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RESEARCH ARTICLE

Surgery Wait Times and Specialty Services for Insured and Uninsured Breast Cancer Patients: Does Hospital Safety Net Status Matter?

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Objective. To determine whether safety net and non-safety net hospitals influence inpatient breast cancer care in insured and uninsured women and in white and African American women.

Data Sources. Six years of Virginia Cancer Registry and Virginia Health Information discharge data were linked and supplemented with American Hospital Association data.

Study Design. Hierarchical generalized linear models and linear probability regression models were used to estimate the relationship between hospital safety net status, the explanatory variables, and the days from diagnosis to mastectomy and the likelihood of breast reconstruction.

Principal Findings. The time between diagnosis and surgery was longer in safety net hospitals for all patients, regardless of insurance source. Medicaid insured and uninsured women were approximately 20 percent less likely to receive reconstruction than privately insured women. African American women were less likely to receive reconstruction than white women.

Conclusions. Following the implementation of health reform, disparities may potentially worsen if safety net hospitals' burden of care increases without commensurate increases in reimbursement and staffing levels. This study also suggests that Medicaid expansions may not improve outcomes in inpatient breast cancer care within the safety net system.

Key Words. Safety net hospitals, disparities, breast cancer, outcomes

Safety net hospitals play an important role in serving the nation's disadvantaged populations. As these facilities are situated in or near medically underserved areas (Hadley and Cunningham 2004), they are likely to continue

providing care to the bulk of low-income patients following the implementation of the Patient Protection and Affordable Care Act (PPACA). As such, safety net hospitals will also continue to play an important role in reducing health care disparities (Weinick et al. 2010), which are widely documented across many diseases including cancer. Breast cancer, in particular, is a cancer site where noted differences in treatment and outcomes exist by race (Gerend and Pai 2008), socioeconomic status (Smith et al. 2008), and insurance coverage (Bradley et al. 2008; Coburn et al. 2008; Ward et al. 2008). In this article, we examined whether there are differences in breast cancer treatment by hospitals with and without a safety net function. We also assess whether safety net hospitals reduce insurance and racial disparities in breast cancer treatment.

We compared the time from breast cancer diagnosis with inpatient mastectomy and the likelihood of reconstruction within 1 year following mastectomy, two key measures of breast cancer treatment quality, between privately insured, Medicaid insured, and uninsured women and between white and African American women treated in safety net and non-safety net hospitals. A meta-analysis found that a delay of 12 or more weeks from symptom detection to treatment initiation is associated with a 15 percent point lower survival rate at 20 years following diagnosis (Richards et al. 1999), and reconstruction is associated with reduced depression and improved well-being in breast cancer survivors (Dean, Chetty, and Forrest 1983; Rowland et al. 2000). We study breast cancer because it affects large numbers of women, its consequences are often dire in low-income, uninsured women and in women from racial and ethnic minorities, and its path from diagnosis and treatment is reasonably well defined. Our models include interaction terms between safety net hospital status and patients' insurance status and between hospital safety net status and race. However, we focus our discussion on the main effects of these variables when interaction terms are statistically insignificant.

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CONCEPTUAL FRAMEWORK

We examined the dual role that safety net hospitals have in providing care for the uninsured and in addressing racial disparities, which are deeply intertwined (Agency for Healthcare Research and Quality 2005). In a review of studies of interventions to reduce racial and ethnic disparities in health care, Chin et al. (2007) developed a common conceptual framework across studies. These researchers noted factors that may improve quality of care and reduce disparities, including access to health care providers; location of providers in communities where racial and ethnic minorities live; and financial incentives to providers that care for racial and ethnic minorities. Safety net hospitals are primarily located in racially and ethnically diverse communities (Hadley and Cunningham 2004); many safety net providers have formed strong community partnerships with the communities they serve (Anderson, Boumbulian, and Pickens 2004); and safety net hospitals receive financial compensation for providing care to underserved populations (Zwanziger, Khan, and Bamezai 2010). In addition, many safety net hospitals offer services such as patient education and translation services that cater to the needs of racial and ethnic minorities. Nonetheless, several studies have shown that hospitals that serve low-income patients and racial and ethnic minorities have lower quality of care (Goldman, Vittinghoff, and Dudley 2007; Hasnain-Wynia et al. 2007; Werner, Goldman, and Dudley 2008). Therefore, differences in care delivery may be observed across hospitals with and without a safety net mission, but the direction of the difference is unclear.

