds of meeting SOC than did those without insurance, with comorbid conditions, or whose comorbid status was unknown. Among women aged <65 years, those with Medicare/Medicaid, Medicare only, or without insurance, along with comorbid conditions, had a lower adjusted odds of meeting SOC. Overall, 92 percent of women met SOC. Factors such as age, insurance type, and comorbid conditions were associated with meeting SOC.

Keywords

breast cancer; localized; Oklahoma; standard of care

INTRODUCTION

Breast cancer is the most frequently diagnosed cancer among women in the U.S. and Oklahoma, with over 250,000 diagnosed in the U.S. and 3,000 in Oklahoma in 2009. With over 40,000 women in the U.S. and 450 in Oklahoma dying from breast cancer disease in 2009, early breast cancer treatment is critical for control of cancer-related sequelae and death. Clinical practice guidelines for first course treatment of invasive breast cancer have been well-established (Burststein et al. 2010; Griggs et al. 2011; Harris et al. 2007; Hellekson 2001; Lyman et al. 2005; National Comprehensive Cancer Network 2012; Recht et al. 2001; Wolff et al. 2007). Despite these well-established clinical guidelines, the standard of care in breast cancer treatment is not universal in the U.S. (Anderson et al. 2008; Berry et al. 2005; Breen et al. 1999; Carcaise-Edinboro, Bradley, and Dahman 2010; Coburn et al. 2008; Du and Simon 2005; Giordano et al. 2005; Gorin et al. 2006; Griggs et al. 2007, 2003; Hershman et al. 2006, 2005; Lee-Feldstein et al. 2000; Li et al. 2003; Lund et al. 2008; McCarthy et al. 2006; Roetzheim et al. 2000; Ward et al. 2008; Wilson et al. 2007; Worthington et al. 2008; Wu et al. 2008). Although studies have had inconsistent findings, a few characteristics have been associated with significantly lower rates of standard of care or treatment including race, ethnicity, insurance status, geographic disparities, and type of treatment facility, disability, marital status, and age. Patterns of care studies, however, have not been reported for all areas of the U.S.

The purpose of this study was to describe the extent to which patients receive guideline-based, stage-specific treatments for localized female breast cancer as defined by the National Comprehensive Cancer Network (NCCN), also referred to as Standard of Care (SOC) and the factors that related to receiving SOC in Oklahoma patients. The study also evaluated the relationship between SOC and demographic and treatment factors among patients who received BCS.

METHODS AND MATERIALS**Data Collection and Description**

Data were obtained from the Oklahoma Central Cancer Registry (OCCR) of the National Program of Central Cancer Registries (NPCR), Centers for Disease Control and Prevention (CDC), which maintains a population-based cancer database of all cancer diagnosed or treated in Oklahoma since January 1, 1997. This statewide population-based registry enables both private and public health agencies to study cancer trends and to develop and assess cancer prevention and control programs with data. OCCR follows standards developed by the North American Association of Central Cancer Registries (NAACCR). This study was exempt from institutional review board review by both the University of Oklahoma Health Sciences Center and the Oklahoma State Department of Health.

We included female invasive breast cancer cases (ICD-O-3 site codes C50.0–C50.9, behavior code 3) (Fritz 2000) diagnosed among residents of Oklahoma from January 1, 2003 to December 31, 2006 with localized stage breast cancers. Cancer stage at diagnosis was determined using the SEER Summary Stage 2000 for cases diagnosed in 2003 and using the derived SEER Summary Stage 2000 for cases diagnosed in 2004 through 2006. Cancer stage at diagnosis was determined using the SEER definition. Stage I was defined as the tumor confined to the breast with a negative lymph node status and negative for distant metastasis. Cases identified solely through a death certificate or at autopsy and those that had a survival of less than one year from the date of diagnosis were excluded. Other exclusion criteria included those that had a history of cancer, patients diagnosed by mammogram but not pathologically confirmed, and out of state cases (meaning patients that resided in Oklahoma but all diagnosis and treatment procedures were performed outside of Oklahoma). Women whose histology codes (9050–9055, 9140, and 9590–9989) specified mesotheliomas, Kaposi sarcomas, and lymphomas were also excluded. Of the 4,190 women that met the case definition, 13 did not have adequate information to evaluate if SOC was met. These 13 women were excluded and the analysis focuses on the 4,177 remaining women.

For this study, review was completed to assure complete treatment and demographic data (McDavid et al. 2004; Simon et al. 2006; Warren and Harlan 2003). The medical records for cases with incomplete treatment data were re-abstracted for additional information. Incomplete treatment was determined as those cases with no surgery code documented or with breast conserving surgery (BCS) and no radiation therapy (RT). Data were collected on first course of cancer-related treatment. First course of treatment included all treatment modalities received until the treatment plan was completed or disease progression or treatment failure. Data collected included details of pathological stage, examinations used to determine stage, and the treatment. Cases were also linked to Oklahoma Hospital Discharge and Oklahoma's Medicaid data to obtain missing payer information, race, reporting facilities, and treatment data. Neither estrogen receptor (ER) nor progesterone receptor (PR) status were re-abstracted as they were not required elements for OCCR at the time. This is reflected in the number of missing or unknown as 47.4 percent of women were reported as missing or unknown in both ER and PR status.

Standard of Care

The NCCN treatment guidelines for localized breast cancer were used in this study (National Comprehensive Cancer Network 2012). The recommended primary treatment for localized or early-stage breast cancer is either a total or modified radical mastectomy (MRM) or BCS followed by RT. Both surgical procedures require surgical axillary lymph node staging. BCS included excisional biopsy/lumpectomy, wedge resection, quadrectomy, tylectomy, and segmented or sub-cutaneous mastectomy. Mastectomy included simple, modified, radical, and NOS (not otherwise specified), with or without removal of the uninvolved contralateral breast. Adjuvant treatments (radiotherapy, chemotherapy, and hormonal therapy) were dichotomized into receipt/no receipt categories.

NCCN treatment guidelines for women aged 70 and older who had BCS differs from that of younger women (National Comprehensive Cancer Network 2012). They could meet SOC

either by having RT or by receiving adjuvant endocrine therapy if they were both ER positive and had removal of lymph nodes (LN) and all were negative. Among the Oklahoma patients aged 70 years and older who received BCS without RT, we categorized women who had LN removal and all LN were negative and who were receiving adjuvant endocrine therapy as meeting SOC ($n = 33$) if the ER status was positive or unknown. We categorized women who met one of the following criteria: negative ER status, EA testing not done, LN not examined, or no adjuvant endocrine therapy, as not meeting SOC ($n = 142$). Women whose adjuvant endocrine therapy status and/or LN removal status were unknown were categorized as unknown ($n = 7$) (Figure 1).

