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Unplanned readmissions following breast cancer surgery

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ABSTRACT

Background: Understanding the underlying factors associated with unplanned readmissions is an important first step toward interventions designed to improve quality of care. This study aimed to identify predictors of unplanned 30-day readmission using a national breast surgery cohort.
Study design: Using the National Cancer Database, we performed a review of patients undergoing surgery for breast cancer from 2006 to 2014. A multivariatble logistic regression model was generated to assess predictors of 30-day unplanned readmission.
Results: Of 944,092 patients identified, 15,695 (1.7%) had an unplanned readmission within 30 days. Significant predictors of readmission included: increased procedure complexity, high co-morbidity score, Medicaid or lack of insurance, and low annual hospital volume; $p < 0.0001$.
Conclusion: Unplanned readmission following breast surgery is an uncommon event. However, our results demonstrate risk factors associated with higher rates of readmission following surgery. Understanding the underlying causes for readmission allows for identification of high-risk individuals and the design of targeted intervention programs.

Introduction

Advances in screening and treatment have led to the majority of patients diagnosed with breast cancer to present with operable disease, or become operable following neoadjuvant therapy. Complication rates following breast cancer surgery are low compared to many other surgical oncology procedures, with post-operative morbidity ranging from 2 to 6% and 30-day mortality rates approaching 0%.[1] However, given the large volume of breast cancer surgery performed annually, even low complication rates represent a significant number of affected patients and cost. Prior studies demonstrate that delays or omissions in breast cancer treatment secondary to complications may negatively impact patient care particularly when timely multimodality treatment is necessary.[2–4] Early post-operative complications may also lead to unplanned hospital readmissions, increasing cost of care and negatively impacting patient experience. As such, unplanned readmissions following breast cancer surgery may have significant implications on quality of care.

Readmission following surgical procedures, when broadly examined, is known to vary considerably, ranging from 1% to 41%,[5] and a number of patient, surgeon, institutional and environmental factors have been implicated. Rates of readmission after breast surgery previously reported ranged from 1 to 4%.[5–7] In a study of the National Surgical Quality Improvement Program (NSQIP) registry, greater patient comorbidity, perioperative complications, and longer operative times were the best predictors of readmission after breast surgery.[7] Some studies have validated these findings[5,8] while others have additionally observed higher readmission rates with differences in socioeconomic status and when procedures are performed at low-volume centers.[6,9]

Prior studies on readmission rates following breast surgery are limited by small volume, low number of readmitted patients, or use of single-institution data. In addition, data are limited on readmissions after breast surgery in the midst of an evolving landscape of surgical techniques, tailored systemic treatments, and increasing experience with reconstructive therapies. The ability to identify patients at high-risk for unplanned readmission would allow for improved efforts to prevent, monitor, and manage postoperative complications, thereby reducing readmission and improving patient care. In this study we aimed to identify predictors of 30-day unplanned readmission in a modern cohort of women using the National Cancer Database.

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Methods

Data source

The National Cancer Database (NCDB), which is a national, facility-based database of oncologic disease, captures approximately 70% of all newly diagnosed cancers in the United States from Commission on Cancer (CoC) certificated hospitals. As all data are collected per protocols from the North American Association of Center Cancer Registries, and all data are routinely de-identified, the institutional review board deemed the study exempt. Data reported from CoC-approved hospitals are abstracted from patient charts by Certified Tumor Registrars (CTR) who undergo training specific to cancer registry operations, and are subject to rigorous data integrity assessment and audits.[10]

The NDCB specifically codes for 'readmission within thirty days of surgical discharge'. This data item records a readmission to the same hospital, for the same illness, within 30 days of discharge

Table 1
General characteristics of the cohort n = 944,092.