Following a behavioral model in which individuals' predisposing, enabling, and need factors are used to predict health care utilization (Aday and Andersen 1984; Andersen 1995), our conceptual framework includes individual and contextual differences that influence health care utilization. A considerable body of research demonstrates a relationship between breast cancer treatment and individual characteristics such as age, race, and income (Bradley, Given, and Roberts 2002; Hershman et al. 2005; Coburn et al. 2008; Press et al. 2008), which are also correlated with having health insurance. Characteristics of the geographic location, including education or income level (Engelman et al. 2002) of the surrounding population, in which an individual resides are also associated with health care utilization (Coughlin et al. 2007). Poverty at the census tract captures socioeconomic differences in health across a wide range of outcomes, including cancer outcomes (Krieger et al. 2002). We also constructed an index of socioeconomic status at the census tract and used this as a predictor of health care utilization. Lastly,

there is a negative relationship between distance travelled and whether treatment is received for breast cancer (Celaya et al. 2006). Therefore, we included in our models the distance patients travelled to hospitals where they were treated.

STUDY DATA AND METHODS

Data

The Virginia Cancer Registry (VCR) and the Virginia Health Information (VHI) discharge data were the two sources of patient data. The VCR, which is population-based, and North American Association of Central Cancer Registries accredited, was the source for the breast cancer sample. The VCR contained data on patient demographic characteristics, cancer site, diagnosis date, stage, tumor size, first course of treatment, primary health insurer, and patient address—including geocoded coordinates and census tract. Inpatient treatment information was extracted from the VHI discharge database, which contained discharge abstracts on all Virginia hospital admissions that exceeded 23 hours. Discharge abstracts included patient information, International Classification of Diseases version 9 (ICD-9) diagnosis and procedure codes, payer information, and dates of admission and discharge. We linked the VCR and VHI data using deterministic and probabilistic matching techniques. Both datasets contained Social Security number (SSN), date of birth, gender, and zip code. Among the matched records for breast cancer patients, 96 percent matched exactly on SSN, date of birth, and gender.

The VHI and the American Hospital Association survey supplied industry information on hospitals including tax status, facility address, staffed beds, total operating expenditures, and expenses for charity care; these data were used to determine hospital safety net status.

Study Sample

According to the VCR, the number of female breast cancer patients aged 21–64 years, diagnosed between January 1, 1999 to December 31, 2005, and for whom mastectomy was recorded as the most definitive surgery within 12 months of diagnosis was 6,678, excluding women where neoadjuvant therapy could not be determined ($n = 23$), women whose hospital information was missing ($n = 23$), women insured by Medicare ($n = 251$), women insured by government plans other than Medicaid (e.g., Veterans Administration,

county plan, jail; $n = 524$), and women with unknown or missing race information ($n = 151$). Medicare patients were removed because they qualified for Medicare as part of Social Security Disability Insurance and may have had conditions that interfered with breast cancer treatment. Over half of these women had evidence of comorbid conditions and they were, on average, 5 years older than other women in the sample. Our analysis of patient characteristics in the unknown and other government insurance groups suggests that they were most similar to uninsured patients, with the exception of having a much higher percentage of unknown stage disease (45 versus 9 percent). Following the exclusion of women without inpatient mastectomy claims ($n = 2,027$) and a handful of subjects ($n = 38$), who were missing information about census tract or other covariates used in the models, the remaining sample was 3,641 women.

Note that 36 percent of the women in the VCR did not have an inpatient claim for a mastectomy in the VHI database. Missing claims are probably due to mastectomies performed out of state or performed in the outpatient setting or in a military hospital that does not report to the VHI, miscoding lumpectomy as a mastectomy in the VCR, and/or a poor match between the VCR and the inpatient file. Patients who received outpatient mastectomies or mastectomies out of state or in a military hospital are irrelevant to our study, but in-state inpatient claims that could not be linked are threatening to our analysis. To address this problem, we identified all mastectomy claims in the VHI for patients who met our age, race, and insurance criteria that were not linked to the VCR ($n = 1,564$). These patients were similar to linked patients in age, race, insurance status, and rates of obesity and diabetes, and the missing data were not concentrated in a single hospital or specific type of hospital. To the extent possible, we replicated our analysis of reconstruction rates on the full sample of patients with mastectomies in the VHI data ($n = 5,205$) to assess the sensitivity of our results. The inpatient claims do not contain date of diagnosis. Therefore, we could not replicate the time from diagnosis to surgery analysis.