Treatment factors analyzed included type of first course treatment, type of surgery (MRM and BCS), and receipt of chemotherapy, radiotherapy, or hormonal therapy. Categories presented are based on treatment guidelines (Burstein et al. 2010; Griggs et al. 2011; Harris et al. 2007; Hellekson 2001; Lyman et al. 2005; National Comprehensive Cancer Network 2012; Recht et al. 2001; Wolff et al. 2007). Age at diagnosis was categorized into five groups (<40, 40–49, 50–64, 65–74, and 75+ years). An individual's race was determined using the OCCR race 1 variable for all racial groups except American Indians, whose race was determined using the Indian Health Service link variable and/or race 1. For Hispanic ethnicity, we relied on the NAACCR Hispanic Identification Algorithm (NHIA), which uses a combination of NAACCR variables to classify individuals directly or indirectly as Hispanic. Tumor size and grade were collected using NAACCR guidelines (Thornton 2010) and grouped using treatment criteria (Burstein et al. 2010; Griggs et al. 2011; Harris et al. 2007; Hellekson 2001; Kaufmann et al. 2007; Lyman et al. 2005; National Comprehensive Cancer Network 2012; Recht et al. 2001; Wolff et al. 2007). Patient's whose address at diagnosis were in metropolitan counties as defined by the rural urban continuum 2000 were classified as metro, with others as non-metro (National Cancer Institute and Surveillance Epidemiology and End Results n.d.). Tumor size was categorized into: 0.0–1.0 mm, 1.1–2.0 mm, 2.1–5.0 mm, and 5.1–14.0 mm, based on the NCCN Guidelines (National Comprehensive Cancer Network 2012). Grade represents the degree of tumor cell differentiation; defined as highly (Grade 1), moderately (Grade 2), poorly (Grade 3), and differentiated or undifferentiated (Grade 4). Comorbidities were assessed with Charlson index of comorbidity (Charlson et al. 1987; Sarfati 2012). Reporting of comorbidities is not required and is primarily reported by larger facilities, thus 11 percent ($n = 452$) are missing information on comorbidities and were classified as unknown.

Poverty and education level were assigned based on census tract of residence from U.S. census data; census tract was determined by complete address, zip code + 4 or zip code only, excluding unknown ($n = 1$) and those with Post Office boxes only ($n = 333$). Each woman was assigned a category based on her census tract of residence at diagnosis for both poverty level (<5 percent, 5–9 percent, 10–19 percent, >20 percent) and education level (<75 percent, 75–82 percent, 83–89 percent, >90 percent). Census tracts were identified at annual geocoding of the cancer cases by the OCCR.

Statistical Analysis

To evaluate the treatment and demographic factors associated with our outcome of interest, we used univariate logistic regression. Our outcome of interest was meeting SOC; this was analyzed in all patients and among patients whose surgery was BCS. For our final analysis, we compared the odds of meeting SOC among those with BCS, stratified by age groups (younger than age 65 years and 65 years and older) and adjusted for the remaining variables in the model using logistic regression. We chose younger than age 65 years compared to 65 years and older because that is the age at which women become eligible for Medicare, which is the insurer for virtually all women aged 65 years and older and insurance is an important variable in the patterns of care. We started with a full model (the initial model included age, race, metro/non-metro status, primary payer, diagnosis year, marital status, tumor size, grade, area poverty level, and area education level) and removed non-significant variables to calculate adjusted odds ratios (ORs) and 95 percent confidence intervals (CIs). We assessed all possible interactions. After removing a variable, if the point estimate for the remaining variables changed more than 20 percent, we treated the variable as a confounder, and it remained in the model. The final model included significant variables (p value $< .05$) and potentially confounding variables. We did not report a p value for these results, but assessed it during the modeling process. We used the Hosmer-Lemeshow Goodness of Fit Test to assess if the model fit the data. All analyses were conducted using SAS®, version 9.2 software (SAS Institute, Cary, NC, USA). All reported p values correspond to two-sided tests. The threshold for statistical significance was set at a two-sided alpha level of .05.

RESULTS

Overall in Oklahoma, 92 percent (3,848/4,177) (95 percent CI: 91 percent, 93 percent) of the localized breast cancer patients diagnosed during 2003–2006 were treated with the recognized SOC (Figure 1, Table 1). Among the 2,573 women who received BCS, 89 percent ($n = 2,282$) met SOC (95 percent CI: 88 percent, 90 percent). All women who received MRM met SOC. A total of 329 women did not meet SOC. Among these women, 291 had BCS but no RT reported. Thirty-eight women had no surgery reported, and of these thirty-eight women, three reported RT (data not shown). Among the thirty-eight cases that did not receive surgery, the reasons given for almost half (47.4 percent) were reported as unknown, but 21.1 percent reported surgery of the primary site was not performed because it was not part of the planned first course treatment, and 15.8 percent of cases refused surgery (data not shown). Among the 149 women aged 69 years and younger who did not receive RT with their BCS, 44.0 percent reported no known reason, 19.4 percent refused RT, and 26.1 percent reported that RT was not a part of planned first course of treatment (data not shown).

Next, we assessed which women received SOC, regardless of treatment type, in Oklahoma (Table 1). Women aged 75 years and older had significantly lower odds of meeting SOC (Table 1; 85.8 percent, OR: 0.41, 95 percent CI: 0.31, 0.55) compared to women aged 50–64 years (93.6 percent). Women with a primary payer of Medicare/Medicaid (88.3 percent, OR: 0.45, 95 percent CI: 0.34, 0.62), Medicare (90.8 percent, OR: 0.59, 95 percent CI: 0.45, 0.78), and those without insurance (86.0 percent, OR: 0.37, 95 percent CI: 0.21, 0.64) had

significantly lower odds than those with private insurance (94.3 percent) to have met SOC. When considering SOC by marital status categories, significantly lower percentages meeting SOC were observed with those who were widowed (89.0 percent, OR: 0.50, 95 percent CI: 0.38, 0.66) and had an unknown marital status (80.1 percent, OR: 0.25, 95 percent CI: 0.17, 0.36) having lower odds of meeting SOC than married women (94.2 percent). Also, differences were observed in SOC by tumor size categories ($p = .04$). Those with tumor size between 10 and 19 mm (93.8 percent, OR: 1.66, 95 percent CI: 1.23, 2.25) had higher odds of meeting SOC than women with a tumor size ≤ 1 mm (90.2 percent). Those with a comorbid index of 1 (89.9 percent, OR: 0.61, 95 percent CI: 0.41, 0.90) or 2 (84.1 percent, OR: 0.36, 95 percent CI: 0.18, 0.72) or unknown comorbid index (83.9 percent, OR: 0.35, 95 percent CI: 0.27, 0.47) had a lower odds of meeting SOC than women with an index of 0 (93.6 percent). We did not find overall differences in SOC by tumor grade, but women having a tumor of grade 2 (93.1 percent, OR: 1.49, 95 percent CI: 1.11, 2.00) had higher odds of meeting SOC than women with grade 1 tumors (90.1 percent). No overall differences were observed in SOC by poverty; however, women in areas with a population between 10 and 19.9 percent living below the federal poverty level (91.0 percent, OR: 0.68, 95 percent CI: 0.47, 0.98) had lower odds of meeting SOC than women living in areas with <5 percent living below the poverty level (93.7 percent). No significant difference in meeting SOC was observed by race, metro/non-metro location, diagnosis year, or education.

