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Variation in the Utilization of Reconstruction Following Mastectomy in Elderly Women

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Abstract

Background—Regardless of their age, women who choose to undergo postmastectomy reconstruction report improved quality of life as a result. However, actual use of reconstruction decreases with increasing age. Whereas this may reflect patient preference and clinical factors, it may also represent age-based disparity.

Methods—Women aged 65 years or older who underwent mastectomy for DCIS/stage I/II breast cancer (2000–2005) were identified in the SEER-Medicare database. Overall and institutional rates of reconstruction were calculated. Characteristics of hospitals with higher and lower rates of reconstruction were compared. Pseudo- R^2 statistics utilizing a patient-level logistic regression model estimated the relative contribution of institution and patient characteristics.

Results—A total of 19,234 patients at 716 institutions were examined. Overall, 6 % of elderly patients received reconstruction after mastectomy. Institutional rates ranged from zero to >40 %. Whereas 53 % of institutions performed no reconstruction on elderly patients, 5.6 % performed reconstructions on more than 20 %. Although patient characteristics (% $R^2 = 70$ %), and especially age (% $R^2 = 34$ %), were the primary determinants of reconstruction, institutional characteristics also explained some of the variation (% $R^2 = 16$ %). This suggests that in addition to appropriate factors, including clinical characteristics and patient preferences, the use of reconstruction among older women also is influenced by the institution at which they receive care.

Conclusions—Variation in the likelihood of reconstruction by institution and the association with structural characteristics suggests unequal access to this critical component of breast cancer

care. Increased awareness of a potential age disparity is an important first step to improve access for elderly women who are candidates and desire reconstruction.

Following the treatment of early-stage breast cancer with mastectomy, women who opt for reconstructive surgery may experience better quality of life without adverse oncologic outcomes.^{1,2} The Women's Health and Cancer Rights Act (WHCRA) passed in 1999 mandates insurance coverage of breast reconstruction after mastectomy for breast cancer.³ Yet, studies have found persistent differences in rates of reconstruction according to patient-related factors, including age, race, socioeconomic status (SES), and insurance status, as well as institutional characteristics, such as urban hospital location, academic institution affiliation, or National Cancer Institute (NCI) cancer center designation.³⁻⁶ Although this may represent appropriate variation based on patient preferences, this also may represent unequal access to care.

Reported reconstruction rates after mastectomy are 15-42 %.⁴⁻¹⁰ On subgroup analysis, these studies show that reconstruction rates for elderly patients are 4.1-14 %, suggesting that decision making about reconstruction in elderly patients differs from that in younger patients. Whereas elderly women who opt for reconstruction report improved quality of life without increased complications, they are more likely to have comorbidities, impaired functional status, limited access to transportation, impaired mental status, and fewer sources of psychosocial support.¹¹⁻¹⁴ These factors might lead to less willingness on the part of both the patient and/or the providers to consider reconstruction as an option. Studies cite advanced age as well as concerns about complications from further surgery as the most common reasons why many elderly patients choose to forgo reconstruction.^{15,16} As a result, disentangling patient preference from external influences, such as physician bias regarding age, lack of availability of plastic surgeons, or institutional culture, is difficult.

The variation of rates of hospital utilization for reconstruction in elderly patients has not been examined. Furthermore, it is unclear whether such differences reflect differences in patient populations or innate features of the institution. We sought to fill this gap by (1) quantifying the degree of institutional variation in utilization rates; and (2) determining whether differences in the patient population can explain this variation.

METHODS

Study Cohort

The data used for this study came from the Surveillance, Epidemiology and End Results (SEER) database linked to Medicare claims for the period 1999–2006. The cohort was limited to patients who were diagnosed with ductal carcinoma in situ (DCIS) or stage I or II adenocarcinoma from Jan 1, 2000 to Dec 31, 2005 and for whom breast cancer was their first or only cancer.

