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Evidence for racial/ethnic disparities in emergency department visits following breast cancer surgery among women in California: a population–based study

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Abstract

Purpose—Racial/ethnic disparities in breast cancer outcomes may be related to quality of care and reflected in emergency department (ED) visits following primary treatment. We examined racial/ethnic variation in ED visits following breast cancer surgery.

Methods—Using linked data from the California Cancer Registry and California Office of Statewide Health Planning and Development, we identified 151,229 women diagnosed with stage 0-III breast cancer between 2005 and 2013 who received surgical treatment. Differences in odds of having at least one breast cancer-related ED visit within 90 days post-surgery were estimated with logistic regression controlling for clinical and sociodemographic variables. Secondary analyses examined health care-related moderators of disparities.

Results—Hispanics and non-Hispanic (NH) Blacks had an increased likelihood of having an ED visit within 90 days of surgery compared to NH Whites [OR = 1.11 (1.04–1.18), $p = 0.0016$; OR = 1.38 (1.27–1.50), $p < 0.0001$, respectively]; the likelihood was reduced in Asian/Pacific Islanders [aOR = 0.77 (0.71–0.84), $p < 0.0001$]. Medicaid and Medicare (vs. commercial insurance) increased the likelihood of ED visit for NH Whites, and to a lesser degree for Hispanics and NH Blacks ($p < 0.0001$ for interaction). Receipt of surgery at an NCI-designated Comprehensive

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Compliance with ethical standards

Conflict of interest Dr. Kang is on the speaker's bureau and served as a consultant for Puma Biotechnology, and has participated in an advisory board for Bristol-Myers Squibb. The other authors report nothing to disclose.

Ethical approval This study was approved by the University of California Institutional Review Board.

Informed consent Informed consent was waived for this retrospective analysis of deidentified data.

Cancer Center or at a for-profit (vs. non-profit) hospital was associated with reduced likelihood of ED visits for all groups.

Conclusion—Racial/ethnic disparities in ED visits following breast cancer surgery persist after controlling for clinical and sociodemographic variables. Improving quality of care following breast cancer surgery could improve outcomes for all groups.

Keywords

Breast cancer; Health disparities; Emergency department visits

Introduction

Racial/ethnic differences in breast cancer outcomes are well documented [1]. Existing evidence suggests that disparities may be attributable, in part, to differences in treatments, stage at diagnosis, tumor characteristics, and access to care. Non-Hispanic (NH) Black, Hispanic, and American Indian/Alaskan Native (AI/AN) women often present with later stage cancer [2]; NH Black and Hispanic women also have higher proportions of triple negative breast cancer [3], and experience longer delays to treatment [4] which may contribute to worse survival outcomes [5, 6]. Quality of care also impacts outcomes: NH Black and Asian/Pacific Islander (A/PI) women are more likely to receive treatment at hospitals scoring lower on quality measures [7]. Although receiving treatment at National Cancer Institute (NCI)-designated cancer centers is associated with better survival outcomes [8], NH Black and Hispanic women are less likely to receive cancer surgery and/or therapy at these hospitals [8, 9].

Sociocultural factors may also contribute to disparities in cancer care. For example, racial/ethnic differences in health literacy [10, 11] and patient-provider communication appear to present additional challenges to navigating health systems in order to obtain necessary care [10, 12]. NH Black and Hispanic women with breast cancer are less likely than NH Whites to report receiving adequate explanation regarding their treatment [13, 14], contributing to lower patient satisfaction rates following breast cancer surgery [15, 16]. NH Black, Hispanic, and A/PI women with breast cancer also rate their experience with health-care systems lower in terms of getting care quickly, ability to obtain needed care or prescription drugs, and overall experience [17]. Unconscious bias among providers may lead to different standards of care or weaker relationships between providers and patients, which could affect the delivery of follow-up care after breast cancer surgery [18].

Emergency department (ED) utilization is an indicator of poor quality of and access to care among cancer patients [19, 20]. One study found that NH Black and Hispanic women with breast cancer are more likely to have ED visits compared to NH White women but examined a small cohort of patients at a single institution [21]. Surgery is a primary treatment modality for breast cancer, and 3–13% of women who receive breast cancer surgery will have a post-operative ED visit [22, 23]. NH Black and Hispanic women are at greater risk of complications following breast cancer surgery [24, 25]. To our knowledge, no studies have yet examined population-based racial/ethnic differences in ED utilization following breast cancer surgery.

To address this gap, we utilized data from the California Cancer Registry (CCR), consisting of three regional registries that are in the NCI's Surveillance, Epidemiology, and End Results (SEER) program, linked with statewide hospital discharge records, ED visits, and ambulatory surgery records maintained by the California Office of Statewide Health Planning and Development (OSHPD), to examine racial/ethnic differences in ED visits within 90 days following the first surgery for breast cancer. We hypothesized that Hispanic and NH Black women would be more likely to have at least one ED visit compared to NH White women. We further hypothesized that these disparities would be moderated by type of insurance coverage and hospital characteristics. Understanding the factors that influence surgical outcomes such as emergency visits is necessary in order to identify patients at greater risk for adverse outcomes following breast cancer surgery and develop targeted interventions.