Because all women with MRM met SOC, we analyzed whether SOC was met among women with BCS only (Table 2). Differences were observed by age group ($p < .0001$), primary payer ($p < .0001$), marital status ($p < .0001$), tumor size ($p = .003$), and comorbid conditions ($p < .0001$). Those who were 75 years and older had a lower odds of meeting SOC than those aged 50–64 years (OR: 0.31, 95 percent CI: 0.23, 0.42). Compared to those with private insurance, women with Medicare/Medicaid (OR: 0.38, 95 percent CI: 0.27, 0.53), Medicare only (OR: 0.47, 95 percent CI: 0.35, 0.64), and those who were not insured (OR: 0.31, 95 percent CI: 0.17, 0.56) had a lower odds of meeting SOC. Women who were single (OR: 0.60, 95 percent CI: 0.38, 0.96), widowed (OR: 0.39, 95 percent CI: 0.29, 0.53), or had unknown marital status (OR: 0.21, 95 percent CI: 0.13, 0.32) had lower odds of meeting SOC than married women. Women with a tumor size >5 mm to ≤ 10 mm (OR: 1.74, 95 percent CI: 1.15, 2.62) or >10 mm to ≤ 20 mm (OR: 1.79, 95 percent CI: 1.30, 2.48) had higher odds of meeting SOC than women with tumors ≤ 1 mm. Women with a comorbid index of 1 (OR: 0.42, 95 percent CI: 0.27, 0.66) or 2 (OR: 0.18, 95 percent CI: 0.08, 0.40) or an unknown comorbid index (OR: 0.27, 95 percent CI: 0.20, 0.38) had lower odds of meeting SOC than women with an index of 0. Although we did not detect overall differences in poverty, women in areas with between 10 and 19.9 percent (OR: 0.62, 95 percent CI: 0.41, 0.91) or ≥ 20 percent (OR: 0.62, 95 percent CI: 0.39, 0.97) living below the federal poverty level had lower odds of meeting SOC than women living in areas with <5 percent living below the poverty level. We observed no significant difference by race, metro/non-metro location, diagnosis year, grade, or education.

Finally, a model was created to assess the relationship between the explanatory variables and SOC among women with BCS only while controlling for other variables. Two models were created stratifying by age (<65 years, ≥ 65 years); age was stratified due to insurance

differences between the two age groups (Table 3). A total of 1,466 women were younger than age 65 years and 1,102 women aged 65 years and older who received BCS. We removed education from both models as an interaction was observed between poverty and education in women aged 65 years or older, and poverty was marginally significant and may be more important than education regarding SOC. We also removed marital status from the models due to interactions as it was not a primary variable of interest. Among women younger than age 65 years, age was not included in the model as it was not related to SOC and was not a confounder. The model fit the data for both age groups based on the Hosmer-Lemeshow Goodness of Fit Test (women aged <65 years, $p = .10$; women aged 65 years, $p = .96$).

Among women aged 65 years and older, the only variables related to SOC were age, primary payer, and comorbid conditions (Table 3). Women aged 75 years and older had a lower odds of meeting SOC than those aged 65–74 years (OR: 0.30, 95 percent CI: 0.20, 0.43). Among women aged 65 years and older, those without insurance had lower odds to meet SOC than those with private insurance (OR: 0.13, 95 percent CI: 0.02, 0.82). Among women aged 65 years and older, those with a comorbid index of 1 or more (OR: 0.38, 95 percent CI: 0.23, 0.62) or an unknown comorbid index (OR: 0.26, 95 percent CI: 0.15, 0.43) also had lower odds of meeting SOC than those with an index of 0.

Among women younger than 65 years of age, insurance, diagnosis year, tumor size, and comorbid conditions were related to meeting SOC (Table 3). Among women younger than age 65 years, those with Medicare/Medicaid combined (OR: 0.32, 95 percent CI: 0.12, 0.86), Medicare alone (OR: 0.29, 95 percent CI: 0.11, 0.73), and those who were uninsured (OR: 0.31, 95 percent CI: 0.16, 0.63) had lower odds of meeting SOC than those with private insurance. We also found differences in the odds of SOC by tumor size. Compared to a tumor size 1 mm, women younger than age 65 years with a tumor size >5 mm to 10 mm (OR: 2.80, 95 percent CI: 1.13, 6.95), >10 mm to 20 mm (OR: 3.09, 95 percent CI: 1.37, 6.96), and >20 mm (OR: 2.75, 95 percent CI: 1.18, 6.40) had higher odds of meeting SOC. Similar to women aged 65 years and older, among women younger than age 65 years, those with an unknown comorbid index had lower odds of meeting SOC than those with an index of 0 (OR: 0.38, 95 percent CI: 0.22, 0.67). Finally, women diagnosed in 2006 had lower odds of meeting SOC than women diagnosed in 2003 (OR: 0.33, 95 percent CI: 0.14, 0.79).

DISCUSSION

Overall, in Oklahoma, 92 percent of the 2003–2006 localized breast cancer patients were treated with the recognized SOC. Thirteen percent ($n = 331$) of women who received BCS ($n = 2,580$) did not receive RT. Women in Oklahoma were highly likely to meet SOC; however, it was not universal, and thus there should be strategies for improvement.

The interplay of the factors associated with the choice between BCS with RT and MRM are complex and often inconsistent. It is well established that women who receive BCS with RT have the same survival as women who receive MRM (Fisher et al. 2002; Veronesi et al. 2002). It is also well established that women who do not receive SOC (by choice or due to other reasons) have decreased survival particularly among the elderly who, as in this study,

are also less likely to meet SOC (Bouchardy et al. 2003; Joseph et al. 2012; Schonberg et al. 2010; Verkooijen et al. 2005; Yood et al. 2008). BCS with RT is often considered a preferable treatment with less risk during surgery, with less complex reconstruction after surgery leaving more of the breast intact, thus better cosmetic outcomes (Arroyo and Lopez 2011; National Institute of Health Consensus Development Panel 1992). Recent research suggests it might even improve survival for earlier stage breast cancers (Brooks et al. 2012; Hwang et al. 2013; Keating et al. 2011). It is not, however, appropriate for all women, such as women with large or multiple tumors, women with genetic mutations, women with sensitivity to radiation therapy or without access to ongoing radiation therapy.

We found several demographic factors associated with lower odds of receiving SOC, including age and insurance status. Women aged 75 and older, those with Medicare/Medicaid, Medicare only, and those without insurance were less likely to receive SOC as compared to those with private insurance. Previous studies have shown that older women are less likely to meet SOC (Freedman et al. 2009; Freeman, Huang, and Dragun 2012; Jaggi et al. 2010; Kimmick et al. 2012; Royak-Schaler et al. 2012; Schonberg et al. 2010). Women aged 75 years and older may have difficulty accessing care due to transportation or mobility issues. Providers and case managers treating the elderly population should identify issues when assessing their patients' ability to complete treatment. Differences by primary payer need to be investigated further.

The variables that had the greatest impact on whether a woman did or did not receive SOC were payer source at diagnosis and Comorbid Index. Those who had no insurance had the lowest odds of receiving SOC as compared with those with private insurance, followed by those on Medicare and Medicare/Medicaid. Disparities remain and some areas continue to require improvement among women in Oklahoma (Freedman and Winer 2008).