Characteristic	No Readmission N (%) 928,397 (98.3%)	Readmission N (%) 15,695 (1.7%)	p-value
Age group (years)			
≤50	306777 (98.34%)	5175 (1.66%)	<0.0001
55-69	381664 (98.38%)	6296 (1.62%)	
≥70	233376 (98.27%)	4224 (1.73%)	
Gender			
Male	7996 (97.82%)	178 (2.18%)	0.0003
Female	920,401 (98.34%)	15517 (1.66%)	
Ethnicity			
white	776156 (98.36%)	12930 (1.64%)	<0.0001
black	103470 (98.09)	2016 (1.91)	
Other/Unknown	48771 (98.49%)	749 (1.51%)	
Facility type			
Academic	273583 (98.54%)	4059 (1.46%)	<0.0001
Community	654814 (98.25%)	11636 (1.23%)	
Stage			
IS	321532 (98.24%)	5775 (1.76%)	<0.0001
Stage I	395253 (98.57%)	5716 (1.43%)	
Stage II	163679 (98.11%)	3152 (1.89%)	
Stage III/IV	47933 (97.85%)	1052 (2.15%)	
Area			
Metro	809203 (98.37%)	13446 (1.63%)	<0.0001
Urban	105561 (98.13%)	2012 (1.87%)	
Rural	13633 (98.29%)	237 (1.71%)	
Insurance			
Private insurance	508357 (98.52%)	7619 (1.48%)	<0.0001
Medicare/Government	332694 (98.22%)	6018 (1.78%)	
Medicaid/other	87406 (97.70%)	2058 (2.30%)	
Income			
<$63,000	582033 (98.24%)	10435 (1.76%)	<0.0001
>$63,000	346364 (98.50%)	5260 (1.50%)	
CDCC[A]			
0	772843 (98.45%)	12149 (1.55)	<0.0001
1	127424 (97.96%)	2650 (2.04%)	
>2	28130 (96.91%)	896 (3.09%)	
Volume			
Low volume	50980 (97.79%)	1152 (2.21%)	<0.0001
Medium volume	348050 (98.04%)	6944 (1.96%)	
High volume	529367 (98.58%)	7599 (1.42%)	
Administration of neoadjuvant chemotherapy			
Yes	71628 (98.52%)	1076 (1.48%)	<0.0001
No	856769 (98.32%)	14619 (1.68%)	
Administration of neodadjuvant Hormonal therapy			
Yes	42791 (98.49%)	654 (1.51%)	0.0101
No	885606 (98.33)	15041 (1.67%)	
Administration of neodadjuvant Radiation therapy			
Yes	3394 (98.43%)	54 (1.57%)	<0.0001
No	925003 (98.34%)	15641 (1.66%)	
Surgery			
Partial mastectomy	578955 (98.78%)	7149 (1.22%)	<0.0001
Mastectomy	138079 (97.91%)	2953 (2.09%)	
Mastectomy + Reconstruction	93529 (97.55%)	2352 (2.45%)	
Radical Mastectomy	92729 (97.40%)	2477 (2.60%)	
Radical Mastectomy + Reconstruction	25105 (97.05%)	764 (2.95%)	
Axillary Rx			
No SLNB	159654 (98.77%)	1981 (1.23%)	<0.0001
SLNB	623769 (98.40%)	10144 (1.60%)	
SLND + ALND	144974 (97.60%)	3570 (2.40%)	

[A]CDCC: Charlson-Deyo Comorbidity Score.
SLNB- Sentinel Lymph node Biopsy.
ALND- Axillary Lymph Node Dissection.

following hospitalization for surgical resection of the primary site. Registry coding instructions specify to consult the patient record or information from the billing department to determine if a readmission to the same hospital occurred within 30 days of the date of surgical discharge, to only record a readmission related to the treatment of primary cancer, and to review the treatment plan to determine whether the readmission was planned.

Patient cohort and variables studied

We retrospectively identify patients from the NCDB who underwent surgery for breast cancer between the years 2006 and 2014. We excluded those who did not have definitive resection at the reporting facility, and those with incomplete key variables. We studied standard available patient demographics as well as clinical and pathologic data, including age, sex, ethnicity/heritage, insurance (Medicare and other insurance includes other government and unknown insurance status), income, and comorbidity score (using the Deyo modification of the Charlson index). Facility location was geographically categorized as metro, urban, or rural, and institution classified as academic or community center. Facility breast cancer surgery volume was defined by volume tertile, grouped into low-, medium-, and high-volume facilities, corresponding to the 33.33rd or lower percentile, 33.33rd to 66.67th percentile, and 66.67th percentile or higher, respectively. Neoadjuvant therapies received were abstracted, as well as type of primary breast and axillary surgery performed. The primary outcome of interest was 30-day, unplanned hospital readmission, which is defined as 'unplanned readmission' for the purpose of this project.

