The American Journal of Surgery (2016) 211, 820-823

The American Journal of Surgery®

Southwestern Surgical Congress

# Is the American College of Surgeons National Surgical Quality Improvement Program surgical risk calculator applicable for breast cancer patients undergoing breast-conserving surgery?

**Brian Lyle, M.D.[a,b], Jeffrey Landercasper, M.D., F.A.C.S.[a,c], Jeanne M. Johnson, M.D., F.A.C.S.[a,c], Mohammed Al-Hamadani, M.B.Ch.B., M.P.H.[d], Choua A. Vang, B.S.[d], Jacqueline Groshek, B.S.[d], Joy L. Hennessy, R.N.[c], Lonna M. Theede, R.N.[c], Kristin Zutavern, B.S.[d], Jared H. Linebarger, M.D., F.A.C.S.[a,c,*]**

*[a]Department of Surgery, Gundersen Health System, 1900 South Avenue, La Crosse, WI, 54601, USA; [b]Department of Medical Education, Gundersen Medical Foundation, La Crosse, WI, USA; [c]Norma J. Vinger Center for Breast Care, Gundersen Health System, 1900 South Avenue, La Crosse, WI, 54601, USA; [d]Department of Medical Research, Gundersen Medical Foundation, La Crosse, WI, USA*

**KEYWORDS:**
Breast-conserving surgery;
Lumpectomy;
Morbidity;
NSQIP risk calculator;
Quality improvement

**Abstract**

**BACKGROUND:** We aimed to analyze the applicability of the National Surgical Quality Improvement Program (NSQIP) calculator to patients undergoing breast-conserving surgery.

**METHODS:** A total of 287 consecutive patients treated with breast-conserving surgery from 2010 to 2012 were identified retrospectively. The risk calculator was applied to each patient to generate an individual risk profile. Risk calculations were then compared with actual outcomes. The performance of the risk calculator was evaluated using 2 metrics: the Brier score and c statistic.

**RESULTS:** The NSQIP calculator performed adequately for all complications, with Brier scores less than .05. However, 37 patients (12.9%) returned to the operating room for oncologic indications. Twenty-nine patients (10.1%) had positive margins, whereas 8 patients (2.8%) returned due to an upgrade in diagnosis.

**CONCLUSIONS:** When considering return to the operating room for oncologic management, the observed rate of 13.9% is significantly higher than the NSQIP prediction. This deviation must be addressed when using the NSQIP risk calculator model during preoperative risk discussion.


Surgeons must assume both ethical and legal obligations to provide a complete, accurate, and patient participatory informed consent discussion regarding operative risk. For this discussion to occur, the surgeon must be aware of patient- and operation-specific risk factors, national benchmarks, and personal as well as institutional outcome data.

The authors declare no conflicts of interest.

* Corresponding author. Tel.: +1-608-782-7300; fax: +1-608-775-4460.The authors declare no conflicts of interest.
E-mail address: jhlineba@gundersenhealth.org

Manuscript received April 10, 2015; revised manuscript July 20, 2015

0002-9610/$ - see front matter © 2016 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.amjsurg.2015.07.013

In breast cancer care, quality outcomes measurement combined with self-reporting and peer performance comparison has been demonstrated to improve patient care.[1] Outcomes of morbidity and mortality after breast cancer surgery are relatively infrequent, and a prospective multiinstitutional database review has aided in establishing national benchmarks.[2] Smith et al[3] proposed a method of bundling quality measures of breast cancer care to create an easily understood report card, provided to patients, focusing on institutional outcomes of importance from the patient's perspective, notably including 1-step surgery success rate.

To facilitate the surgical informed consent process, the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) has developed a universal risk estimation tool.[4] This calculator takes into account patient- and procedure-specific factors, is available to anyone with Internet access, and has been validated to estimate the risk of most operations.[5] The purpose of this study was to analyze the applicability of the NSQIP risk calculator to patients undergoing breast-conserving surgery (BCS) for breast cancer at our institution.