Furthermore, women with 1 or more on the Charlson Comorbid Index had a lower odds of meeting SOC as compared to those with an index of 0, regardless of treatment type and adjusted for other demographic and treatment variables among women who received BCS. This is consistent with previous studies assessing radiation therapy compliance following BCS in women with Medicaid and in women with any stage of breast cancer with diagnosis and treatment delays (Foley et al. 2007; Gorin et al. 2006). It is unclear why women who received BCS with unknown Charlson Comorbid Index had lower odds of receiving SOC than those with an index of 0. One possible explanation is that these women were treated at smaller, more rural hospitals that did not report comorbidities even though they were present.

The major limitation for this study was the lack of information on ER, PR, and HER2 status. The results of these tests are some of the most important factors in determining the treatment standard for breast cancer, which would include targeted therapy in women testing positive for any one of these measures. These important factors influence—although we do not believe that it affected our outcomes—in particular, the proportion of women who received SOC among women aged 70 years and older. However, this also influences the choices between MRM and BCS with RT. Another limitation was the lack of individual data for poverty or education. While this is an ongoing issue among all studies using cancer registry data, it did limit the strength of our study. A third limitation was the often incomplete

comorbidity data in cancer registry data. While the data were abstracted and linked to Oklahoma Hospital Discharge, 452 cases had missing data.

Finally, we realize that these data are only applicable to Oklahoma and may not be generalizable outside of the unique social and health systems of the state. Our study showed similar results to many other studies, and we believe that the results strengthen the understanding of patterns of care throughout the U.S. We recognize that we see differences between our results and those from the nationally representative SEER database. American Indians in SEER primarily reflect American Indian populations in the southwestern U.S. and Alaska who have different cultural influences than American Indian populations in Oklahoma; data from the Cherokee Nation in Oklahoma has only recently, in 1997, been included in SEER but are not included in SEER datasets available for analysis (Surveillance Epidemiology and End Results Program 2014). More population-based studies of SOC need to be completed to understand the entire U.S. context of care.

In summary, women in Oklahoma had disparities in receiving SOC for localized breast cancer. In particular, controlling for other factors, such as race and area poverty, women who were older, women with larger tumors, and those with comorbid conditions, as well as women with specific payer sources were important factors related to disparities in receiving SOC for localized breast cancer in Oklahoma. This has important implications for physicians, case managers, patient navigators, and social workers in recommending and monitoring women in treatment for breast cancer.

References

- Anderson RT, Kimmick GG, Camacho F, Whitmire JT, Dickinson C, Levine EA, Torti FM, Balkrishnan R, Anderson RT, Kimmick GG, Camacho F, Whitmire JT, Dickinson C, Levine EA, Torti FM, Balkrishnan R. Health system correlates of receipt of radiation therapy after breast-conserving surgery: A study of low-income Medicaid-enrolled women. *American Journal of Managed Care*. 2008; 14(10):644–52. [PubMed: 18837642]
- Arroyo JM, Lopez ML. Psychological problems derived from mastectomy: A qualitative study. *International Journal of Surgical Oncology*. 2011; 2011:132461. [PubMed: 22312492]
- Berry DA, Cronin KA, Plevritis SK, Fryback DG, Clarke L, Zelen M, Mandelblatt JS, Yakovlev AY, Habbema JD, Feuer EJ. Intervention Cancer, and Collaborators Surveillance Modeling Network. Effect of screening and adjuvant therapy on mortality from breast cancer. *The New England Journal of Medicine*. 2005; 353(17):1784–92.10.1056/NEJMoa050518 [PubMed: 16251534]
- Bouchardy C, Rapiti E, Fioretta G, Laissue P, Neyroud-Caspar I, Schafer P, Kurtz J, Sappino AP, Vlastos G. Undertreatment strongly decreases prognosis of breast cancer in elderly women. *Journal of Clinical Oncology*. 2003; 21(19):3580–87.10.1200/JCO.2003.02.046 [PubMed: 12913099]
- Breen N, Wesley MN, Merrill RM, Johnson K. The relationship of socio-economic status and access to minimum expected therapy among female breast cancer patients in the National Cancer Institute Black-White cancer survival study. *Ethnicity & Disease*. 1999; 9(1):111–25. [PubMed: 10355480]
- Brooks JM, Chrischilles EA, Landrum MB, Wright KB, Fang G, Winer EP, Keating NL. Survival implications associated with variation in mastectomy rates for early-staged breast cancer. *International Journal of Surgical Oncology*. 2012; 2012:127854. [PubMed: 22928097]
- Burstein HJ, Prestrud AA, Seidenfeld J, Anderson H, Buchholz TA, Davidson NE, Gelmon KE, Giordano SH, Hudis CA, Malin J, Mamounas EP, Rowden D, Solky AJ, Sowers MR, Stearns V, Winer EP, Somerfield MR, Griggs JJ. American society of clinical oncology clinical practice guideline: Update on adjuvant endocrine therapy for women with hormone receptor-positive breast cancer. *Journal of Clinical Oncology*. 2010; 28(23):3784–96.10.1200/JCO.2009.26.3756 [PubMed: 20625130]