Statistical analysis

Baseline characteristics were compared by chi-square test. A multivariable logistic regression model was then fit to evaluate the predicted probability of having a readmission. Due to the low frequency of events, the Firth's penalized maximum likelihood estimation was used to minimize bias.[11] Statistical analysis was performed with SAS 9.4 (SAS Institute, Cary, NC, USA).

Results

This study identified 944,092 women who underwent surgery for breast cancer between years 2006 and 2014. Of these patients, 15,695 (1.7%) had an unexpected readmission within 30 days of surgical discharge. Cohort characteristics are summarized in Table 1. When comparing patients who were readmitted to those who were not, patients who experienced readmission were more likely to have higher comorbidity scores, non-private insurance, African American ethnicity, and lower median income (all $p < 0.0001$). Cases of unplanned readmissions were more likely to be associated with advanced stage of disease ($p < 0.05$), non-receipt of neoadjuvant chemotherapy, and more complex surgical procedures (both $p < 0.0001$). Furthermore, readmissions were more commonly observed in surgical cases performed at community centers and at low-volume facilities (both $p < 0.0001$) (see Table 2).

On multivariable regression analysis (forest plot depicted in Fig. 1), adjusted variables in the model associated with higher rates of readmission included increasing complexity of surgery: Lymph node dissection (OR: 1.25), Mastectomy (OR: 1.55), Modified Radical Mastectomy (OR: 1.71), Reconstruction (OR: 2.19–2.47), as well as higher comorbidity score (OR 1.82), non-private insurance (OR 1.20–1.47), community-based facilities (OR: 1.27), low volume centers (OR: 1.46), and African American heritage (OR 1.09). Higher income groups experienced lower rates of readmission when compared to lower income groups (OR 0.95). Administration of neoadjuvant chemotherapy was associated with lower rates of readmission (OR 0.70).

Table 2
Multivariable analysis for Re-admission.

Characteristic	OR	95% CI	p-value
Gender			
Male	1.053	0.903–1.220	0.498
Female	1 [Ref]		
Age			
≤55	0.991	0.952–1.032	
55-69	0.992	0.947–1.039	0.882
≥70	1 [Ref]		
Ethnicity			
white	1 [Ref]		
black	1.093	1.040–1.148	0.002
Other/Unknown	0.932	0.864–1.004	
Facility type			
Academic	0.925	0.890–0.961	<0.0001
Community	1 [Ref]		
Stage			
IS	1 [Ref]		
Stage I	0.773	0.743–0.805	<0.0001
Stage II	0.876	0.835–0.918	
Stage III/IV	0.944	0.875–1.018	
Area			
Metro	1 [Ref]		
Urban	1.020	0.970–1.071	0.195
Rural	0.901	0.788–1.024	
Insurance			
Private insurance	1 [Ref]		
Medicare/Government	1.199	1.146–1.255	<0.0001
Medicaid/other	1.471	1.398–1.547	
Income			
<$63,000	1 [Ref]		
>$63,000	0.949	0.916–0.984	0.004
CDCC[A]			
0	1 [Ref]		
1	1.241	1.188–1.295	<0.0001
>2	1.821	1.696–1.952	
Volume			
Low volume	1.458	1.365–1.556	
Medium volume	1.343	1.297–1.390	<0.0001
High volume	1 [Ref]		
Administration of neoadjuvant chemotherapy			
yes	0.694	0.638–0.754	<0.0001
No	1 [Ref]		
Administration of neodadjuvant Hormonal therapy			
Yes	0.930	0.842–1.026	0.147
No	1 [Ref]		
Administration of neodadjuvant Radiation therapy			
yes	0.990	0.747–1.283	0.943
No	1 [Ref]		
Surgery			
Partial mastectomy	1 [Ref]		
Mastectomy	1.552	1.483–1.624	
Mastectomy + Reconstruction	2.190	2.082–2.302	<0.0001
Radical Mastectomy	1.710	1.619–1.807	
Radical Mastectomy + Reconstruction	2.472	2.280–2.676	
Axillary Rx			
No SLNB	0.805	0.763–0.850	
SLNB	1 [Ref]		<0.0001
SLND + ALND	1.255	1.200–1.311	

[A]CDCC: Charlson-Deyo Comorbidity Score.
SLNB- Sentinel Lymph node Biopsy.
ALND- Axillary Lymph Node Dissection.