Methods

Case identification

We included records of adult women ages 18 and older in California who were diagnosed with and received surgical treatment for breast cancer between January 1, 2005 and December 31st, 2013. Primary malignant breast cancer cases were identified by using SEER site recode (26000). Patients with stage IV cancer were excluded because surgery is not recommended as standard treatment for these patients, and therefore, patients with stage IV cancer who do receive surgery may differ in other ways from patients with earlier stage cancer who receive surgery. Patients with unknown stage were excluded because we could not be certain that their cancer was not stage IV. Records were excluded if they had missing/unknown race or ethnicity, had previously been diagnosed with any cancer, or were diagnosed with another primary cancer within 90 days after index surgery; if a record of breast cancer-related surgery could not be located in the OSHPD data (see Surgery Definitions below); if the patient died within one day of surgery (or discharge from inpatient surgery); or if the record indicated military, Veteran's Administration, or TRICARE insurance, public insurance other than Medicare/Medicaid, self-pay, or unknown insurance. The case selection flow is detailed in Fig. 1. The study was approved by the University of Southern California Institutional Review Board.

Surgery definitions

We examined available OSHPD records (from state licensed ambulatory care surgical centers, emergency departments, and inpatient hospitalizations) for each patient from 2 months prior to diagnosis (to include women diagnosed after surgery based on tumor pathology) through one year after diagnosis to capture breast cancer-related surgeries. Surgeries were identified based on the common procedural terms (CPT) and International Classification of Disease, Ninth Edition (ICD-9) procedure codes associated with the records (Supplemental Table 1).

Primary Outcome

The primary outcome was breast cancer-related ED visits in the 90 days following date of breast cancer surgery (or date of discharge from inpatient surgery); a 90-day window

provides a more complete picture of complications following breast surgery [26]. ED records were drawn from the OSHPD data, and outcomes were dichotomized into 0 versus at least 1 visit. Breast cancer-related ED visits were identified based on ICD-9 diagnostic codes indicating breast cancer or possible complications of treatment (surgical complications, fever, pain, or complications from adjuvant treatment) in one of the first three diagnosis fields associated with the visit (Supplemental Table 2) [22, 23].

Covariates

Demographics—Age at diagnosis, race/ethnicity, marital status, socioeconomic status (SES), and immigrant status were determined based on CCR data. Race/ethnicity was grouped as NH White, NH Black, Hispanic, A/PI, or AI/AN based on the primary race recorded in the CCR data (abstracted from the medical record). Hispanic origin information was enhanced using the NAACCR Hispanic Identification Algorithm [27]. Marital status was defined as married or unmarried/unknown. SES indicators were developed using the CCR's published area-based methodologies updated using census block group level information from Census 2000 and American Community Survey (ACS) 2007–2011 5-year estimates [28–30]. SES was categorized as low (bottom two quintiles), middle (middle quintile), or high (top two quintiles) based on the frequency distribution. Immigrant status was categorized as US born, foreign born, or unknown, using the country of birth information reported to CCR and a well-established estimation method for the year of social security number issuance [31].

Cancer stage

Cancer stage was defined as stage 0 (in situ), I, II, or III based on the SEER-modified American Joint Committee on Cancer (AJCC) staging system [32].

Non–surgical treatment

Receipt of chemotherapy and/or radiotherapy (adjuvant or neoadjuvant) was based on CCR data; each was categorized as "yes," "no," or "unknown."

Surgery type and setting

Surgeries were classified as lumpectomy or mastectomy based on the code for the index surgery in the relevant OSHPD dataset (Supplemental Table 1). Surgical setting was defined as inpatient surgery if the record was drawn from hospital discharge data, or outpatient surgery if drawn from ambulatory surgery data.

Time to first treatment

The difference between date of diagnosis and the earliest date for any treatment type was categorized as ≤ 60 days vs. > 60 days based on previous reports showing worse outcomes when treatments are delayed for more than 60 days after diagnosis [5, 6].

Comorbidities

Comorbidity burden was based on the Charlson Comorbidity Index (CCI) calculated by the CCR using OSHPD data [33]. The comorbidity variable was categorized as CCI = 0, 1,

2 or more, or unknown. In addition, because hypertension is not included in the CCI and can be associated with wound healing, we included a variable for hypertension (categorized as “yes,” “no,” or “unknown”) based on whether or not they had a secondary diagnosis or comorbid complication of hypertension recorded in the CCR (Supplemental Table 3).

Insurance

Insurance type was based on actual source of payment for surgery recorded in the OSHPD datasets, categorized as commercial insurance, Medicaid, or Medicare (Supplemental Table 4).

Hospital characteristics

Characteristics of the hospital where surgery was performed were identified from publicly available financial report data through OSHPD (https://data.chhs.ca.gov/dataset/hospitalannual-utilization-report). Ownership types were defined as non-profit, for profit, public, and other/unknown (Supplemental Table 5) [34].

NCI–designated Comprehensive Cancer Centers (NCI–CCC)

We identified these through the NCI website (https://www.cancer.gov/research/infrastructure/cancer-centers/find#California); NCI-CCC status was designated “yes” for those who received surgery at one of these 8 centers, and “no” for all others.