- Carcaise-Edinboro P, Bradley CJ, Dahman B. Surveillance mammography for Medicaid/Medicare breast cancer patients. *Journal of Cancer Survivorship: Research and Practice*. 2010; 4(1):59–66.10.1007/s11764-009-0107-0 [PubMed: 20091247]
- Charlson ME, Pompei P, Ales KL, Mackenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *Journal of Chronic Diseases*. 1987; 40(5):373–83.10.1016/0021-9681(87)90171-8 [PubMed: 3558716]
- Coburn N, Fulton J, Pearlman DN, Law C, DiPaolo B, Cady B, Coburn N, John Fulton DN, Pearlman CL, DiPaolo B, Cady B. Treatment variation by insurance status for breast cancer patients. *Breast Journal*. 2008; 14(2):128–34.10.1111/j.1524-4741.2007.00542.x [PubMed: 18315690]
- Du W, Simon MS. Racial disparities in treatment and survival of women with stage I–III breast cancer at a large academic medical center in metropolitan Detroit. *Breast Cancer Research & Treatment*. 2005; 91(3):243–48.10.1007/s10549-005-0324-9 [PubMed: 15952057]
- Fisher B, Anderson S, Bryant J, Margolese RG, Deutsch M, Fisher ER, Jeong JH, Wolmark N. Twenty-year follow-up of a randomized trial comparing total mastectomy, lumpectomy, and lumpectomy plus irradiation for the treatment of invasive breast cancer. *The New England Journal of Medicine*. 2002; 347(16):1233–41.10.1056/NEJMoa022152 [PubMed: 12393820]
- Foley KL, Kimmick G, Camacho F, Levine EA, Balkrishnan R, Anderson R. Survival disadvantage among Medicaid-insured breast cancer patients treated with breast conserving surgery without radiation therapy. *Breast Cancer Research & Treatment*. 2007; 101(2):207–14.10.1007/s10549-006-9280-2 [PubMed: 16838114]
- Freedman RA, He Y, Winer EP, Keating NL. Trends in racial and age disparities in definitive local therapy of early-stage breast cancer. *Journal of Clinical Oncology*. 2009; 27(5):713–19.10.1200/JCO.2008.17.9234 [PubMed: 19103731]
- Freedman RA, Winer EP. Reducing disparities in breast cancer care—a daunting but essential responsibility. *JNCI Journal of the National Cancer Institute*. 2008; 100(23):1661–63.10.1093/jnci/djn412 [PubMed: 19033563]
- Freeman AB, Huang B, Dragun AE. Patterns of care with regard to surgical choice and application of adjuvant radiation therapy for preinvasive and early stage breast cancer in rural Appalachia. *American Journal of Clinical Oncology*. 2012; 35(4):358–63.10.1097/COC.0b013e3182118d27 [PubMed: 21422902]
- Fritz, AG. International classification of diseases for oncology: ICD-O. 3. Geneva, Switzerland: World Health Organization; 2000.
- Giordano SH, Hortobagyi GN, Kau SWC, Theriault RL, Bondy ML. Breast cancer treatment guidelines in older women. *Journal of Clinical Oncology*. 2005; 23(4):783–91.10.1200/JCO.2005.04.175 [PubMed: 15681522]
- Gorin SS, Heck JE, Cheng B, Smith SJ, Gorin SS, Heck JE, Cheng B, Smith SJ. Delays in breast cancer diagnosis and treatment by racial/ethnic group. *Archives of Internal Medicine*. 2006; 166(20):2244–52. [PubMed: 17101943]
- Griggs JJ, Culakova E, Sorbero MES, Poniewierski MS, Wolff DA, Crawford J, Dale DC, Lyman GH. Social and racial differences in selection of breast cancer adjuvant chemotherapy regimens. *Journal of Clinical Oncology*. 2007; 25(18):2522–27.10.1200/JCO.2006.10.2749 [PubMed: 17577029]
- Griggs JJ, Somerfield MR, Anderson H, Henry NL, Hudis CA, Khatcheressian JL, Partridge AH, Prestrud AA, Davidson NE. American society of clinical oncology endorsement of the cancer care ontario practice guideline on adjuvant ovarian ablation in the treatment of premenopausal women with early-stage invasive breast cancer. *Journal of Clinical Oncology*. 2011; 29(29):3939–42.10.1200/JCO.2011.36.4950 [PubMed: 21900112]
- Griggs JJ, Sorbero ME, Stark AT, Heininger SE, Dick AW. Racial disparity in the dose and dose intensity of breast cancer adjuvant chemotherapy. *Breast Cancer Research and Treatment*. 2003; 81(1):21–31.10.1023/A:1025481505537 [PubMed: 14531494]
- Harris L, Fritsche H, Mennel R, Norton L, Ravdin P, Taube S, Somerfield MR, Hayes DF, Bast RC. American society of clinical oncology 2007 update of recommendations for the use of tumor markers in breast cancer. *Journal of Clinical Oncology*. 2007; 25(33):5287–312.10.1200/JCO.2007.14.2364 [PubMed: 17954709]

- Hellekson KL. NIH statement on adjuvant therapy for breast cancer. *American Family Physician*. 2001; 63(9):1857–58. 1861. [PubMed: 11352296]
- Hershman D, McBride R, Jacobson JS, Lamerato L, Roberts K, Grann VR, Neugut AI. Racial disparities in treatment and survival among women with early-stage breast cancer. *Journal of Clinical Oncology*. 2005; 23(27):6639–46.10.1200/JCO.2005.12.633 [PubMed: 16170171]
- Hershman DL, Wang XY, McBride R, Jacobson JS, Grann VR, Neugut AI. Delay of adjuvant chemotherapy initiation following breast cancer surgery among elderly women. *Breast Cancer Research and Treatment*. 2006; 99(3):313–21.10.1007/s10549-006-9206-z [PubMed: 16583264]
- Hwang ES, Lichtensztajn DY, Gomez SL, Fowble B, Clarke CA. Survival after lumpectomy and mastectomy for early stage invasive breast cancer: The effect of age and hormone receptor status. *Cancer*. 2013; 119(7):1402–11.10.1002/cncr.27795 [PubMed: 23359049]
- Jagsi R, Abrahamse P, Morrow M, Hawley ST, Griggs JJ, Graff JJ, Hamilton AS, Katz SJ. Patterns and correlates of adjuvant radiotherapy receipt after lumpectomy and after mastectomy for breast cancer. *Journal of Clinical Oncology*. 2010; 28(14):2396–403.10.1200/JCO.2009.26.8433 [PubMed: 20351324]
- Joseph K, Vrouwe S, Kamruzzaman A, Balbaid A, Fenton D, Berendt R, Yu E, Tai P. Outcome analysis of breast cancer patients who declined evidence-based treatment. *World Journal of Surgical Oncology*. 2012; 10:118. [PubMed: 22734852]
- Kaufmann M, Von Minckwitz G, Bear HD, Buzdar A, McGale P, Bonnefoi H, Colleoni M, Denkert C, Eiermann W, Jackesz R, Makris A, Miller W, Pierga JY, Semiglazov V, Schneeweiss A, Souchon R, Stearns V, Untch M, Loibl S. Recommendations from an international expert panel on the use of neoadjuvant (primary) systemic treatment of operable breast cancer: New perspectives 2006. *Annals of Oncology*. 2007; 18(12):1927–34.10.1093/annonc/mdm201 [PubMed: 17998286]
- Keating NL, Landrum MB, Brooks JM, Chrischilles EA, Winer EP, Wright K, Volya R. Outcomes following local therapy for early-stage breast cancer in non-trial populations. *Breast Cancer Research and Treatment*. 2011; 125(3):803–13.10.1007/s10549-010-0865-4 [PubMed: 20376555]
- Kimmick GG, Camacho F, Hwang W, Mackley H, Stewart J, Anderson RT. Adjuvant radiation and outcomes after breast conserving surgery in publicly insured patients. *Journal of Geriatric Oncology*. 2012; 3(2):138–46.10.1016/j.jgo.2012.01.004 [PubMed: 22712029]
- Lee-Feldstein A, Feldstein PJ, Buchmueller T, Katterhagen G. The relationship of HMOs, health insurance, and delivery systems to breast cancer outcomes. *Medical Care*. 2000; 38(7):705–18.10.1097/00005650-200007000-00003 [PubMed: 10901354]
- Li CI, Malone KE, Daling JR, Li CI, Malone KE, Daling JR. Differences in breast cancer stage, treatment, and survival by race and ethnicity. *Archives of Internal Medicine*. 2003; 163(1):49–56. [PubMed: 12523916]
- Lund MJ, Brawley OP, Ward KC, Young JL, Gabram SSG, Eley JW. Parity and disparity in first course treatment of invasive breast cancer. *Breast Cancer Research and Treatment*. 2008; 109(3): 545–57.10.1007/s10549-007-9675-8 [PubMed: 17659438]
- Lyman GH, Giuliano AE, Somerfield MR, Benson AB 3rd, Bodurka DC, Burstein HJ, Cochran AJ, Cody HS 3rd, Edge SB, Galper S, Hayman JA, Kim TY, Perkins CL, Podoloff DA, Sivasubramanian VH, Turner RR, Wahl R, Weaver DL, Wolff AC, Winer EP. Oncology American Society of Clinical. American Society of Clinical Oncology guideline recommendations for sentinel lymph node biopsy in early-stage breast cancer. *Journal of Clinical Oncology*. 2005; 23(30):7703–20.10.1200/JCO.2005.08.001 [PubMed: 16157938]
- McCarthy EP, Ngo LH, Roetzheim RG, Chirikos TN, Li D, Drews RE, Iezzoni LI, McCarthy EP, Ngo LH, Roetzheim RG, Chirikos TN, Donglin L, Drews RE, Iezzoni LI. Disparities in breast cancer treatment and survival for women with disabilities [see comment] [summary for patients in *Annals of Internal Medicine* 2006 Nov 7;145(9): I16;PMID: 17088572]. *Annals of Internal Medicine*. 2006; 145(9):637–45. [PubMed: 17088576]
- McDavid K, Schymura MJ, Armstrong L, Santilli L, Schmidt B, Byers T, Steele CB, O'Connor L, Schlag NC, Roshala W, Darcy D, Matanoski G, Shen T, Bolick-Aldrich S. Quality Prostate Cancer Data, Group Patterns of Care Study. Rationale and design of the national program of cancer registries' breast, colon, and prostate cancer patterns of care study. *Cancer Causes & Control*. 2004; 15(10):1057–66.10.1007/s10552-004-1555-5 [PubMed: 15801489]