In the analysis of time from diagnosis to surgery, we excluded patients that had identical surgery and diagnosis dates ($n = 118$) because they probably received a diagnosis prior to the surgery, but the cancer diagnosis was not reported to the registry until surgery. The time from a suspicious mammogram to surgery would better reflect the time period between diagnosis and surgery, but these data are unavailable. Therefore, our estimates are conservative relative to the actual time between diagnosis and surgery. We also excluded patients who received neoadjuvant chemotherapy ($n = 248$), which

can delay surgery by several months or more. The remaining sample size for this analysis was 3,272.

Variable Definition

Safety Net Hospitals. A consensus on how to identify a hospital as a safety net provider has not been reached (Zwanziger and Khan 2008). Some researchers identify safety net hospitals as those with a proportion of discharges from low-income patients that is more than one standard deviation above the average proportion for all short-term general hospitals in the state (Gaskin and Hadley 1999). Low-income patients include those whose source of payment is Medicaid, self-pay, and/or charity care. Some researchers consider Medicaid payments only (Gaskin and Hadley 1999; Gaskin, Hadley, and Freeman 2001; Hadley and Cunningham 2004), whereas others have focused on uncompensated care as the relevant metric (Atkinson, Helms, and Needleman 1997; Zuckerman et al. 2001; Bazzoli et al. 2006; Lindrooth et al. 2006). Other safety net definitions incorporate a dependency measure that accounts for the degree to which a community is dependent on a hospital to care for its poor (Atkinson, Helms, and Needleman 1997; Fishman and Bentley 1997; Zuckerman et al. 2001; Bazzoli et al. 2006). Finally, some researchers consider all nonfederal public hospitals as safety net providers (Gaskin and Hadley 1999; Hadley and Cunningham 2004). Zwanziger and Khan (2008) concluded that “all definitions that have been used result in non-safety net hospitals also providing a significant fraction of uncompensated care” (p. 480).¹

Using the proportion of charges for charity care and the proportion of charges for Medicaid and receipt of Disproportionate Share funds, two hospitals clearly emerged as safety net providers in our sample. Table 1 reports safety net designation and characteristics of the hospitals where the patients received mastectomies. The two safety net institutions were teaching hospitals, publicly owned, and were much larger than hospitals in the other two categories. They had a greater proportion of discharges and charges that were Medicaid or charity care (14 and 11 percent, respectively). In contrast, 7 percent of non-safety net hospitals’ total average charges were for Medicaid patients, and about 2 percent of their charges were for charity care.

Patient Variables. We included patient race and age in all models. Race was categorized as White or African American. We did not distinguish Hispanic origin because it was missing or unknown in 14 percent of the records. Age at the

Table 1: Hospital Characteristics by Safety Net Status

<i>Hospital Characteristics</i>	<i>Safety Net (N = 2)</i>	<i>Non-Safety Net (N = 59)</i>
	<i>N(%)</i> , 1999–2006	
Teaching hospital [†]	2 (100)**	2 (3.39)
Ownership [†]		
Investor owned	0 (0.00)**	14 (23.73)
Government	2 (100)**	0 (0.00)
Non-government, Non-profit	0 (0.00)**	45 (76.27)
	<i>Mean (SD)</i> , 1999–2006	
Bed size	617.5 (64.35)***	195.71 (155.55)
	<i>Mean (SD)</i> , 1999–2006, \$ Thousands	
Patient days [†]	1327.87 (90.76)**	364.78 (324.55)
Total discharges [‡]	239.98 (6.74)***	86.40 (67.26)
Medicaid discharges [‡]	47.18 (14.94)***	9.24 (8.48)
	<i>Mean (SD)</i> , 1999–2006, \$ Millions	
Total operating expenses [§]	4787.09 (217.40)***	903.66 (754.84)
Gross patient revenue [§]	1034.29 (69.19)***	271.07 (271.42)
Charity [§]	113.26 (60.38)***	5.13 (5.31)
Total inpatient Medicaid charges [§]	109.07 (24.50)***	12.53 (16.23)
Medicaid charges [§]	145.02 (30.07)***	19.09 (21.55)
	<i>Mean (SD)</i> , 1999–2006, %	
Charity [§]	10.78 (5.12)***	1.91 (0.69)
Inpatient Medicaid charges [§]	10.49 (1.67)***	4.20 (1.71)
Medicaid charges [§]	13.96 (1.97)***	7.13 (2.70)
Medicaid inpatient discharges [‡]	19.58 (5.68)***	10.42 (4.45)