Statistical analyses

Descriptive statistics were obtained for all variables. Base-line differences in demographic and clinical variables were examined with Chi-square tests. Racial/ethnic differences (adjusted odds ratios, aORs) in risk of breast cancer-related ED visit within 90 days of surgery were estimated using multivariable logistic regression. Age group, cancer stage, marital status, SES, immigrant status, comorbidity, chemotherapy, radiotherapy, surgery type, surgery setting, insurance type, hospital type, NCI-CCC status, and time to treatment were tested as covariates; non-significant covariates were allowed to drop from the model using backwards elimination with Bayesian information criteria. To determine whether the results generalized to non-breast cancer-related ED visits and/or all ED visits, we repeated the same model twice, substituting first non-breast cancer-related ED visits and then all ED visits as the outcome measure in secondary analysis. As an exploratory analysis, we examined relationships between race/ethnicity and surgical setting using similar models with surgical setting (outpatient vs. inpatient) as the outcome; this analysis was completed in the full sample with race/ethnicity as a predictor and in separate models stratified by race/ethnicity.

To assess whether factors related to access to care or the health system moderated the association between race/ethnicity and breast cancer-related ED visits, we used a similar model with the addition of interaction terms for insurance type, hospital type, and NCI-CCC status by race/ethnicity, followed by post hoc analyses using multivariable logistic regression models stratified by race/ethnicity. After applying Bonferroni correction for five post hoc comparisons, we considered results significant at $p < 0.01$.

Results

Descriptive data

Table 1 reports demographic, clinical, and procedural variables by race/ethnicity. There were significant racial/ethnic differences compared to NH White patients for all variables (all ps < 0.0001). More NH Black women had treatment delays longer than 60 days (21.0% vs. 12.2% in NH White); a higher percentage of Hispanic women received chemotherapy (40.0% vs. 30.1% NH White); and lower percentages of A/PI and NH Black women received radiotherapy (45.7% and 45.8%, respectively, vs. 50.2% NH White). A/PI women had the highest percentages of mastectomy (36.7% vs. 29.5% NH White). Hispanic and AI/AN women had the highest percentage receiving surgery at a public hospital (14.5% each; Table 1). Hispanics also had the lowest percentage receiving surgery at an NCI-CCC (4.9%), whereas A/PI and AI/AN had the highest (each 8.7%). Hispanic women had the lowest percentages of outpatient surgery (69.0% vs. 73.7% NH White); however, in the exploratory analysis, Hispanic and Asian women were more likely and NH Black women were less likely to receive outpatient surgery compared to NH white women after controlling for sociodemographic, clinical, and health system-related covariates (Hispanic OR 1.10, $p < 0.0001$; Asian OR = 1.20, $p < 0.0001$; NH Black OR = 0.92, $p = 0.013$) (Supplemental Table 6). In the models stratified by race/ethnic group, relationships between covariates and receipt of outpatient surgery were generally similar between race/ethnic groups (Supplemental Table 7). All covariates were tested in the multivariable model of breast cancer-related ED visits; immigrant status and time to treatment were non-significant and allowed to drop.

Overall, 14,192 patients (9.4%) had at least one ED visit in the 90 days following surgery; approximately half of these ($n = 7528$, 53.0%) had at least one breast cancer-related visit. Among those with breast cancer-related visits, the most common diagnoses were for breast cancer or breast disorders [$n = 4762$ (63.3%) had at least one of these codes during at least one visit]; 1963 (26.1%) had a diagnosis for complications of procedures; 1,174 (15.6%) included surgical aftercare; 389 (5.2%) included pain; 362 (4.8%) included complications of prosthetics; 331 (4.4%) included neutropenia; 243 (3.2%) included skin infections; 76 (1.0%) included thromboembolism or phlebitis; and 745 (9.9%) included other breast cancer-related issues.

Predictors of ED visits

In the multivariable model, Hispanic and NH Black women were significantly more likely to have a breast cancer-related ED visit compared to NH White women [aOR (95% confidence interval): Hispanic 1.11 (1.04–1.18), $p = 0.0016$; NH Black 1.38 (1.27–1.50), $p < 0.0001$; Table 2], whereas A/PI women were significantly less likely to have an ED visit [aOR = 0.77 (0.71–0.84), $p < 0.0001$]. The odds of having at least one ED visit were higher among AI/AN women compared to NH White women, but this relationship did not survive correction for multiple testing [aOR = 1.40 (1.06–1.86), $p = 0.019$]. Medicaid and Medicare coverage were each associated with higher odds of ED visits compared to commercial insurance [aOR (95% CI): Medicaid 1.81 (1.69–1.95), $p < 0.0001$; Medicare 1.36 (1.24–1.50), $p < 0.0001$]. Receipt of surgery at public hospitals was associated with higher odds of ED visit compared to non-profit hospitals [aOR 1.19 (1.11–1.29), $p < 0.0001$];

for-profit hospitals were associated with lower odds [aOR 0.79 (0.73 – 0.87), $p < 0.0001$]. Receipt of surgery at NCI-CCCs showed substantially lower odds of ED visits compared to non-NCI-CCCs [aOR 0.48 (0.42–0.54, $p < 0.0001$]. In the stratified analysis, relationships between sociodemographic, clinical, and health system-related covariates and odds of breast cancer-related ED visit were generally similar within each racial/ethnic group to the overall model (Supplemental Table 8).