- National Cancer Institute, and Surveillance Epidemiology and End Results. [accessed September 10, 2012] Beale codes. n.d. http://seer.cancer.gov/seerstat/variables/ses/beale_codes/yr1969_2002/
- National Comprehensive Cancer Network. Breast cancer. National comprehensive cancer network, Inc; 2012. National Comprehensive Cancer Network (NCCN) clinical practice guidelines in oncology. http://www.nccn.org/professionals/physician_gls/pdf/breast.pdf [accessed December 29, 2012]
- National Institute of Health Consensus Development Panel. Consensus statement: Treatment of early-stage breast cancer. *Journal of the National Cancer Institute Monographs*. 1992; 11:1–5.
- Recht A, Edge SB, Solin LJ, Robinson DS, Estabrook A, Fine RE, Fleming GF, Formenti S, Hudis C, Kirshner JJ, Krause DA, Kuske RR, Langer AS, Sledge GW Jr, Whelan TJ, Pfister DG. Oncology American Society of Clinical. Postmastectomy radiotherapy: Clinical practice guidelines of the American Society of Clinical Oncology. *Journal of Clinical Oncology: Official Journal of the American Society of Clinical Oncology*. 2001; 19(5):1539–69. [PubMed: 11230499]
- Roetzheim RG, Gonzalez EC, Ferrante JM, Pal N, Van Durme DJ, Krischer JP. Effects of health insurance and race on breast carcinoma treatments and outcomes. *Cancer*. 2000; 89(11):2202–13.10.1002/(ISSN)1097-0142 [PubMed: 11147590]
- Royak-Schaler R, Pelsner C, Langenberg P, Hayes J, Gardner L, Nesbitt K, Citron W, Drogula CL, Dwyer D. Characteristics associated with the initiation of radiation therapy after breast-conserving surgery among African American and white women diagnosed with early-stage breast cancer in Maryland, 2000–2006. *Annals of Epidemiology*. 2012; 22(1):28–36.10.1016/j.annepidem.2011.10.001 [PubMed: 22037379]
- Sarfati D. Review of methods used to measure comorbidity in cancer populations: No gold standard exists. *Journal of Clinical Epidemiology*. 2012; 65(9):924–33.10.1016/j.jclinepi.2012.02.017 [PubMed: 22739245]
- Schonberg MA, Marcantonio ER, Li DL, Silliman RA, Ngo L, McCarthy EP. Breast cancer among the oldest old: Tumor characteristics, treatment choices, and survival. *Journal of Clinical Oncology*. 2010; 28(12):2038–45.10.1200/JCO.2009.25.9796 [PubMed: 20308658]
- Simon MS, Banerjee M, Crossley-May H, Vigneau FD, Noone A-M, Schwartz K. Racial differences in breast cancer survival in the Detroit metropolitan area. *Breast Cancer Research and Treatment*. 2006; 97(2):149–55.10.1007/s10549-005-9103-x [PubMed: 16322888]
- Surveillance Epidemiology and End Results Program. [accessed October 6, 2014] About the SEER registries. 2014. <http://seer.cancer.gov/registries/>
- Thornton, M., editor. Standards for cancer registries volume II: Data standards and data dictionary, record layout version 12.1. Springfield, IL: North American Association of Central Cancer Registries; 2010.
- Verkooijen HM, Fioretta GM, Rapiti E, Bonnefoi H, Vlastos G, Kurtz J, Schaefer P, Sappino A-P, Schubert H, Bouchardy C. Patients' Refusal of Surgery Strongly Impairs Breast Cancer Survival. *Annals of Surgery*. 2005; 242(2):276–80.10.1097/01.sla.0000171305.31703.84 [PubMed: 16041219]
- Veronesi U, Cascinelli N, Mariani L, Greco M, Saccozzi R, Luini A, Aguilar M, Marubini E. Twenty-year follow-up of a randomized study comparing breast-conserving surgery with radical mastectomy for early breast cancer. *The New England Journal of Medicine*. 2002; 347(16):1227–32.10.1056/NEJMoa020989 [PubMed: 12393819]
- Ward E, Halpern M, Schrag N, Cokkinides V, DeSantis C, Bandi P, Siegel R, Stewart A, Jemal A, Ward E, Halpern M, Schrag N, Cokkinides V, DeSantis C, Bandi P, Siegel R, Stewart A, Jemal A. Association of insurance with cancer care utilization and outcomes. *CA: A Cancer Journal for Clinicians*. 2008; 58(1):9–31. [PubMed: 18096863]
- Warren JL, Harlan LC. Can cancer registry data be used to study cancer treatment? *Medical Care*. 2003; 41(9):1003–05.10.1097/01.MLR.0000086827.00805.B5 [PubMed: 12972839]
- Wilson RT, Adams-Cameron M, Burhansstipanov L, Roubidoux MA, Cobb N, Lynch CF, Edwards BK. Disparities in breast cancer treatment among American Indian, Hispanic and non-Hispanic white women enrolled in Medicare. *Journal of Health Care for the Poor & Underserved*. 2007; 18(3):648–64.10.1353/hpu.2007.0071 [PubMed: 17675720]