Notes. **Significantly different from non-safety net hospitals, $p < .05$.

***Significantly different from non-safety net hospitals, $p < .01$.

[†]Derived from the American Hospital Association (AHA) and Virginia Health Information (VHI) Industry report data.

[‡]Calculated from the VHI patient discharge data.

[§]Calculated from the VHI industry report data.

SD, standard deviation.

time of diagnosis was entered into the model as a continuous variable. We included variables for cancer stage using the American Joint Commission on Cancer (AJCC) criteria, which indicated the tumor size, degree of cancer progression, nodal involvement, and metastasis. Stage was categorized as early stage (AJCC 0 or I) and advanced stage, but no metastases (AJCC II or III).² In the analysis of days from diagnosis to surgery, we added a dichotomous variable indicating if the patient had reconstructive surgery at the time of mastectomy because scheduling a breast surgeon and plastic surgeon on the same day may introduce a delay. Obesity and diabetes are sometimes contraindications for reconstructive surgery (McCarthy et al. 2008), and therefore we included a variable for these conditions as well. We also included

a variable for whether the patient had radiation following mastectomy because radiation can sometimes delay reconstruction (Kronowitz and Robb 2004).

Following a method developed by Diez Roux et al. (2001), we constructed a summary measure of socioeconomic status for each census tract code in Virginia using data from the 2000 U.S. Census, which was linked to patients' census tract of residence.³ Three measures of household wealth and income (median household income, median value of housing units, proportion of households with interest, dividend, or rental income), two education variables (proportion of adult residents completing high school and proportion of adult residents completing college), and one variable regarding occupational status (proportion of employed residents with management, professional, and related occupations) comprise the summary measure. The mean and standard deviations were calculated for each of the six variables (Birkmeyer et al. 2008) and a z-score was constructed for each census tract code by subtracting the mean of all Virginia census tracts and dividing by the standard deviation for each variable. The summary measure was the summation of the six z-scores and ranged from -12.2 to 17.5 . We standardized summary scores by transforming them to 0–100 scale (with 0 scores corresponding to greatest socioeconomic disadvantage and 100 corresponding to greatest socioeconomic advantage). Lastly, travel distance was computed from the patients' address to the hospitals' address using the straight line method. Distance was grouped into three categories: less than or equal to 20 miles, 21–60 miles, and >60 miles.

Statistical Implementation

Hierarchical generalized linear models were used to estimate the relationship between the explanatory variables and the days from diagnosis to mastectomy. Days from diagnosis to mastectomy was treated as a log-transformed continuous variable. To account for the clustering of patients within hospitals and to estimate the intra-class correlations among patients within each hospital, hospital-level random intercepts were included in the model. This model permits the separation of within-hospital and between-hospital variations after adjustment for patient characteristics. Similarly, we used a hierarchical linear probability model to predict the likelihood of reconstruction. In each model, we included interaction terms between safety net status and insurance status and between safety net status and race. The linear probability model avoids challenges associated with the interpretations of interaction terms in nonlinear models predicting probabilities (Ai and Norton 2003).