All patients who had undergone mastectomy within 30 days prediagnosis through 1 year postdiagnosis were identified through International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure codes or Current Procedural Terminology (CPT) codes. Patients who had undergone reconstruction were identified

through ICD-9-CM procedure codes or Healthcare Common Procedure Coding System (HCPCS) codes for within 30 days before mastectomy through 1 year following the mastectomy. This study was approved by the Institutional Review Board at the Dana-Farber Cancer Institute (Boston, MA).

Variable Definitions

Variables reflecting patient characteristics were identified at the time of diagnosis from the SEER registry data. Hospital characteristics were identified at the time of surgery using the hospital file provided by SEER-Medicare. Patient comorbidity information was captured with the Deyo implementation of the Charlson comorbidity score and utilized both hospital and physician claims data in the 12 months before diagnosis as described by Klabunde.¹⁷⁻¹⁹ Socioeconomic status was measured at the census tract level as median income and percent college education. State buy-in program participation was used as a proxy for low-income status. State buy-in means that the state has paid the premium and/or cost sharing for Part B for the beneficiary through traditional Medicaid or one of the other Medicare Savings Programs administered by the state Medicaid Program, and this variable has been used in other population studies.^{20,21} Availability of plastic surgeons was obtained through linkage of the Area Resource File at the healthcare service area (HSA) level for each patient in the cohort.

Hospitals were considered to be part of an oncology group if they participated in any of the cooperative groups captured in the hospital file. NCI-designated Clinical Cancer Centers and Comprehensive Cancer Centers were examined in aggregate as NCI centers.

Data Analysis

Our patient cohort was limited to those from hospitals where five or more mastectomies were performed to increase the stability of our data. Rates of reconstruction were calculated for each hospital, and hospitals were grouped as zero (0 %), middle (>0 – <20 %), and high (≥ 20 %) utilizers of reconstruction according to their rates of reconstruction (henceforth called “utilization groups” and “zero, middle, or high recon hospitals”). Wilcoxon rank-sum tests for continuous variables and Fisher’s exact tests for categorical variables were used to compare patient level medians and frequencies of hospital characteristics of the utilization groups.

A patient-level multivariable logistic regression model was developed to assess factors associated with reconstruction after adjusting for other covariates. Generalized linear mixed models (GLMM) were used to estimate the logistic regression parameters while accounting for clustering by institutions.^{22,23} Within the GLMM framework, pseudo-R square statistics were used to quantify the contribution of (fixed) hospital-level and patient-level characteristics to observed variation in the use of reconstruction. Changes in pseudo-R square statistics were used to quantify the relative explanatory capacity of each variable. The variance of the hospital random effects measure the residual (unexplained) effects of hospitals after adjusting for the fixed hospital-level and patient-level characteristics.

All p values were two-sided and were considered statistically significant if $p < 0.05$. Analyses were performed with SAS version 9.2 (SAS institute Inc, Cary, NC).

RESULTS

A total of 19,234 patients received mastectomy for DCIS/stage I/II breast cancer at 716 institutions. Overall, 6 % of elderly patients received reconstruction after mastectomy. Table 1 shows characteristics of patients who received postmastectomy reconstruction compared with patients who did not. Patients who received reconstruction after mastectomy were generally younger, white, and unmarried. They lived in higher income areas, had less comorbidities, and were more likely to have DCIS (vs. invasive cancer; Table 1). They lived in areas with greater numbers of plastic surgeons; the median number of plastic surgeons per 100,000 females per healthcare service area (HSA) was 5.1 (interquartile range (IQR) 2.7–6.1) for patients who received mastectomy alone and 5.8 (IQR 4.0–7.4) for patients who underwent reconstruction after mastectomy ($p < 0.0001$). Education level, estrogen receptor (ER) status, progesterone receptor (PR) status, and receipt of radiation therapy were not different.

The distribution of hospitals by rates of reconstruction is shown in Fig. 1. Institutional rates of reconstruction ranged from 0 to >40 %. Although 53 % of institutions performed no reconstruction ($n = 378$), 5.6 % of hospitals performed reconstructions on more than 20 % of mastectomy patients ($n = 40$) and 41 % of institutions fell between these extremes ($n = 298$).

