The National Surgical Quality Improvement Program 30-Day Challenge: Microsurgical Breast Reconstruction Outcomes Reporting Reliability

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INTRODUCTION

The use of large-volume databases in surgical outcomes research has grown substantially over the last decade, with surgeon, hospital, and regional-level outcomes increasingly being evaluated using clinical outcomes and measures of resource utilization.1–29 Large volume databases can be broadly categorized as either administrative or clinical. These databases offer unique opportunities to study large-scale patterns of care, variation in practice, and outcomes following surgical intervention. Studies based on national registries and other administrative datasets have made significant contributions to the field of breast cancer surgery.1–24 In recent years, research derived from administrative datasets has also been used to evaluate outcomes of breast reconstruction with free tissue transfer.1–5

Background: The aim was to assess reliability of the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) 30-day perioperative outcomes and complications for immediate, free-tissue transfer breast reconstruction by direct comparisons with our 30-day and overall institutional data, and assessing those that occur after 30 days.

Methods: Data were retrieved for consecutive immediate, free-tissue transfer breast reconstruction patients from a single-institution database (2010–2015) and the ACS-NSQIP (2011–2014). Multiple logistic regressions were performed to compare adjusted outcomes between the 2 datasets.

Results: For institutional versus ACS-NSQIP outcomes, there were no significant differences in surgical-site infection (SSI; 30-day, 3.6% versus 4.1%, \(P = 0.818\); overall, 5.3% versus 4.1%, \(P = 0.198\)), wound disruption (WD; 30-day, 1.3% versus 1.5%, \(P = 0.526\); overall, 2.3% versus 1.5%, \(P = 0.560\)), or unplanned readmission (URA; 30-day, 2.3% versus 3.3%, \(P = 0.714\); overall, 4.6% versus 3.3%, \(P = 0.061\)). However, the ACS-NSQIP reported a significantly higher unplanned reoperation (URO) rate (30-day, 3.6% versus 9.5%, \(P < 0.001\); overall, 5.3% versus 9.5%, \(P = 0.025\)). Institutional complications consisted of 5.3% SSI, 2.3% WD, 5.3% URO, and 4.6% URA, of which 23.0% SSI, 28.6% WD, 12.5% URO, and 7.1% URA occurred at 30–60 days, and 6.3% SSI, 14.3% WD, 18.8% URO, and 42.9% URA occurred after 60 days.

Conclusion: For immediate, free-tissue breast reconstruction, the ACS-NSQIP may be reliable for monitoring and comparing SSI, WD, URO, and URA rates. However, clinicians may find it useful to understand limitations of the ACS-NSQIP for complications and risk factors, as it may underreport complications occurring beyond 30 days. (Plast Reconstr Surg Glob Open 2018;6:e1643; doi: 10.1097/GOX.0000000000001643; Published online 6 March 2018.)
methods

Institutional review board approval was obtained. Data were collected from patient records within a single institution from 2010 to 2015 with a minimum follow-up of 1 year, and ACS-NSQIP data were retrieved for the years 2011–2014 using Current Procedural Terminology (CPT) codes (see table, Supplementary Digital Content 1, which displays the CPT mastectomy and breast reconstruction codes, http://links.lww.com/PRSGO/A659). We extracted data from the respective time periods to account for as many possible data points for the variables of interest. Our inclusion criteria consisted of female patients over the age of 18 years who underwent IFTBR following mastectomy. We excluded patients who underwent combined free tissue reconstruction with other autologous or alloplastic techniques. In ACS-NSQIP, a patient was considered to have undergone IFTBR if concurrent mastectomy and reconstruction CPT codes were registered.

Patient characteristics of interest were restricted to those recorded in both the institutional and ACS-NSQIP databases, to enable direct comparison. These included age, body mass index (BMI), smoking, diabetes, hypertension, coagulopathy, steroid use, number of comorbidities, mastectomy type, operation time (OT) in minutes, and length of stay (LOS) in days. Bilateral mastectomy was determined based on the presence of 2 CPT codes for mastectomy. Outcomes of interest were surgical-site infection (SSI), wound disruption (WD), unplanned reoperation (URO), unplanned readmission (URA), and the specific causes of URO or readmission. Before 2011, the ACS-NSQIP data did not include the cause of URO and URA variables. As such, URO and readmission data were extracted from ACS-NSQIP 2012–2014. Institutional complications were only recorded if they were related to the index IFTBR procedure and fit the ACS-NSQIP definitions for SSI, WD, URO, and URA.

URO was classified into categories based on correlating ACS-NSQIP variables for the root cause, consisting of complications pertaining to the flap itself, SSI, wound-site disruption, hemorrhage, hematoma, and seroma. URA was classified into categories based on correlating ACS-NSQIP variables for the root cause, consisting of complications pertaining to the flap itself, SSI, wound-site disruption, hematoma, seroma, and postoperative pain. These were extracted from the ACS-NSQIP (2012–2014) using the inbuilt reason for URO variable and International Classification of Diseases, Ninth Revision, Clinical Modification codes (see table, Supplementary Digital Content 2, which displays International Classification of Diseases, Ninth Revision, Clinical Modification cause of URO or readmission codes, http://links.lww.com/PRSGO/A660).