To ease the interpretation of the nonlinear regression-based coefficients including interaction terms between hospital type and insurance and patient race, we obtained estimates of the log-transformed days from diagnosis to surgery and the percent of patients who received reconstruction using the expected values for patients in each of the subgroups of safety net hospital status, health insurance status, and race. We calculated the adjusted estimated expectation as $\hat{E}(T_{jk}) = \exp(\mathbf{x}'_{jk}\hat{\beta}) \times \bar{\varepsilon}$ where $\hat{E}(T_{jk})$ is the estimated expected value of days to surgery of the k^{th} insurance group at hospitals of the j^{th} safety net status, $\hat{\beta}$ is the vector of estimated model parameter coefficients, and $\bar{\varepsilon}$ is Duan's nonparametric smear estimate (Duan 1983), which is the mean of the retransformed residuals. We also estimated the difference between days to surgery and percent of patients who received reconstruction between insurance groups and racial differences within each type of hospital and between hospital types within each insurance group and by race. We used the bootstrap method to construct the nonparametric percentile and 95 percent confidence intervals for the estimates and the differences in the days to surgery by patient insurance, race, and safety net hospital designation. One thousand random samples of the same size as the original analytical data set were withdrawn with replacement. The same method was used to obtain the 95 percent confidence intervals for the percent of women receiving reconstruction by insurance, race, and hospital type and the differences of percentages between combinations of these groups. All analyses were conducted using SAS, version 9.2 (SAS 2009).

RESULTS

Descriptive Statistics

Table 2 reports characteristics of women in the sample by hospital safety net status for the VCR sample that linked to the VHI claims and for the full sample of VHI patients who had a mastectomy. In the sample restricted to linked VCR and VHI patients, approximately 17 percent of women treated at safety net hospitals were uninsured relative to only 5 percent of the women at non-safety net hospitals, and 6 percent of women treated in safety net hospitals were Medicaid insured relative to 3 percent of women treated in non-safety net hospitals. Forty-four percent of women treated in safety net hospitals lived within 20 miles of the hospital, whereas 85 percent of women treated at non-safety net hospitals lived within 20 miles of the hospital. There was a higher rate of neoadjuvant chemotherapy in safety net hospitals, and women treated in safety net hospitals were slightly more likely to have earlier stage disease

Table 2: Breast Cancer Sample Characteristics by Hospital Type

	VCR Patients Linked to VHI Claims			All VHI Patients	
	Safety Net (N = 356)	Non-Safety Net (N = 3,283)	p-Value*	Safety Net (N = 557)	Non-Safety Net (N = 4,825)
Insurance					
Medicaid	6.15%	3.02%	<.0001	6.82%	4.10%
Private	76.54%	92.35%		78.82%	91.94%
Uninsured	17.32%	4.63%		14.36%	3.96%
Race					
African American	21.51%	18.95%	0.2425	20.47%	19.19%
White	78.49%	81.05%		79.53%	80.81%
Stage [†]					
0/I	46.37%	40.85%	0.0440	20.96%	27.95%
II/III	53.63%	59.15%		79.04%	72.05%
Distance					
≤ 20 miles	43.58%	85.32%	<.0001	42.91%	83.36%
21–60 miles	39.66%	12.88%		34.47%	13.02%
>60 miles	16.76%	1.80%		22.44%	2.51%
Neoadjuvant chemotherapy	12.57%	6.18%	<.0001	N/A	N/A
Obese or diabetic	17.88%	15.78%		17.06%	14.88%
Radiation	18.44%	23.94%		N/A	N/A
Reconstruction within 1 year	43.58%	53.52%	0.0003	42.73%	50.49%

continued

Table 2. Continued

	VCR Patients Linked to VHI Claims			All VHI Patients	
	Safety Net (N = 358)	Non-Safety Net (N = 3,283)	p-Value*	Safety Net (N = 557)	Non-Safety Net (N = 4,825)
Mean (SD)					
Age at diagnosis	49.15 (8.89)	50.19 (8.38)	0.0267	49.97 (8.66) [‡]	50.69 (8.35) [‡]
Census tract socioeconomic score ^{§¶}	40.14 (9.99)	44.49 (12.23)	<.0001	N/A	N/A
Days from diagnosis to mastectomy (n = 3,272) [§]	59.62 (43.43)	43.53 (40.96)	<.0001	N/A	N/A

Notes: *Statistical significance is based on tests of equality of means for continuous variables determined using the *F*-test; for the categorical variables, it is based on the test for statistical independence and determined using the likelihood ratio chi-square test.
[†]Stage for patients appearing only in claims data is derived using method developed by Cooper et al. (1999).
[‡]Age at mastectomy from claims.
[§]Excludes patients with the same date of surgery and date of diagnosis (n = 118), patients who had neoadjuvant chemotherapy (n = 248).
[¶]Could not be estimated for patients without a link to the VCR.
VCR, Virginia Cancer Registry; VHI, Virginia Health Information.

and less likely to have radiation following mastectomy. Women treated in safety net hospitals resided in census tracts with significantly lower socioeconomic scores relative to the women treated in non-safety net hospitals (40 and 44, respectively).