Table 2 describes the patient and hospital characteristics of the institutions according to their utilization group. Middle recon hospitals composed the referent group. Zero recon hospitals served patients who were generally older, white, less likely to be married, of lower income and education, sicker, with more advanced cancers, and who lived in locations where fewer plastic surgeons were available. There was a greater chance of zero reconstruction hospitals being in the South and Midwest. These hospitals were less likely to be in an urban location, part of an oncology group, a teaching hospital, have a medical school affiliation, or have a residency program. In contrast, high reconstruction hospitals generally treated younger and healthier women. There was a greater chance of high reconstruction hospitals being in the West, and these hospitals were more likely to be in an urban location, be a NCI center, and have a residency program.

Table 3 shows the results of the patient-level multivariable logistic regression model. When compared with 65- to 70-year-old patients, patients aged 70–75 years were only half as likely (odds ratio (OR) 0.43), aged 75–80 years were a quarter as likely (OR 0.23), and patients older than 80 years old rarely were observed (OR 0.07) to receive reconstruction after mastectomy. Other characteristics associated with a decreased likelihood of getting reconstruction were the presence of invasive cancer, presence of comorbidities, nonwhite race, nonmarried status, lower income level, and having participated in a state buy-in program.

Additionally, patients treated in a hospital that was not a NCI center, not a part of an oncology group, or not a teaching hospital were less likely to receive reconstruction after

mastectomy. Compared with the Northeast, patients in the Midwest and South were less likely to receive reconstruction, whereas patients from the West coast had a greater likelihood of reconstruction. Reconstruction rates increased over time, and elderly patients treated in 2000 were less likely to get reconstruction than in 2005. The number of plastic surgeons available, urban hospital location, medical school affiliation, and presence of a residency program were not significant after adjusting for other variables in the model.

Determination of the relative importance of the explanatory variables through the examination of differences in pseudo- R square statistics ($\% R^2$) is shown in Table 4. Patient characteristics in aggregate explained the largest part (70 %) of the observed variation in postmastectomy reconstruction. Hospital characteristics in aggregate explained an additional 16 % of the variation, and geographic location and year of diagnosis accounted for 1.5 % and 1 %, respectively (Table 4). Among patient characteristics, age was the most significant determinant and accounted for 34 % of the observed difference between patients who did and did not get reconstruction after mastectomy. All other individual patient characteristics explained less than 5 % of the observed variation.

DISCUSSION

Similar to previous studies, we found that hospital rates of reconstruction for elderly women are lower than reported for the general population.⁴⁻¹⁰ Our study highlights that these rates are not uniform, and there is a wide range in institutional utilization rates of postmastectomy reconstruction for elderly patients. Whereas most hospitals did not perform reconstruction on any of their elderly mastectomy patients, some hospitals performed reconstruction on greater than 20 % of their elderly patients. More so than individual hospital rates of reconstruction, hospital variation has implications for quality, because it may suggest issues of equal access.

Through patient-level analysis, we found that patient characteristics, especially age, were the most significant predictor of whether or not an elderly woman underwent reconstruction after mastectomy for breast cancer. Variation related to age may appropriately represent patient preferences. However, the observed variation after controlling for known patient and institutional variables, along with additional information derived from hospital-level analysis, suggests that variation due to age also may represent system-level factors, such as: (1) provider bias due to age, socioeconomic status, or race; or (2) limitations of resource availability at the institution (e.g., plastic surgeons or operating room time).

Variation in postmastectomy reconstruction is difficult to study, particularly in the elderly. Ideally, reconstruction after mastectomy should be a choice determined by patient preference and clinical factors and not influenced by bias or system-level constraints. In their study examining the influence of outpatient mastectomies on receipt of reconstruction in SEER-Medicare patients aged 65-69 years, Bian et al. reported similar variations according to patient and institutional characteristics, as well as the availability of plastic/reconstructive surgeons.¹⁰ We build on their results by investigating the relative importance of the structural characteristics and of the patient population served by an institution as explanatory factors for variation in the utilization of reconstruction.