Moderating influence of insurance and hospital variables

We observed a significant interaction between race/ethnicity and insurance coverage on odds of having at least one breast cancer-related ED visit. Post hoc analysis showed that NH White women had higher odds of having a breast cancer-related ED visit if they were covered by Medicaid or Medicare (vs. commercial insurance); Hispanic, Asian, and NH Black women had greater odds of an ED visit if they were covered by Medicaid (Fig. 2; $p < 0.0001$ for interaction term). Although numerically there was a larger percentage increase in ED visits for Hispanic and NH Black patients treated at public hospitals (versus non-profit) compared to the increase for NH White patients, and a larger increase in ED visits for AI/AN patients treated at for-profit hospitals (versus non-profit) compared to other groups (Figure S1), the pattern of the effect of hospital type was similar for each race/ethnicity group, and the overall race/ethnicity by hospital type interaction term was non-significant ($p > 0.1$). Similarly, although numerically there was a larger decrease in ED visits among all racial/ethnic minority groups when treated at an NCI-CCC (versus a non-NCI-CCC) compared to the decrease among NH White patients (Figure S2), the race/ethnicity by NCI-CCC interaction term was non-significant ($p > 0.05$). However, as shown in Table 1, the proportion of patients receiving care at an NCI-CCC was quite low (ranging from ~ 5% of NH Black and Hispanic patients to 8.7% of A/PI and AI/AN patients).

In the secondary analyses, associations between race/ethnicity and risk of non-breast cancer-related ED visits (Supplemental Table 9) or overall ED visits (Supplemental Table 10) followed the same pattern as the primary model.

Discussion

In the first population-based study to examine racial/ethnic differences in ED visits following breast cancer surgery, we show that NH Black and Hispanic women were more likely than NH White women to have at least one ED visit in the 90 days following surgery after controlling for relevant sociodemographic and clinical variables. These disparities existed for both breast cancer-related and non-breast cancer-related events and persisted across insurance types. Commercial insurance reduced the likelihood of an ED visit for most racial/ethnic groups compared to Medicaid. However, we found a significant interaction effect that showed that not all groups benefited to the same degree; the benefit was greatest for NH White women, smaller for Hispanic and NH Black women, and non-significant for A/PI and AI/AN. These findings suggest that risk factors such as clinical history, sociodemographic factors, and insurance coverage do not fully explain racial/ethnic disparities in ED encounters following breast cancer surgery. However, it is notable that

patients receiving surgery at for-profit hospitals and NCI-CCCs had fewer ED visits than those at non-profit and public hospitals or non-NCI-CCCs.

Our findings extend those of three prior studies showing poorer outcomes in terms of ED visits and unplanned readmissions after breast cancer surgery for NH Black and Hispanic women compared to NH White women. A study using data from the National Cancer Database found that women with unplanned hospital readmissions within 30 days of breast cancer surgery were more likely to be Black [35], but the investigators did not examine ED visits and were unable to examine trends in other racial/ethnic groups due to small cell sizes. One study of a small cohort of women hospitalized with cancer at a single institution over the course of one year found that NH Black and Hispanic women with breast cancer were more likely than NH White women to have an ED visit [21]. Nasser and colleagues [22] observed numeric trends similar to those in our study but could not test differences due to missing data. We add significantly to these findings with a population-based and racially diverse sample examining ED visits after breast cancer surgery, an important measure of quality of cancer care.

To our knowledge, this is the first study to examine the impact of interactions between race/ethnicity and systemic factors related to health-care access and quality of care on breast cancer-related ED visits following surgery. Our finding of increased rates of ED visits among patients with Medicaid and Medicare compared to commercial insurance is consistent with prior literature [22]; however, the significant interaction effect suggests that not all patients benefit equally from similar coverage. NH White women realized the largest benefit from having commercial insurance compared to Medicaid; Hispanic and NH Black women showed a slightly smaller reduction in ED visits when they had access to commercial insurance versus Medicaid; and benefits for Asian/PI and AI/AN women were non-significant. It is possible that the ability to fully utilize insurance benefits may be influenced by sociocultural factors such as familiarity with the health system, health literacy, and prior positive or negative experiences with health care. Future studies examining interactions between insurance coverage, health-care utilization, and race/ethnicity may help better understand this finding of differential benefit of commercial insurance. This should be paired with studies of interventions (e.g., culturally competent patient navigation) to optimize health-care utilization and outcomes for patients of diverse cultural backgrounds.

Higher ED visit rates may reflect lower quality of care [19, 20]. Studies have shown that up to a third of post-surgical ED visits result from common post-operative complications that are potentially preventable with timely outpatient follow-up care [22, 23, 36]. NH Black and Hispanic women may be more likely to experience complications such as surgical site issues or infection after breast cancer surgery [24, 25]. NH Black women are also more likely to receive surgery at hospitals with low surgical volume [37], which is associated with greater risk of complications [38]. A study of Medicare patients found worse quality of cancer care for racial minority patients on half of the metrics examined, including greater risk of ED visits [39]. Our findings of reduced risk of ED visits for all racial/ethnic groups treated at NCI-CCCs suggest that improving quality of care for racial/ethnic minorities could improve outcomes following breast cancer surgery. Integration of culturally competent patient navigation programs may also ameliorate issues related to patient/provider

communication and understanding of how to navigate the health system to improve care for minority women [12].