There were significant differences between hospital types in the outcomes of interest. The rate of reconstruction was lower in safety net hospitals (44 percent) compared with non-safety net hospitals (54 percent). The average number of days between diagnosis and mastectomy was greatest in safety net hospitals (60 days) compared with the days between diagnosis and surgery in non-safety net hospitals (44 days). When we include all VHI patients who met inclusion criteria in the sample, similar patterns emerge as observed in the linked sample.

Days to Mastectomy

Table 3 reports coefficient estimates from models predicting the log number of days from diagnosis to mastectomy. Women treated in safety net hospitals experienced 48 percent longer wait times between diagnosis and mastectomy relative to women treated in non-safety net hospitals ($e^{0.39} - 1 = 0.48$; $p < .01$). African American women had longer wait times between diagnosis and mastectomy than white women (approximately 23 percent longer).

Reconstruction

Table 3 also reports results from a linear probability model that predicted the likelihood of reconstruction within 1 year following mastectomy. Hospital safety net status was not statistically significant. However, uninsured and Medicaid insured women were much less likely to have reconstruction than privately insured women (20–29 percent points, respectively; $p < .01$). African American women were 6 percentage points less likely to receive reconstruction than white women ($p < .01$). These results were nearly identical when we used all patients with mastectomy claims.

Interpretation and Interactions

Table 4 reports the estimated days between diagnosis and mastectomy and the estimated probabilities of receiving reconstruction derived from models when interaction terms are included. The time between diagnosis and surgery was between 17 and 28 days longer in a safety net hospital, depending on the

Table 3: Parameter Coefficients of Models Predicting Log of Days from Diagnosis to Mastectomy and Probability of Reconstruction

	<i>Days to Surgery, Log-normal, Linked Patients (N = 3,272)</i>	<i>Reconstruction Within 1 Year, Linear Probability Model, Linked Patients (N = 3,641)</i>	<i>Reconstruction Within 1 Year, Linear Probability Model, All VHI Patients (N = 5,205)</i>
Insurance status			
Uninsured	-0.04 (0.07)	-0.25 (0.04)***	-0.25 (0.03)***
Private	Referent	Referent	Referent
Medicaid	0.04 (0.08)	-0.19 (0.05)***	-0.20 (0.03)***
Hospital safety net status			
Safety net hospital	0.39 (0.19)**	-0.08 (0.13)	0.06 (0.15)
Non-safety net	Referent	Referent	Referent
Age	0.004 (0.002)**	-0.01 (0.001)***	-0.01 (0.001)***
Race			
African American	0.21 (0.04)***	-0.06 (0.02)***	-0.08 (0.02)***
White	Referent	Referent	Referent
Stage			
0/I	0.20 (0.03)***	0.13 (0.02)***	-0.11 (0.01)***
II/III	Referent	Referent	Referent
Obesity and/or diabetes	0.07 (0.04)*	-0.11 (0.02)***	-0.09 (0.02)***
Neoadjuvant chemotherapy	N/A	-0.13 (0.03)***	-0.13 (0.04)***
Reconstruction with mastectomy	0.44 (0.03)***	N/A	N/A
Had radiation	N/A	-0.13 (0.02)***	-0.02 (0.01)**
Distance travelled to hospital			
≤ 20 miles	-0.11 (0.07)	0.02 (0.04)	-0.02 (0.03)
21–60 miles	-0.07 (0.08)	0.01 (0.04)	-0.02 (0.03)
>60 miles	Referent	Referent	Referent
Socioeconomic score	0.003 (0.001)***	0.003 (0.001)***	N/A

Notes. SE, standard errors shown in parentheses.