## Methods

Institutional review board approval was obtained for retrospective review of a prospectively maintained breast cancer registry at a community-based multidisciplinary breast care center. All patients undergoing BCS for breast cancer from January 2010 to December 2012 were identified. BCS was defined as lumpectomy, lumpectomy with sentinel lymph node biopsy or lumpectomy with axillary lymph node dissection. Patients with metastatic disease, those who received treatment elsewhere, and those who underwent mastectomy were excluded.

Preoperative patient characteristics, as defined by the NSQIP risk model, were entered into the risk calculator to generate an individual risk profile. Patient medical record review yielded actual 30-day postoperative morbidity and mortality data for 10 outcomes as defined by the NSQIP: serious complication, any complication, pneumonia, cardiac complication, surgical site infection, urinary tract infection, venous thromboembolism, renal failure, return to operating room (OR), and death.[4] The performance of the universal risk calculator was evaluated using 2 metrics: the c statistic and the Brier score. The c statistic is a measure of discrimination, which is a rank-based method of category comparison that does not directly assess prediction accuracy. Models are generally considered reasonable with a c statistic greater than .7. C statistic values were not calculated for defined outcomes without observed events. The Brier score is a proper score function that measures the accuracy of probabilistic predictions. This score is defined as the average squared difference between patients' predicted probabilities (which must range from 0 to 1) and observed outcomes (1 for an event, 0 for a nonevent). As a predictive model approaches perfection, its Brier score will approach .0.

Observed 30-day reoperation data were recorded for all indications, including those not captured by the NSQIP definition. These indications included positive margins and upgrade in diagnosis on surgical pathology review.

## Results

We identified 287 patients who underwent BCS between 2010 and 2012. Patient age ranged from 36 to 97 years (median, 65 years). Surgical procedure performed included lumpectomy in 69 (24%), lumpectomy with sentinel lymph node biopsy in 193 (67%), lumpectomy with axillary lymph node dissection in 11 (4%), and lumpectomy with sentinel node biopsy converted to axillary node dissection based on intraoperative frozen section in 14 patients (5%). American Joint Committee on Cancer anatomic stage after surgery was observed as follows: 54 patients (19%), stage 0; 167 (58%), stage IA; 4 (1%), stage IB; 48 (17%), stage IIA; 11 (4%), stage IIB; and 3 (1%), stage IIIA.

There was no mortality after BCS. The 30-day postoperative complication rate was 3.5%, with the most frequent being surgical site infection (n = 6, 2.1%). One patient (.3%) developed a postoperative pneumonia, whereas another was found to have a urinary tract infection (.3%). Three patients (1.0%) required a return to the OR for hematoma evacuation; 2 of these patients were on warfarin with perioperative enoxaparin bridging. There were no patients with a perioperative cardiac complication, venous thromboembolism, or renal failure.

A comparison of observed outcomes vs those predicted by the NSQIP risk calculator is provided in Table 1. The calculator slightly overestimated the rates of serious complication (2.4% observed vs 5.0% predicted; Brier, .024), any complication (3.5% vs 6.7%, .034), and return to the OR (1.0% vs 5.0%, .012). Conversely, our patients experienced a slightly higher rate of surgical site infection than was predicted (2.1% vs 1.1%, .024). Brier scores approached 0 for pneumonia, cardiac complication, urinary tract infection, venous thromboembolism, renal failure, and death.

In addition to the 3 patients that returned to the OR for hematoma evacuation, 37 patients (12.9%) returned for oncologic indications (Table 2). If all causes of oncologic and nononcologic return to the OR after initial BCS are included, then the observed rate in our patient population was 13.9%.

## Comments

As the most common cancer affecting women in the United States, the psychological, physical, social, and economic implications of diagnosis and treatment of breast cancer cannot be overstated. Surgical management remains a cornerstone of therapy, and BCS is relatively safe with oncologic effectiveness equivalent to mastectomy.[6] The