Strengths of this study include the large racially and ethnically diverse population-based registry data linked with patient discharge data records to provide a more complete picture than discharge or registry data alone. A limitation is that we were only able to examine outcomes for patients who received surgery at licensed surgical centers in California; unlicensed surgical centers (which are usually smaller, physician-led centers) are not required to report to OSHPD. Approximately 17% of patients with records of surgery in the CCR did not have surgical records in OSHPD and may have received treatment at one of these unlicensed ambulatory surgery centers; therefore, caution should be taken in generalizing these results. Further, although our use of retrospective registry and hospital discharge data allows us to examine some of the systemic factors that influence racial and ethnic disparities in a large, diverse population, it does not capture other important sociocultural factors such as patient–provider communication, health literacy, or life-time experience of discrimination. These are likely to be important contributors to the observed disparities in surgical outcomes, and further research on these topics will be essential to reducing disparities.

Racial/ethnic disparities in breast cancer-related ED visit within 90 days after breast cancer surgery persisted after controlling for relevant clinical and sociodemographic variables, suggesting differences in quality of breast surgical care. In this population-based observational study, we were not able to identify causes of racial/ethnic disparities in ED visits, but our goal was to identify whether disparities exist. The results of our study suggest not only that disparities in breast cancer-related ED visits after surgery exist, but that they cannot solely be addressed by providing similar access to care through similar insurance coverage (i.e., groups did not benefit to the same degree from commercial insurance coverage compared to Medicare or Medicaid). Additional research is necessary to clarify the interactions between socioeconomic inequity and systemic discrimination in health care and their impact on health-care decisions (such as type of hospital, type of surgery, or surgery setting) that influence surgical outcomes. Carefully designed prospective studies are needed in order to clarify the relative impact of sociocultural factors, access, and quality of care in promoting ED visits and to test culturally competent individual and systems-based interventions to reduce racial/ethnic disparities in ED visits and breast cancer outcomes. Developing efficient systems to disseminate patient-oriented procedures in use at NCI-CCCs to improve quality of care following breast cancer surgery at all hospitals could improve outcomes for all women with breast cancer.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data availability

Due to the Data Use Agreement with the California Cancer Registry (CCR), the data underlying this article cannot be shared publicly. Researchers interested in accessing CCR data may submit a request as detailed at https://www.ccrcal.org/retrieve-data/data-for-researchers/how-to-request-ccr-data/.

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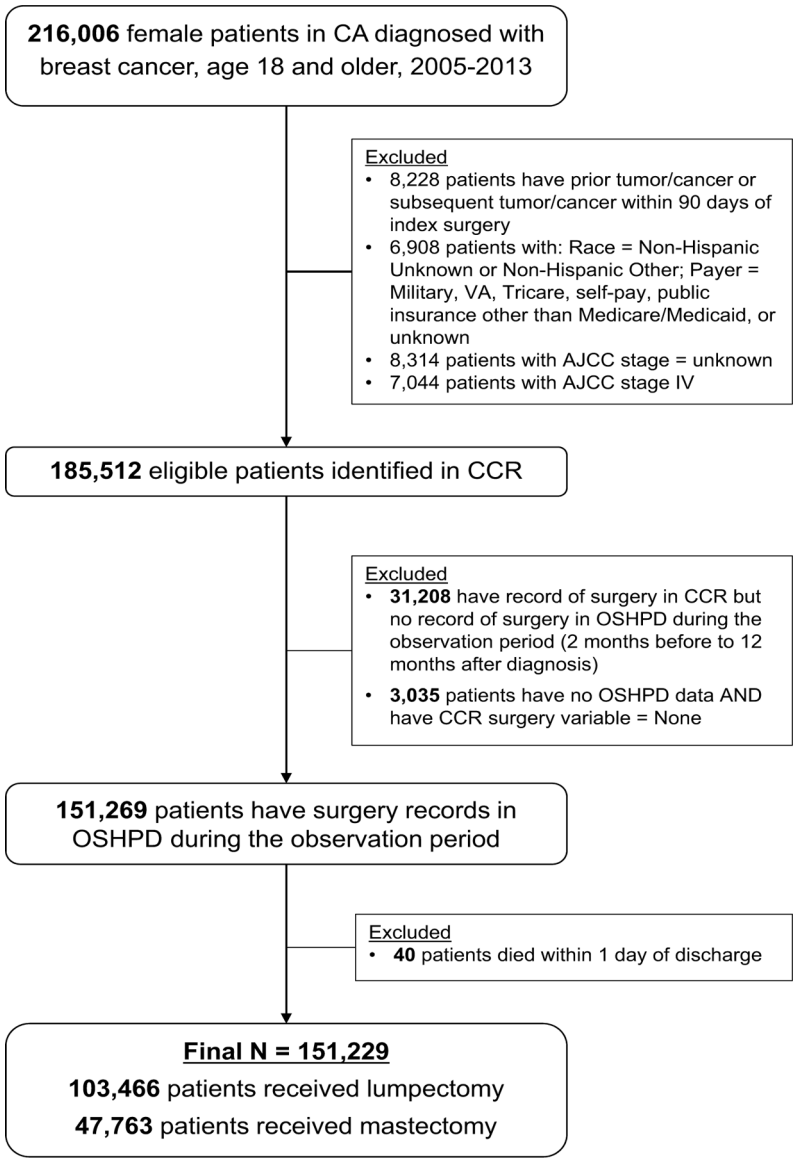