** $p < .05$, *** $p < .01$.

VHI, Virginia Health Information.

type of insurance coverage. The interaction term between safety net hospital and insurance is not statistically significant. African American women waited, on average, 13 days longer for surgery in safety net hospitals and 8 days longer in non-safety net hospitals, respectively, than white women. The interaction between safety net hospitals and race generated from models using the bootstrap confidence intervals to estimate time to surgery are not statistically significant.

Over half of privately insured women received reconstruction. In contrast, 28 percent of uninsured women had reconstruction, and approximately 30 percent of Medicaid insured women had reconstruction. About 45 to 55

Table 4: Days from Diagnosis to Surgery and Rates of Reconstruction for Patients Treated in Safety Net and Non-Safety Net Hospitals

	<i>Safety Net Hospital</i>	<i>Non-Safety Net Hospital</i>
	Time to Mastectomy (Days) [†]	
Uninsured	62.71 (53.07, 73.16)**	35.10 (28.44, 40.49)
Medicaid	54.79 (42.91, 67.53)**	38.09 (32.6, 44.38)
Private	53.87 (49.24, 59.96)**	36.50 (33.27, 39.94)
African American	64.72 (56.23, 75.15)**,**	43.11 (37.21, 48.39)***
White	52.00 (47.18, 59.24)**	34.91 (32.30, 38.18)
	Rates of reconstruction (%) [‡]	
Uninsured	27.58 (19.72, 35.68)*	27.46 (20.04, 33.82)*
Medicaid	31.08 (22.39, 39.36)*	29.19 (20.70, 37.48)*
Private	52.03 (45.14, 58.81)	51.91 (47.32, 56.68)
African American	54.92 (43.06, 66.60)	45.00 (39.17, 50.56)***
White	48.63 (41.05, 55.61)	50.81 (46.18, 55.75)

Notes. * Significantly different from privately insured patients $p < 0.05$.
**Significantly different from non-safety net hospitals $p < 0.05$.
***Significantly different from white patients $p < 0.05$.
[†]Expected values in the table were computed by fixing the values of combinations of insurance status, safety net hospital status, and race and applying Duan's correction to estimates of time to mastectomy.
[‡]Ninety-five percent bootstrap confidence intervals shown in parentheses generated using the percentile method on the regression predicted outcomes of 1,000 random samples from the original data.

percent of African American women received reconstruction. Compared with white women, African American women were less likely to receive reconstruction in non-safety net hospitals.

DISCUSSION

There is little evidence to suggest that safety net hospitals attenuate treatment differences between insurance and racial groups. The time between diagnosis and surgery was longer in safety net hospitals for all patients, regardless of insurance source or race. Perhaps safety net hospitals are operating at capacity and are unable to schedule surgeries in a timely manner. If this is the case, their resources may be further stretched following the passage of the PPACA. Alternatively, as these hospitals are teaching hospitals, they may perform additional diagnostic tests prior to scheduling surgery or physicians who treat low-income patients may have a slower referral process.

Insurance differences in the rates of reconstruction were observed, although differences were not observed by hospital type. Privately insured women were nearly twice as likely to receive a reconstruction within 1 year following mastectomy than uninsured women. These differences may be due to differences in unobserved disease severity, differences in patient preferences, or differences in access to specialty services such as those provided by a plastic surgeon. Although uninsured patients have high levels of comorbid conditions (Robbins et al. 2009), we control for a limited set of conditions (obesity and diabetes) in our models and we control for cancer stage (American Joint Committee on Cancer 2010). It is unlikely that women differ in their preference for reconstruction given the many noted benefits of reconstruction on recovery and well-being (Dean, Chetty, and Forrest 1983; Rowland et al. 2000). However, uninsured women may be unable to pay for the out-of-pocket portion for reconstruction following mastectomy or they may be unable to find a plastic surgeon that will perform reconstruction at a greatly reduced rate. Other studies have documented disparities in access to specialty services for the uninsured (Asplin et al. 2005; Cook et al. 2007). However, women insured by Medicaid were not statistically significantly different from uninsured women in their rate of reconstruction. Therefore, the marginal benefit afforded by public insurance may not be sufficient to access specialty care. Our results suggest that interventions beyond health insurance, particularly Medicaid insurance, will be needed to fully close the gap between low and upper income women in breast cancer treatment.