- Wolff AC, Hammond ME, Schwartz JN, Hagerty KL, Allred DC, Cote RJ, Dowsett M, Fitzgibbons PL, Hanna WM, Langer A, McShane LM, Paik S, Pegram MD, Perez EA, Press MF, Rhodes A, Sturgeon C, Taube SE, Tubbs R, Vance GH, Van De Vijver M, Wheeler TM, Hayes DF. Oncology American Society of Clinical, Pathologists College of American. American Society of Clinical Oncology/College of American Pathologists guideline recommendations for human epidermal growth factor receptor 2 testing in breast cancer. *Journal of Clinical Oncology*. 2007; 25(1):118–45.10.1200/JCO.2006.09.2775 [PubMed: 17159189]
- Worthington J, Waterbor JW, Funkhouser E, Falkson C, Cofield S, Fouad M. Receipt of standard breast cancer treatment by African American and White women. *International Journal of Medical Sciences*. 2008; 5(4):181–88. [PubMed: 18645609]
- Wu X, Richardson LC, Kahn AR, Fulton JP, Cress RD, Shen T, Wolf HJ, Bolick-Aldrich S, Chen VW. Survival difference between non-Hispanic black and non-Hispanic white women with localized breast cancer: The impact of guideline-concordant therapy. *Journal of the National Medical Association*. 2008; 100(5):490–98. [PubMed: 18507201]
- Yood MU, Owusu C, Buist DS, Geiger AM, Field TS, Thwin SS, Lash TL, Prout MN, Wei F, Quinn VP, Frost FJ, Silliman RA. Mortality impact of less-than-standard therapy in older breast cancer patients. *Journal of the American College of Surgeons*. 2008; 206(1):66–75.10.1016/j.jamcollsurg.2007.07.015 [PubMed: 18155570]

FIGURE 1.
Flow chart for Oklahoma patterns of care, 2003–2006.

TABLE 1

The Relationship Between Demographic and Treatment Characteristics by Standard of Care (SOC) Met Among Women With Stage 1 Breast Cancer, Oklahoma, 2003–2006

Characteristic	Total	% SOC Met	OR (95% CI)	p value
Total	4,177	92.1		
Age group, years				<.0001
<40	152	94.7	1.23 (0.58, 2.57)	
40–49	651	94.0	1.07 (0.73, 1.57)	
50–64	1,490	93.6	Referent	
65–74	995	93.9	1.04 (0.75, 1.45)	
75+*	889	85.8	0.41 (0.31, 0.55)	
Race				.27
American Indian	162	90.7	0.84 (0.49, 1.45)	
White	3742	92.1	Referent	
Asian/PI	44	93.2	1.17 (0.36, 3.80)	
African-American	216	94.0	1.34 (0.75, 2.37)	
Other/unknown	13	76.9	0.29 (0.08, 1.04)	
Metro/non-metro				.75
Metro	2,707	92.4	Referent	
Non-metro	1,468	91.7	0.91 (0.72, 1.15)	
Unknown	2	100.0	Not estimable	
Primary payer				<.0001
Private insurance	2,011	94.3	Referent	
Indian Health	51	92.2	0.71 (0.25, 1.99)	
Medicare/Medicaid*	650	88.3	0.45 (0.34, 0.62)	
Medicaid	162	93.2	0.83 (0.44, 1.57)	
Medicare*	1,107	90.8	0.59 (0.45, 0.78)	
Not insured*	121	86.0	0.37 (0.21, 0.64)	
Tricare/VA	66	93.9	0.93 (0.33, 2.61)	
Unknown	9	88.9	0.48 (0.06, 3.88)	
Diagnosis year				.29
2003	1,015	91.2	Referent	
2004	1,064	93.1	1.29 (0.93, 1.77)	
2005	1,065	92.8	1.23 (0.90, 1.70)	
2006	1,033	91.4	1.02 (0.75, 1.39)	
Marital status				<.0001
Married	2,481	94.2	Referent	
Separated/divorced	385	92.5	0.76 (0.50, 1.15)	
Single	297	91.6	0.67 (0.43, 1.04)	
Widowed*	798	89.0	0.50 (0.38, 0.66)	
Unknown*	216	80.1	0.25 (0.17, 0.36)	

Characteristic	Total	% SOC Met	OR (95% CI)	<i>p</i> value
Tumor size ^a				.04
1 mm	1,209	90.2	Referent	
>1 mm, 5 mm	207	91.8	1.22 (0.72, 2.08)	
>5 mm, 10 mm	521	92.7	1.39 (0.95, 2.03)	
>10 mm, 20 mm *	1,182	93.8	1.66 (1.23, 2.25)	
>20 mm	818	92.1	1.27 (0.92, 1.74)	
Unknown	240	92.9	1.43 (0.84, 2.43)	
Charlson Comorbid Index ^b				<.0001
0	3,339	93.6	Referent	
1 *	307	89.9	0.61 (0.41, 0.90)	
2 *	63	84.1	0.36 (0.18, 0.72)	
3+	16	87.5	0.48 (0.11, 2.11)	
Unknown *	452	83.9	0.35 (0.27, 0.47)	
Tumor grade				.11
Grade 1	980	90.1	Referent	
Grade 2 *	1,444	93.1	1.49 (1.11, 2.00)	
Grade 3	1,238	92.3	1.32 (0.98, 1.78)	
Grade 4	28	100.0	Not estimable	
Unknown	487	92.2	1.30 (0.88, 1.92)	
% Living in poverty in census tract				.18
<5%	638	93.7	Referent	
5–9.9%	1,081	92.5	0.83 (0.56, 1.22)	
10–19.9% *	1,484	91.0	0.68 (0.47, 0.98)	
20%	640	91.6	0.73 (0.48, 1.11)	
Unknown	334	93.7	1.00 (0.58, 1.72)	
Education ^c				.48
<75%	809	91.6	Referent	
75–82%	1,048	91.1	0.94 (0.68, 1.31)	
83–89%	904	92.6	1.15 (0.81, 1.63)	
90%	1,082	92.6	1.15 (0.82, 1.61)	
Unknown	334	93.7	1.37 (0.82, 2.27)	

^aTumor size from NCCN Guidelines Version 3.2012.

^bHigher Charlson index of comorbidity indicates higher number and/or severity of comorbidities present at diagnosis.

^cEducation: percentage of residents of the census tract of the included subject who completed high school.

* indicates significant differences (*p* value indicates overall significance of the variable).

TABLE 2

The Relationship Between Demographic and Treatment Characteristics and Standard of Care (SOC) Met Among Women With Breast Conserving Surgery (BCS), Oklahoma, 2003–2006

Characteristic	SOC met		OR (95% CI)	Overall <i>p</i> value
	Total with BCS	%		
Total	2,573	88.7		
Age group, years				<.0001
<40	74	91.9	1.07 (0.45, 2.53)	
40–49	408	91.9	1.07 (0.70, 1.63)	
50–64	987	91.4	Referent	
65–74	625	91.4	0.99 (0.70, 1.42)	
75+*	479	76.4	0.31 (0.23, 0.42)	
Race				.69
White	2,295	88.6	Referent	
Asian/PI	26	88.5	0.99 (0.30, 3.31)	
American Indian	108	88.9	1.03 (0.56, 1.91)	
African-American	136	91.2	1.33 (0.73, 2.44)	
Other/unknown	8	75.0	0.39 (0.08, 1.93)	
Metro/non-metro ^a				.06
Metro	1,751	89.5	Referent	
Non-metro	821	87.0	0.78 (0.61, 1.01)	
Primary payer ^a				<.0001
Private insurance	1,320	92.5	Referent	
Medicare/Medicaid*	377	82.5	0.38 (0.27, 0.53)	
Tricare/VA	42	90.5	0.77 (0.27, 2.20)	
Medicaid	90	87.8	0.58 (0.30, 1.13)	
Medicare*	634	85.3	0.47 (0.35, 0.64)	
Indian Health	34	91.2	0.84 (0.25, 2.79)	
Not insured*	72	79.2	0.31 (0.17, 0.56)	
Diagnosis year				.20
2003	589	87.1	Referent	
2004	651	89.7	1.29 (0.91, 1.83)	
2005	684	90.2	1.36 (0.96, 1.93)	
2006	649	87.5	1.04 (0.74, 1.45)	
Marital status				<.0001
Single*	187	87.2	0.60 (0.38, 0.96)	
Married	1,589	91.9	Referent	
Separated/divorced	243	90.5	0.85 (0.53, 1.35)	
Widowed*	440	81.6	0.39 (0.29, 0.53)	
Unknown*	114	70.2	0.21 (0.13, 0.32)	