Fig. 1.
Study flow diagram

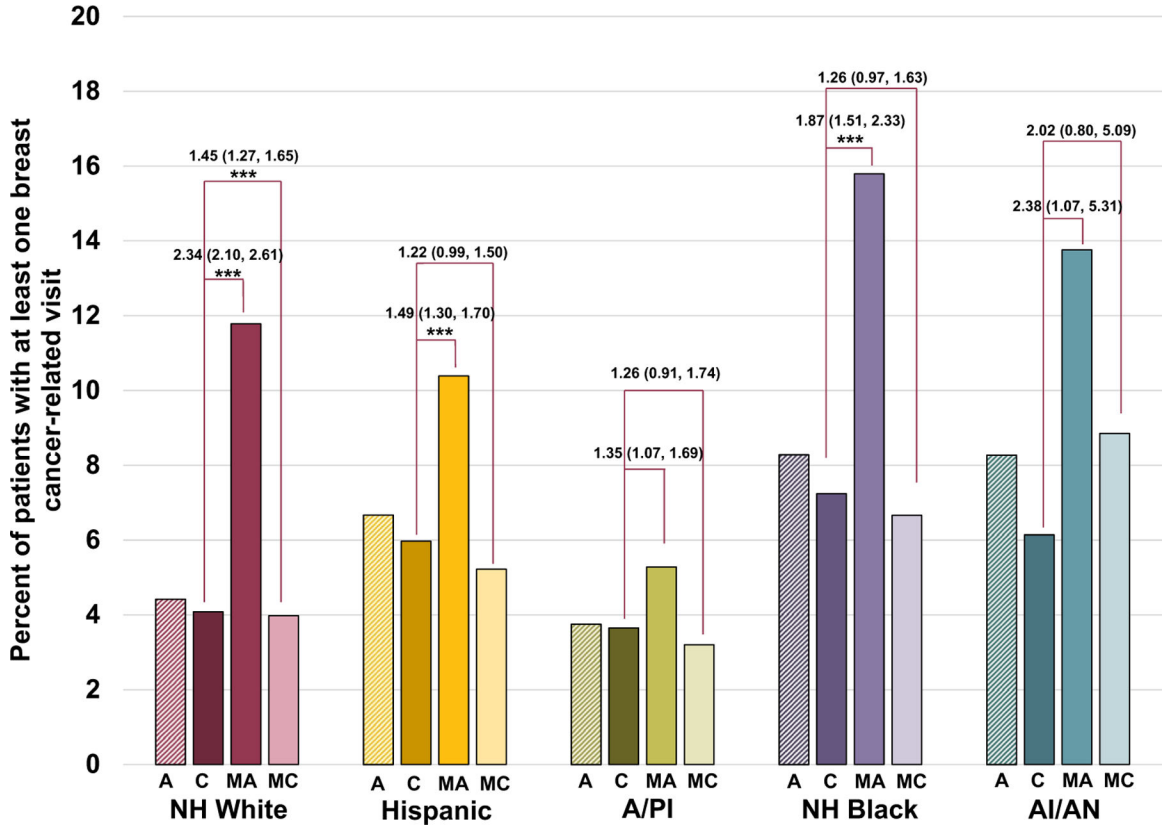

Fig. 2.

ED visits by race/ethnicity and insurance coverage. Percent of patients with at least one ED visit in the 90 days after surgery by race/ethnicity and insurance coverage. In the multivariable logistic regression, there was a significant race/ethnicity by insurance coverage interaction effect ($p < 0.0001$). Values shown are adjusted odds ratios (95% confidence intervals) from post hoc logistic regression models of relationship between insurance coverage and ED visits stratified by race/ethnicity. *A* all, *C* commercial, *MA* Medicaid, *MC* Medicare; *$p < 0.01$; **$p < 0.001$; ***$p < 0.0001$