African American women experienced disparities in care. They had 23 percent longer wait times between diagnosis and mastectomy, and they were approximately 6 percent less likely to receive reconstruction following mastectomy as white women. African American women were more likely to receive reconstruction if treated in a safety net hospital than if they were treated elsewhere (55 versus 45 percent), but they had longer wait times than white women in safety net hospitals. Barriers to equivalent care for African American women extend well beyond health insurance and hospital type.

The study has several notable strengths including the use of population-based data, the ability to link patients across discharges, an examination of specialty care services, and access to rich patient, disease, institutional, and contextual information. However, there are four main limitations. First, a third of the claims could not be linked to the cancer registry. We believe that a significant portion of claims could not be linked because they were diagnosed prior to the study period but treated during the study period. For example, a woman could have been diagnosed in 1998 (1 year before the start date of the

VCR sample) but received a mastectomy in 1999 and thus had a claim in the VHI data. The problem of missing claims is difficult to assess, although our analysis of reconstruction rates using all mastectomy claims indicated that the results were robust. To improve match rates between files, the quality of both files needs to be improved, the information collected expanded, and state registries could be routinely linked to hospital discharge data rather than linked only for a specific research agenda. A few states (e.g., Michigan, Georgia), with federal support, have linked many years of registry and claims data, but ongoing support for these efforts is uncertain. At present, states have few incentives to use these data for research purposes, and with budget shortfalls, further investments may not occur. Therefore, investments in data infrastructure are needed at the national level to create datasets for research into outcomes such as those explored in this article and to measure progress toward goals to reduce health disparities (Bradley et al. 2010).

Second, there may be unobserved differences in severity and comorbid conditions between patients seen at different hospitals. The hierarchical model we estimated should have corrected for much of these differences, but residual differences may remain. Third, only two hospitals were considered safety net hospitals. Patients treated in these two hospitals had statistically significantly more days between diagnosis and surgery than patients treated in any other hospital. Nonetheless, in a sensitivity analysis, we relaxed our definition of a safety net hospital to include hospitals just below our original cut-offs for Medicaid and charity care provided. The results were robust until the fifth hospital was added to the safety net category (results not shown). With the addition of the fifth hospital, the sample of patients treated in safety net hospitals increased by 43 percent and became diluted. Finally, we report findings from only one cancer site within a single state. Nonetheless, the ability to link young patients (i.e., under age 65) from a cancer registry to inpatient discharges can only occur at the state level. An earlier study that used data from only one safety net hospital observed longer wait times between diagnosis and surgery for uninsured patients relative to insured patients (Bradley et al. 2008). However, this study considered both inpatient and outpatient surgery and breast conserving surgery in addition to mastectomy, and so the findings are not comparable.

One of the primary means the PPACA proposes to provide health insurance to low-income previously uninsured patients is through Medicaid expansions (Allen et al. 2010; Ku 2010). This study suggests that Medicaid insurance will not improve reconstruction rates and if low-income women are still treated in safety net hospitals following the implementation of the PPACA, then wait times will remain longer and may potentially increase if the

burden of care for low-income patients increases without commensurate increases in reimbursement and staffing levels. Safety net hospitals, which will probably remain the primary health care provider for low-income patients in the foreseeable future, may have an even greater challenge providing quality care if funding from sources such as Disproportionate Share are reduced. Access to specialty services such as reconstruction may remain limited for low-income women, regardless of expansions of Medicaid insurance. The question of how to reduce racial disparities remains a mystery, and it is not likely to be solved by health insurance or access alone. Nevertheless, a reduction in disparities is a challenge that requires pursuit, even after the passage and implementation of the PPACA.

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NOTES

1. For a review of methods used to define safety net hospitals and how these definitions influence quality of care outcomes, see McHugh, Kang, and Hasnain-Wynia (2009).
2. In the model that predicts reconstruction rates for the VHI patients (linked and unlinked claims), we did not have stage for patients who could not be linked to the VCR. Therefore, we used the claim files to approximate stage using the method developed by Cooper et al. (1999).
3. Exact address was not available for patients who were not linked to the VCR. Only ZIP code was available for these patients.

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