Discussion

In this population of patients with operable breast cancer undergoing surgery between 2006 and 2014, unplanned readmission within 30 days of surgery was an uncommon event, seen in 1.7% of patients. Cumulatively this represents a greater total number of

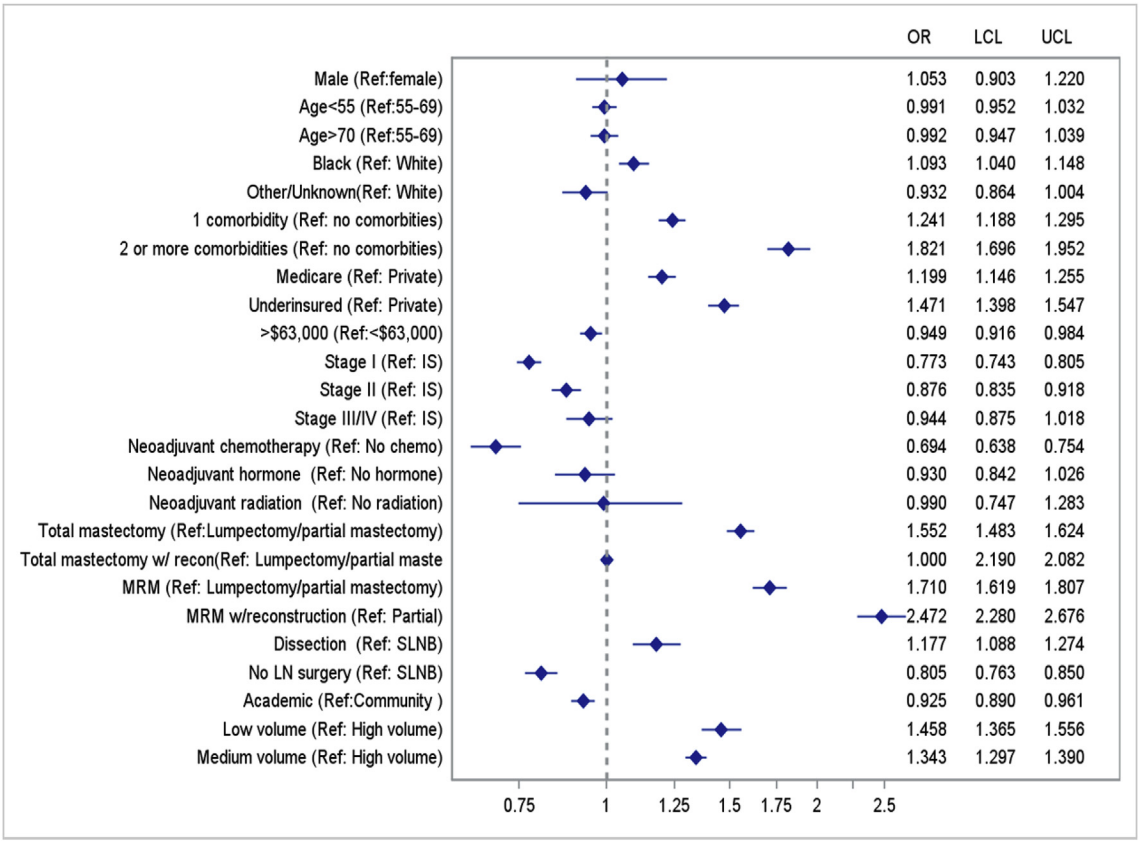

Fig. 1. Significant predictors of readmission (forest plot).

cases compared to other more complex surgical oncology procedures with higher rates of complications and readmissions.