Institutional outcomes in the 30-day window and overall, including both 30-day complications and those occurring after 30 days, were each independently compared with ACS-NSQIP outcomes to assess reliability of the database. Late complications occurring after 30 days are representative of the number of complications potentially missed by ACS-NSQIP. Institutional outcomes were subgrouped into those that occurred within the 30-day window (early), those that occurred after 30 days (late), and the overall (early and late) complication incidence. In addition, complications that occurred after 30 days were further subcategorized into 60-day and 60-day+ groups.
Statistical Analysis

Data were compared using Pearson’s χ² or Fisher’s exact test tests and Wilcoxon-Mann-Whitney for categorical and nonparametric continuous variables, respectively. To account and adjust for potential confounders when analyzing outcomes of interest, logistic regression models were used to assess patient outcomes of SSI, WD, URO, and causes of URO or readmission. Statistical analysis was performed using SPSS Version 22 (IBM, Armonk, N.Y.). For all analysis, a value of P < 0.05 was considered statistically significant.

RESULTS

Patient Characteristics

During the study period, a total of 2,402 patients were admitted for IFTBR, with 304 (12.6%) patients from our institution and 2,098 (87.3%) patients from the ACS-NSQIP (2011–2014; Table 1). Patients were well matched for most patient characteristics. No significant differences were observed in age (P = 0.315), diabetes (P = 0.680), coagulopathy (P = 0.675), steroid use (P = 0.613), number of comorbidities (P = 0.550), LOS (P = 0.274), and proportion of radical mastectomy (P = 0.114). Although the average patient in both was classified by BMI as “obese,” patients in our institution had a significantly lower BMI (28.2 ± 5.6 versus 29.9 ± 5.9 kg/m², P < 0.001), longer OT (702.4 ± 166.9 versus 524.0 ± 182.3 minutes, P < 0.001), and underwent more bilateral (55.9% versus 40.2%, P < 0.001) and total simple mastectomies (96.7% versus 82.3%, P < 0.001) when compared with the ACS-NSQIP database. However, fewer patients in our institutional group were smokers (3.6% versus 8.9%, P = 0.002), had hypertension (18.4% versus 24.6%, P = 0.018), or underwent modified radical mastectomy (1.6% versus 14.0%, P < 0.001) compared with the ACS-NSQIP database. Patients in our institutional database underwent deep inferior epigastric perforator (96.2%), superior gluteal artery perforator (96.2%), and free transverse rectus abdominis myocutaneous (free TRAM) (0.2%) flap reconstructions, whereas this breakdown was not able to be assessed in the ACS-NSQIP database.

Table 1. Institutional Versus the ACS-NSQIP Patient Characteristics

| Patient Characteristics | Institutional | ACS-NSQIP | P |
|------------------------|--------------|----------|---|
| Total                  | 304 (12.6)   | 2,098 (87.3) | 0.315 |
| Age (y)                | 51.19 ± 9.14 | 50.55 ± 9.16 | 0.315 |
| BMI (kg/m²)            | 28.2 ± 5.6   | 29.9 ± 5.9   | <0.001 |
| Smoking                | 11 (3.6)     | 187 (8.9)   | 0.002 |
| Diabetes               | 13 (4.3)     | 101 (4.8)   | 0.680 |
| Hypertension           | 56 (18.4)    | 516 (24.6)  | 0.018 |
| Coagulopathy           | 2 (0.7)      | 11 (0.5)    | 0.675 |
| Steroid use            | 3 (1.0)      | 32 (1.5)    | 0.613 |
| No. comorbidities      | 0 (0.0)      | 1,351 (73.0) | 0.176 |
| 1                      | 63 (20.7)    | 498 (23.7)  | 0.246 |
| ≥2                     | 8 (2.6)      | 68 (3.3)    | 0.570 |
| Mastectomy             |             |           |    |
| Bilateral              | 170 (55.9)   | 844 (40.2)  | <0.001 |
| Simple                 | 294 (96.7)   | 1,726 (82.3) | <0.001 |
| Modified radical       | 5 (1.6)      | 293 (14.0)  | <0.001 |
| Radial                 | 2 (0.7)      | 44 (2.1)    | 0.114 |
| OT (min)               | 702.4 ± 166.9 | 524.0 ± 182.3 | <0.001 |
| Length of stay (d)     | 4.33 ± 1.41  | 4.64 ± 8.42 | 0.274 |

Bold type signifies p-value has reached statistical significance.