Although our study found patient characteristics to be the most important driver of institutional variation in the use of reconstruction, it is difficult to know the etiology of these patient-based differences. Studies have found reconstruction to be a safe option in elderly women; however, they also suggest that patients consider both advanced age and risk of complications when deciding whether to proceed with reconstruction.^{12,15,16} It therefore is difficult to determine the preferences of the patient from the biases of the physician.

Much like other studies, we also found socioeconomic status (SES) and race to be contributors to variation in reconstruction rates.^{4,6,7,24} Similarly, whereas differences found by race may reflect cultural preferences, studies have shown that limited information about the procedure and less access to care are areas that need to be targeted.^{7,25,26}

Variation in institutional reconstruction rates after mastectomy driven by age and patient characteristics may represent appropriate variation (e.g., that driven by patient preference or clinical risk); however, variation associated with hospital characteristics represents inappropriate variation that should be targeted for improvement. Medicare claims data were used to assign each patient to the hospital where the mastectomy occurred and allowed us to analyze simultaneously both hospital and patient characteristics. As such, we are only able to detect self- or physician-based referral to a hospital offering reconstruction after, not before, mastectomy. For example, if mastectomy was done at hospital A, then got referred for reconstruction at hospital B, credit for the reconstruction was given to hospital A.

Patients who underwent mastectomy in NCI-designated cancer centers, institutions participating in oncology groups, and teaching hospitals were more likely to undergo reconstruction. While patient-related unmeasured effects may be a possible explanation, this also may represent systemic barriers to care, such as lack of access to plastic surgeons or premastectomy referral of patients desiring reconstruction to other institutions. Although it is difficult for reconstructive services to be provided at every hospital, reconstructive options should be discussed in conjunction with discussions about mastectomy, and patients who wish to get reconstruction can be referred elsewhere for these services.

Our study provides important information about variation in postmastectomy reconstruction rates in elderly patients by examining patient- and hospital-level predictors. Whereas the patient-level analysis shows a stark difference in reconstruction rates associated with age, the difference in average ages in the three hospital utilization groups were not clinically meaningful. This may suggest that while one's chances of reconstruction within an institution are based on age, the chances of reconstruction in general may be influenced by how aggressively the hospital utilizes reconstruction for their elderly mastectomy patients.

There are several limitations to our study, primarily related to factors that are not available in the dataset. NCCN guidelines suggest that patient selection for reconstruction should be influenced by the need for postmastectomy radiation, patient body habitus, smoking history, comorbidities, and patient concerns.²⁷ Although we were able to adjust for postmastectomy radiation and comorbidities, we were unable to adjust for variables not routinely collected by the cancer registries, such as body mass index, smoking status, functional status, family history of breast cancer, or history of radiation.

Recently, there has been a strong emphasis on personalized medicine. It is imperative to allow elderly patients to base their decision about postmastectomy reconstruction for breast cancer on personal preference and surgical risk. Multiple factors need to be taken into account, such as frailty, mental health, willingness to undergo additional treatment, personal situations (such as spousal dependency), and social and cultural beliefs. It was reassuring to see that patient characteristics, and not hospital characteristics, accounted for a majority of the variation. However, more granular studies, using focus groups or surveys are necessary to confirm that these differences represent patient preference and not unwarranted bias from the physician or institutional beliefs regarding certain clinical factors, such as age.

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FIG. 1.

Distribution of hospitals by rates of reconstruction after mastectomy for breast cancer.

Hospital rates of reconstruction were grouped as zero, middle and high utilization hospitals for further analysis. Zero: 0 %, Middle: >0–20 % and High: 20 %

TABLE 1

Characteristics of elderly women who received reconstruction after mastectomy for breast cancer