Table 1

Demographics, clinical, and setting variables

	Non-Hispanic White ***n*** **= 94,675 (62.6%)**	**Hispanic** ***n*** **= 26,032 (17.2%)**	**Asian/Pacific Islander** ***n*** **= 20,260 (13.4%)**	**Non-Hispanic Black** ***n*** **= 9585 (6.3%)**	**American Indian/Alaskan Native** ***n*** **= 677 (0.5%)**
Age group					
18–44 years	9138 (9.7%)	4803 (18.5%)	3678 (18.2%)	1351 (14.1%)	96 (14.2%)
45–64 years	47,137 (49.8%)	14,081 (54.1%)	11,075 (54.7%)	5130 (53.5%)	372 (55.0%)
65+ years	38,400 (40.6%)	7148 (27.5%)	5507 (27.2%)	3104 (32.4%)	209 (30.9%)
SES					
Low	19,820 (20.9%)	13,258 (50.9%)	4426 (21.9%)	4757 (49.6%)	312 (46.1%)
Middle	19,075 (20.2%)	5364 (20.6%)	3979 (19.6%)	2075 (21.7%)	67 (24.7%)
High	55,780 (58.9%)	7410 (28.5%)	11,855 (58.5%)	2753 (28.7%)	198 (29.3%)
Immigrant					
Foreign-born	11,535 (12.2%)	13,122 (50.4%)	14,821 (73.2%)	744 (7.8%)	35 (5.2%)
US-born	82,876 (87.5%)	12,807 (49.2%)	5356 (26.4%)	8820 (92.0%)	642 (94.8%)
Unknown	264 (0.3%)	103 (0.4%)	83 (0.4%)	21 (0.2%)	0 (0.0%)
Marital status					
Married	54,949 (58.0%)	15,231 (58.5%)	13,802 (68.1%)	3464 (36.1%)	341 (50.4%)
Unmarried	37,355 (39.5%)	9947 (38.2%)	5977 (29.5%)	5791 (60.4%)	316 (46.6%)
Unknown	2371 (2.5%)	854 (3.3%)	481 (2.4%)	330 (3.4%)	20 (3.0%)
Insurance type					
Commercial	53,441 (56.5%)	13,694 (52.6%)	13,004 (64.2%)	4971 (51.9%)	342 (50.5%)
Medicaid	4611 (4.9%)	5323 (20.5%)	2539 (12.5%)	1387 (14.5%)	109 (16.1%)
Medicare	36,623 (38.7%)	7,015 (26.9%)	4717 (23.3%)	3227 (33.7%)	226 (33.4%)
Stage at diagnosis					
In situ	18,217 (19.2%)	5000 (19.2%)	4858 (24.0%)	1956 (20.4%)	114 (16.8%)
I	41,007 (43.3%)	9150 (35.2%)	7569 (37.4%)	3223 (33.6%)	277 (40.9%)
II	26,500 (28.0%)	8435 (32.4%)	6031 (29.8%)	3138 (32.7%)	205 (30.3%)
III	8951 (9.5%)	3447 (13.2%)	1802 (8.9%)	1268 (13.2%)	81 (12.0%)
Charlson comorbidity index					
0	72,574 (76.7%)	18,706 (71.9%)	15,783 (77.9%)	6096 (63.6%)	> 423 (> 62.4%)

	Non-Hispanic White *n* = 94,675 (62.6%)	Hispanic *n*= 26,032 (17.2%)	Asian/Pacific Islander *n* = 20,260 (13.4%)	Non-Hispanic Black *n* = 9585 (6.3%)	American Indian/Alaskan Native *n* = 677 (0.5%)
1	15,078 (15.9%)	4856 (18.7%)	2984 (14.7%)	2003 (20.9%)	150 (22.2%)
2+	5979 (6.3%)	1941 (7.5%)	1149 (5.7%)	1317 (13.7%)	93 (13.7%)
Missing	1044 (1.1%)	529 (2.0%)	344 (1.7%)	169 (1.8%)	< 11 (< 1.6%)
Hypertension					
No	81,267 (85.8%)	22,630 (86.9%)	17,661 (87.2%)	7865 (82.1%)	567 (83.8%)
Yes	13,407 (14.2%)	3402 (13.1%)	2599 (12.8%)	1720 (17.9%)	110 (16.3%)
Time to first treatment					
0–60 days	79,501 (84.0%)	20,394 (78.3%)	16,611 (82.0%)	7294 (76.1%)	549 (81.1%)
> 60 days	11,587 (12.2%)	4622 (17.8%)	2910 (14.4%)	2017 (21.0%)	> 117 (> 17.3%)
Unknown	3587 (3.8%)	1016 (3.9%)	739 (3.7%)	274 (2.9%)	< 11 (< 1.6%)
Type of surgery					
Lumpectomy	66,767 (70.5%)	16,745 (64.3%)	12,816 (63.3%)	6687 (69.8%)	451 (66.6%)
Mastectomy	27,908 (29.5%)	9287 (35.7%)	7444 (36.7%)	2898 (30.2%)	226 (33.4%)
Surgery setting					
Inpatient	24,902 (26.3%)	8069 (31.0%)	5871 (29.0%)	2853 (29.8%)	205 (30.3%)
Outpatient	69,773 (73.7%)	17,963 (69.0%)	14,389 (71.0%)	6732 (70.2%)	472 (69.7%)
Chemotherapy					
Yes	28,508 (30.1%)	10,424 (40.0%)	7060 (34.9%)	3764 (39.3%)	257 (38.0%)
No	65,043 (68.7%)	15,237 (58.5%)	13,009 (64.2%)	5702 (59.5%)	> 409 (> 60.4%)
Unknown	1,124 (1.2%)	371 (1.4%)	191 (0.9%)	119 (1.2%)	< 11 (< 1.6%)
Radiation therapy					
Yes	47,549 (50.2%)	11,975 (46.0%)	9254 (45.7%)	4389 (45.8%)	329 (48.6%)
No	47,098 (49.8%)	> 14,046 (> 53.9%)	> 10,995 (> 54.3%)	> 5185 (> 54.1%)	> 337 (> 49.8%)
Unknown	28 (< 0.1%)	< 11 (< 0.1%)	< 11 (< 0.1%)	< 11 (< 0.1%)	< 11 (< 0.1%)
Hospital type					
Non-profit	72,495 (76.6%)	18,867 (72.5%)	14,642 (72.3%)	7431 (77.5%)	495 (73.1%)
For-profit	8488 (9.0%)	2629 (10.1%)	2297 (11.3%)	711 (7.4%)	60 (8.9%)
Public	9456 (10.0%)	3771 (14.5%)	2493 (12.3%)	1180 (12.3%)	98 (14.5%)
Unknown	4236 (4.5%)	765 (2.9%)	828 (4.1%)	263 (2.7%)	24 (3.6%)
NCI-designated Comprehensive Cancer Center	6403 (6.8%)	1282 (4.9%)	1764 (8.7%)	490 (5.1%)	59 (8.7%)