Characteristic	SOC met		OR (95% CI)	Overall <i>p</i> value
	Total with BCS	%		
Tumor size ^b				.003
1 mm	698	85.7	Referent	
>1 mm, 5 mm	144	89.6	1.44 (0.81, 2.56)	
>5 mm, 10 mm*	387	91.2	1.74 (1.15, 2.62)	
>10 mm, 20 mm*	809	91.5	1.79 (1.30, 2.48)	
>20 mm	424	86.1	1.04 (0.73, 1.46)	
Unknown	111	87.4	1.16 (0.64, 2.11)	
Charlson Comorbid Index ^c				<.0001
0	2,150	91.2	Referent	
1*	151	81.5	0.42 (0.27, 0.66)	
2*	29	65.5	0.18 (0.08, 0.40)	
3+	2	50.0	0.10 (0.01, 1.55)	
Unknown*	241	73.9	0.27 (0.20, 0.38)	
Grade				.41
Grade 1	683	87.0	Referent	
Grade 2	901	90.1	1.37 (1.00, 1.87)	
Grade 3	714	88.2	1.12 (0.82, 1.55)	
Grade 4	11	100.0	Not estimable	
Unknown	264	89.0	1.21 (0.78, 1.90)	
% Living in poverty in census tract of residence				.08
<5%	416	91.6	Referent	
5–9.9%	687	89.5	0.79 (0.51, 1.20)	
10–19.9%*	908	87.0	0.62 (0.41, 0.91)	
20%*	385	87.0	0.62 (0.39, 0.97)	
Unknown	177	91.0	0.92 (0.50, 1.72)	
Education ^d				.34
<75%	469	87.4	Referent	
75–82%	635	87.1	0.97 (0.68, 1.39)	
83–89%	580	89.3	1.20 (0.82, 1.76)	
90%	712	89.9	1.28 (0.89, 1.84)	
Unknown	177	91.0	1.45 (0.81, 2.59)	

^aExcluded one observation with missing metro/non-metro and four observations with missing primary payer.

^bTumor size from NCCN Guidelines Version 3.2012.

^cHigher Charlson index of comorbidity indicates higher number and/or severity of comorbidities present at diagnosis.

^dEducation: percentage of residents of the census tract of the included subject who completed high school.

* indicates significant differences (*p* value indicates overall significance of the variable).

TABLE 3

Odds Ratios and 95 Percent Confidence Intervals (CI) for the Association Between Demographic and Treatment Characteristics and Standard of Care Among Women With Breast Conservative Therapy in Women Stratified by Age Group

Characteristic	65 years (<i>n</i> = 1,102) Adjusted OR ^b (95% CI)	<65 years (<i>n</i> = 1,466) Adjusted OR ^b (95% CI)
Age group, years ^a		
65–74	Referent	
75+*	0.30 (0.20, 0.43)	
Race		
White	Referent	Referent
Asian/PI	1.63 (0.58, 4.62)	1.30 (0.55, 3.07)
American Indian	0.65 (0.21, 1.97)	1.17 (0.46, 3.02)
African-American	0.70 (0.07, 6.60)	0.62 (0.14, 2.83)
Other/unknown	0.56 (0.09, 3.62)	Not estimable
Metro/non-metro ^c		
Metro	Referent	Referent
Non-metro	0.84 (0.56, 1.27)	1.12 (0.72, 1.75)
Primary payer ^c		
Private insurance	Referent	Referent
Medicare/Medicaid*	1.19 (0.63, 2.23)	0.32 (0.12, 0.86)
Tricare/VA	Not estimable	0.69 (0.23, 2.03)
Medicaid	Not estimable	0.51 (0.25, 1.05)
Medicare*	1.48 (0.81, 2.72)	0.29 (0.11, 0.73)
Indian health	Not estimable	0.58 (0.14, 2.41)
Not insured*	0.13 (0.02, 0.82)	0.31 (0.16, 0.63)
Diagnosis year		
2003	Referent	Referent
2004	1.23 (0.55, 2.71)	0.61 (0.26, 1.42)
2005	0.98 (0.43, 2.25)	0.56 (0.24, 1.30)
2006	0.93 (0.41, 2.09)	0.33 (0.14, 0.79)
Tumor size ^d		
1 mm	Referent	Referent
>1 mm, 5 mm	0.84 (0.30, 2.37)	2.09 (0.69, 6.33)
>5 mm, 10 mm*	1.17 (0.49, 2.76)	2.80 (1.13, 6.95)
>10 mm, 20 mm*	1.22 (0.56, 2.65)	3.09 (1.37, 6.96)
>20 mm*	0.47 (0.21, 1.07)	2.75 (1.18, 6.40)
Unknown	0.79 (0.27, 2.30)	2.28 (0.75, 6.94)
Charlson Comorbid Index ^e		
No (0)	Referent	Referent

Characteristic	65 years (<i>n</i> = 1,102) Adjusted OR ^b (95% CI)	<65 years (<i>n</i> = 1,466) Adjusted OR ^b (95% CI)
Yes (1, 2, 3+) [*]	0.38 (0.23, 0.62)	0.64 (0.29, 1.41)
Unknown [*]	0.26 (0.15, 0.43)	0.38 (0.22, 0.67)
Grade		
Grade 1	Referent	Referent
Grade 2	1.47 (0.95, 2.27)	1.08 (0.63, 1.86)
Grade 3	1.44 (0.86, 2.41)	0.68 (0.41, 1.14)
Grade 4	Not Estimable	Not Estimable
Unknown	1.64 (0.88, 3.08)	1.00 (0.47, 2.12)
% Living in poverty in census tract of residence		
<5%	Referent	Referent
5–9.9%	1.02 (0.54, 1.91)	0.76 (0.40, 1.45)
10–19.9%	0.80 (0.43, 1.47)	0.74 (0.39, 1.41)
20%	0.82 (0.40, 1.68)	0.86 (0.41, 1.80)
Unknown	1.32 (0.48, 3.61)	1.05 (0.41, 2.65)

^a Age excluded in the model in women <65 as removal did not change remaining estimates by >20 percent.

^b Adjusted by the other variables in the table.

^c Excluded one observation with missing metro/non-metro and four observations with missing primary payer.

^d Tumor size from NCCN Guidelines Version 3.2012.

^e Higher Charlson index of comorbidity indicates higher number and/or severity of comorbidities present at diagnosis.

* indicates significant differences.