Characteristic	Total patients (N = 19,234)	Patients receiving reconstruction [n (%)]
Age (yr)		
65–<70	4,454	626 (14) *
70–<75	4,724	349 (7) *
75–<80	4,703	177 (4) *
80+	5,353	60 (1) *
AJCC stage		
0	2,473	312 (13) *
1	7,679	475 (6) *
2	9,082	435 (5) *
DCIS vs. invasive cancer		
Stage 0	2,473	312 (13) *
Stage 1 and 2	16,761	910 (5) *
Charlson comorbidity score		
0	12,674	983 (8) *
1	4,313	176 (4) *
2+	2,274	63 (3) *
Race		
White	17,049	1,152 (7) *
Black	1,335	43 (3) *
Asian/PI/other	850	27 (3) *
Median census tract income quartiles		
0–25 percentile	5,720	150 (3) *
>25–50 percentile	5,162	214 (4) *
>50–75 percentile	4,513	328 (7) *
>75–100 percentile	3,839	530 (14) *
% some college census tract quartiles		
0–25 percentile	4,874	327 (7)
>25–50 percentile	4,596	255 (6)
>50–75 percentile	4,879	281 (6)
>75–100 percentile	4,885	359 (7)
Marital status at diagnosis		
Married	11,135	490 (4) *
Not married	8,099	732 (9) *
ER		
Negative	4,451	357 (8) *

Characteristic	Total patients (N = 19,234)	Patients receiving reconstruction [n (%)]
Positive	12,119	704 (6) *
Unknown/missing/ indeterminate	2,664	161 (6) *
PR		
Negative	4,699	372 (8) *
Positive	9,731	567 (6) *
Unknown/missing/ indeterminate	4,804	283 (6) *
DM		
No	6,124	385 (6)
Yes	13,110	837 (6)
Year of diagnosis		
2000	3,502	193 (6) **
2001	3,710	229 (6) **
2002	3,513	206 (6) **
2003	3,127	198 (6) **
2004	2,782	202 (7) **
2005	2,620	194 (7) **

Bold indicates statistical significance

AJCC American Joint Committee on Cancer, DCIS ductal carcinoma in situ, PI Pacific Islander, ER estrogen receptor status, PR progesterone receptor status, DM diabetes

*
 $p < 0.001$

**
 $p < 0.05$

TABLE 2

Patient and hospital characteristics stratified by degree of hospital utilization rates of reconstruction for elderly breast cancer patients

	Zero utilization hospitals (n = 378)	Middle utilization hospitals [reference group] (n = 298)	High utilization hospitals (n = 40)
Patient characteristics			
Median age			
Median (IQR)	76 (73.6–77.8) **	75.4 (74.0–76.6)	74.1 (72.2–76.8) *
% White			
Median (IQR)	96.1 (81.8–100) **	93.3 (85.2–98.5)	93.2 (86.7–100)
% Married			
Median (IQR)	37.8 (28.6–50) *	42.9 (35.3–48.6)	46.8 (39.4–56.2) *
Mean income quartile			
Median (IQR)	1.8 (1.3–2.4) *	2.5 (2.0–3.0)	3.0 (2.5–3.5) *
Mean education quartile			
Median (IQR)	2.3 (1.7–3) *	2.7 (1.9–3.3)	2.7 (2.1–3.1)
% Charlson zero			
Median (IQR)	63.1 (53.8–75)	66.7 (58.1–72.7)	71.9 (57.1–82.1) **
% Diabetes			
Median (IQR)	18.2 (11.1–27.8) *	16.3 (10.9–21.7)	12.9 (6.5–20.2)
% DCIS			
Median (IQR)	10.0 (0–16.7) *	12.9 (8.1–18.2)	15.3 (8.2–25.9) **
% ER positive			
Median (IQR)	83.3 (75–91.3)	83.3 (76.5–88.3)	85.4 (75.0–92.6)
% XRT			
Median (IQR)	10.9 (0–25.6) *	14.3 (9.1–19.4)	16.7 (12.1–20.6)
Resource availability			
Median # PS per 100,000 female; median (IQR)	3.1 (0.8–5.9) *	5.3 (3.4–6.2)	6.4 (5.1–7.4) *
Hospital characteristics			
Hospital region			
Northeast	10.1 % *	21.8 %	20 %
South	30.2 % *	17.1 %	7.5 %
Midwest	18 % *	12.1 %	5%
West	41.8 % *	49 %	67.5 %
Urban	68.8 % *	94 %	100%
NCI center	1.6 %	3.7 %	12.5 % **
Oncology group	30.7 % *	69.5 %	67.5 %
Teaching hospital	37.6 % *	48.3 %	60 %