Values shown are *N* (%).

Categories with < 11 patients have been masked per the CCR data deidentification policy

Table 2

Multivariable logistic regression of breast cancer-related ED visits

Predictor	ED visits, *N* (%)	Odds ratio	95% Conf. interval	*P* > *z*
Race/ethnicity				
NH White	4181 (4.4%)	1.00 [Ref]		
Hispanic	1737 (6.7%)	1.11	1.04–1.18	**0.0016**
A/PI	760 (3.8%)	0.77	0.71–0.84	< **0.0001**
NH Black	794 (8.3%)	1.37	1.27–1.50	< **0.0001**
AI/AN	56 (8.3%)	1.4	1.06–1.86	0.019
Insurance type				
Commercial	3855 (4.5%)	1.00 [Ref]		
Medicaid	1464 (10.5%)	1.81	1.69–1.95	< **0.0001**
Medicare	2209 (4.3%)	1.36	1.24–1.50	< **0.0001**
Age group (years)				
18–44	1278 (6.7%)	1.00 [Ref]		
45–64	4142 (5.3%)	0.87	0.81–0.93	< **0.0001**
65+	2108 (3.9%)	0.57	0.51–0.63	< **0.0001**
Cancer stage				
In situ	698 (2.3%)	1.00 [Ref]		
I	2480 (4.1%)	1.53	1.40–1.67	< **0.0001**
II	2987 (6.7%)	1.79	1.63–1.97	< **0.0001**
III	1363 (8.8%)	1.97	1.76–2.20	< **0.0001**
Marital status				
Married	3906 (4.5%)	1.00 [Ref]		
Unmarried/unknown	3622 (5.7%)	1.15	1.09–1.21	< **0.0001**
SES group				
Low	2755 (6.5%)	1.00 [Ref]		
Middle	1624 (5.3%)	0.98	0.92–1.05	0.44
High	3,149 (4.0%)	0.87	0.82–0.92	< **0.0001**
Charlson comorbidity index				
0	4924 (4.3%)	1.00 [Ref]		

Predictor	ED visits, *N* (%)	Odds ratio	95% Conf. interval	*P* > *z*
1	1661 (6.6%)	1.53	1.44–1.63	< **0.0001**
2 or more	857 (8.2%)	2.01	1.85–2.18	< **0.0001**
Unknown	86 (4.1%)	0.53	0.43–0.67	< **0.0001**
Hypertension				
No	6571 (5.1%)	1.00 [Ref]		
Yes	957 (4.5%)	0.86	0.80–0.93	< **0.0001**
Chemotherapy				
Yes	4147 (8.3%)	1.00 [Ref]		
No	3273 (3.3%)	0.49	0.46–0.52	< **0.0001**
Unknown	108 (6.0%)	0.67	0.55–0.82	< **0.0001**
Radiotherapy				
Yes	3293 (4.5%)	1.00 [Ref]		
No	4235 (5.5%)	1.26	1.19–1.32	< **0.0001**
Unknown	0 (0.0%)	*	*	*
Surgery type				
Lumpectomy	4351 (4.2%)	1.00 [Ref]		
Mastectomy	3177 (6.7%)	1.16	1.09–1.24	< **0.0001**
Surgery setting				
Inpatient	2708 (6.5%)	1.00 [Ref]		
Outpatient	4820 (4.4%)	1.09	1.02–1.17	**0.008**
Hospital type				
Non-profit	5665 (5.0%)	1.00 [Ref]		
For profit	569 (4.0%)	0.79	0.73–0.87	< **0.0001**
Public	1107 (6.5%)	1.2	1.11–1.29	< **0.0001**
Unknown	187 (3.1%)	0.73	0.63–0.85	< **0.0001**
NCI-designated cancer center				
No	7232 (5.1%)	1.00 [Ref]		
Yes	296 (3.0%)	0.48	0.42–0.54	< **0.0001**

Bold values indicate statistical significance ($p < 0.01$)

*OR could not be calculated for Hypertension = unknown and Radiotherapy = unknown because no patients in this category had an ED visit