Additionally, specific factors increasing the risk of unplanned readmission following breast surgery were observed. The most significant predictors of readmission were related to procedural complexity (e.g., mastectomy with reconstruction), higher comorbidity score, non-private insurance, and facility type (community and low volume centers). Perhaps not surprisingly, our finding suggest that post-operative complications are the primary driver of unplanned readmissions in breast surgery, and that factors that increase the risk of complications increase the likelihood of a readmission. Several studies looking at common causes of surgical readmission have shown that postoperative complications are significantly associated with readmissions following surgery.[12–18] Indeed, each of the risk factors identified in our study have previously been associated with higher rates of complications in the literature.

Our study observed that performing a more complex breast cancer operation (e.g. mastectomy, lymph node dissection, or breast reconstruction) was associated with a greater risk of readmission. These findings align with previously studies reporting an association of these factors with increased rates of post-operative complications.[19–21] In fact, breast reconstruction was associated with increased risks of wound complications compared to mastectomy alone, with studies reporting up to 49% incidence of post-operative reconstruction related complications.[21] Therefore, it is reasonable to attribute the higher rate of readmission following complex breast procedures to higher complications rates.

Patient comorbidities have also been observed to increase the risk of complication following breast surgery, especially in the elderly population.[1,22] In a retrospective review of 449 patients undergoing breast surgery, the number of comorbid conditions correlated to increased risk of postoperative complications and lower overall survival.[23]

Although not specific for patients undergoing breast cancer surgery, prior studies demonstrate that non-private insurance and lower income were associated with an increased risk of complications, greater length of stay, and higher mortality following surgical operations.[24,25] This finding underscores the importance of addressing the larger socioeconomic factors impacting the quality of health care in order to improve surgical outcomes for patients.

The relationship between volume and facility type with clinical outcomes in breast cancer surgery has been demonstrated in numerous studies,[6,26–29] and supports the suggestion that high-volume centers may have lower complications rates, especially when performing more complex or high-risk procedures. In addition to volume, other systems-based or process of care factors associated with high-volume centers may further contribute to best practices associated with fewer complications or their ability to reduce the risk of failure-to-rescue (i.e. rapidly identify and treat complications when they occur, thereby mitigating the sequelae leading to emergency in-patient readmissions).

Of interest, the use of neoadjuvant therapy was associated with fewer hospital readmissions. This finding may reflect fewer complications associated with decreased tumor burden at the time of surgery, or having more time for preoperative evaluation and preparation to avoid complications with anesthesia and surgery. Additionally, patients receiving their entire course of chemotherapy pre-operatively would not be exposed to the risk of potential readmissions resulting from adjuvant chemotherapy administered during the early post-surgical period.

Strategies aimed at identifying high-risk patients or conditions

may be successful in reducing unplanned returns to the hospital following breast surgery. Prior studies have demonstrated that appropriately designed interventions based on specific patient characteristics and risk factors are effective in reducing hospital readmissions.[30] The risk factors identified in this study may help to identify patients at increased risk of unplanned readmission. This may provide a useful and practical initial step for addressing the issue of readmission following breast surgery. Furthermore, future actions may be taken to reduce the severity or even prevent complications by identifying and applying interventions for high-risk patients or clinical scenarios.

Limitations

The study findings and the developed risk model are limited by the retrospective nature and by factors inherent to the data registry. Analysis is limited to variables provided within the NCDB. Notably, there is no information or ability to analyze specific complications or the exact reason necessitating readmission. Rates of readmission may also be underestimated by the lack of information on admissions to in-patient facilities other than the initial treating hospital.

Conclusions

Unplanned readmissions following breast surgery may be largely attributed to postoperative complications. Patient-specific, procedure-specific, and facility-specific risk factors for readmission have been identified. Variations observed based on hospital volume, facility type, and socioeconomic factors particularly provide potential opportunities for quality improvement through standardization and implementation of best practices. Identifying high-risk clinical conditions and understanding the underlying mechanisms leading to readmission allows for the design and application of targeted interventions that may improve outcomes.

Conflicts of interest

I confirm that there are no conflicts of interest to disclose relevant to the research presented in this paper.

Acknowledgement

The authors have no conflicts of interest to declare. This study was presented in oral format at the American College of Surgeons Clinical Congress on October 25th, 2017. The findings presented in this manuscript have not been published elsewhere.

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