	Zero utilization hospitals (n = 378)	Middle utilization hospitals [<i>reference group</i>] (n = 298)	High utilization hospitals (n = 40)
Medical school affiliation	22.5 % *	43.3 %	60 %
Resident program	15.3 % *	30.9 %	52.5 % **

Bold indicates statistical significance

Hospital-level descriptive analysis of the average patient and hospital characteristics of hospitals constituting each utilization group. Utilization groups were created according to the percent of reconstructions performed for elderly patients at a given hospital. Zero: 0 %, Middle: >0–20 %, and High: 20 % (see Fig. 1)

IQR interquartile range, *DCIS* ductal carcinoma in situ, *ER* estrogen receptor status, *XRT* radiation therapy, *PS* plastic surgeons, *NCI* National Cancer Institute designated cancer center

P values are for comparison with reference group:

*
 $p < 0.01$

**
 $p < 0.05$

TABLE 3

Multivariable analysis of factors associated with reconstruction after mastectomy for breast cancer

	Odds ratio (95 % CI)
Patient characteristics	
Age (yr)	
65–<70	Ref
70–<75	0.43 (0.38–0.51) *
75–<80	0.23 (0.19–0.28) *
80+	0.07 (0.05–0.09) *
DCIS vs invasive cancer	
Stage 0	Ref
Stage 1 and 2	0.47 (0.41–0.55) *
Charlson comorbidity score	
0	Ref
1	0.63 (0.52–0.75) *
2+	0.52 (0.39–0.69) *
Race	
White	Ref
Black	0.63 (0.44–0.89) **
Asian/PI/Other	0.30 (0.19–0.46) *
Median census tract income quartiles	
0–25 percentile	0.44 (0.35–0.55) *
>25–50 percentile	0.51 (0.42–0.62) *
>50–75 percentile	0.70 (0.59–0.82) *
>75–100 percentile	Ref
State buy-in program participant	
No	Ref
Yes	0.42 (0.32–0.54) *
Marital status at diagnosis	
Married	Ref
Other	0.82 (0.72–0.94) **
Year of diagnosis	
2000	0.68 (0.54–0.86) *
2001	0.81 (0.64–1.01)
2002	0.76 (0.61–0.96) **
2003	0.90 (0.72–1.13)
2004	1.07 (0.85–1.35)
2005	Ref
Geographic location	
Northeast	Ref
South	0.78 (0.54–1.13)

	Odds ratio (95 % CI)
Midwest	0.54 (0.35–0.78) **
West	1.36 (1.02–1.83) **
Hospital characteristics	
NCI cancer center	
No	0.55 (0.34–0.9) **
Yes	Ref
Oncology group	
No	0.53 (0.42–0.69)*
Yes	Ref
Teaching hospital	
No	0.57 (0.48–0.67)*
Yes	Ref

Bold indicates statistical significance

Multivariable analysis using generalized estimating equations (GEE) were used to identify patient-level variables associated with reconstruction after mastectomy while controlling for other factors and accounting for clustering by institutions

CI confidence interval; DCIS ductal carcinoma in situ; NCI National Cancer Institute

*
 $p < 0.001$

**
 $p < 0.05$

TABLE 4

Relative contribution of characteristics as explanatory variables

	Relative contribution (% R^2)
Patient characteristics	70.1
Age	33.8
DCIS vs. Invasive cancer	4.5
Median census tract income quartiles	3.9
State buy-in program participant	2.9
Race	2.3
Charlson score	2.2
Marital status at diagnosis	0.5
Hospital characteristics	15.9
Geographic location	1.5
Year of diagnosis	1

Bold indicates statistical significance

Changes in pseudo- R square statistics quantify the relative contribution of variables that account for patient-level variation in reconstruction rates seen after mastectomy for breast cancer