Table 2. Institutional (Total and ≤30 Days) Versus the ACS-NSQIP Outcomes

| Patient Outcomes | Institutional | ACS-NSQIP | P |
|------------------|--------------|----------|---|
| SSI              |              |          |    |
| Total            | 16 (5.3)     | 86 (4.1) | 0.198 |
| 30-d             | 11 (3.6)     | 86 (4.1) | 0.818 |
| WD               |              |          |    |
| Total            | 7 (2.3)      | 31 (1.5) | 0.560 |
| 30-d             | 4 (1.3)      | 31 (1.5) | 0.526 |
| URO              |              |          |    |
| Total            | 16 (5.3)     | 173* (9.5) | 0.025 |
| 30-d             | 11 (3.6)     | 173* (9.5) | <0.001 |
| URA              |              |          |    |
| Total            | 14 (4.6)     | 60† (3.3) | 0.061 |
| 30-d             | 7 (2.3)      | 60† (3.3) | 0.714 |

*This value was determined after excluding any UROs not categorizable for comparison. It was extracted from ACS-NSQIP (2012–2014).
†This value was determined after excluding any URAs not categorizable for comparison. It was extracted from ACS-NSQIP (2012–2014).

Bold type signifies p-value has reached statistical significance.

Patient Outcomes (Institution Versus ACS-NSQIP)

Table 2 summarizes the adjusted patient outcomes for 30-day and overall institutional versus the ACS-NSQIP, respectively. No significant differences were seen when comparing either institutional 30-day or overall complications to ACS-NSQIP outcomes for SSI (30-day, 3.6% versus 4.1%, P = 0.818; overall, 5.3% versus 4.1%, P = 0.198), WD (30-day, 1.3% versus 1.5%, P = 0.526; overall, 2.3% versus 1.5%, P = 0.560), and URA (30-day, 2.3% versus 3.3%, P = 0.714; overall, 4.6% versus 3.3%, P = 0.061). However, there were significantly lower URO rates in our institutional data compared with ACS-NSQIP data (30-day, 3.6% versus 9.5%, P < 0.001; overall, 5.3% versus 9.5%, P = 0.025). Institutionally, 5 (31.3%) of 16 UROs and 3 (21.4%) of 14 URAs were independent, with an overlap between UROs and readmissions in the remaining 11 cases. In the ACS-NSQIP, 136 (78.6%) of 173 UROs and 23 (38.3%) of 60 URAs were independent, with an overlap between UROs and readmissions in the remaining 37 cases. The discrepancy may be due to some reoperations not necessarily necessitating a readmission, or vice versa, due to the ACS-NSQIP definition of an URA being for an “inpatient” stay or an URO being performed within the same index inpatient stay.

URO (Institutional Versus ACS-NSQIP)

Reasons for URO are listed in Table 3. There were significantly fewer UROs reported in our institutional database compared with the ACS-NSQIP after selecting for specific complications (30-day, 3.6% versus 9.5%, P < 0.001; overall, 5.3% versus 9.5%, P = 0.025). Compared with institutional data, there were a greater number of hematomas requiring URO in the ACS-NSQIP database (30-day, 1.0% versus 4.1%, P = 0.009; overall, 1.0% versus 4.1%, P = 0.009).
Early Versus Late Complications (Institution)

In our institutional database, the complication profile consisted of 5.3% SSIs, 2.3% WDs, 5.3% UROs, and 4.6% URAs. Table 5 summarizes the percentage of these complications occurring after the 30 days. When observing what percentage of total complications were late, we found that 31.3% (25.0% by 30–60 days, 6.3% after 60 days) of SSIs, 42.9% of WDs (28.6% by 30–60 days, 14.3% after 60 days), 31.3% of UROs (12.5% by 30–60 days, 18.8% after 60 days), and 50.0% of URAs (7.1% by 30–60 days, 42.9% after 60 days) occurred after 30 days.

**DISCUSSION**

Large clinical databases such as the ACS-NSQIP serve as a unique platform for retrospective clinical studies, providing large patient populations suitable for studying outcomes and variations in treatment. Within the field of breast reconstruction, large-volume databases are being increasingly utilized. Studies based on clinical databases have made significant contributions to the field of plastic surgery with development of clinical guidelines and health policy. It is important for clinicians and researchers to understand the strengths and weaknesses of these databases to enable appropriate data interpretation.

The current study aims to assess the validity of the ACS-NSQIP database for IFTBR by comparing its reported incidence of complications to those reported in a reasonably high-volume academic center. Our results show that ACS-NSQIP may accurately represent the incidence of both 30-day and overall complications for SSI, WD, and URA, and as such be reliable for complication monitoring and comparison studies. However, it did not accurately capture overall URAs due to infection. The ACS-NSQIP also reported a significantly higher rate of URO than that found in our institutional data, which was attributable to the higher rate of URO for hematoma. Although there were no significant differences between overall versus ACS-NSQIP complication rates, we found that a large percentage of SSIs, WDs, UROs, and URAs occur after the 30-day window, suggesting that ACS-NSQIP may underreport complications. As such, it may not be reliable for studies evaluating true overall complication profiles or risk factor calculation.

URO rates were 1 important difference between institutional and ACS-NSQIP data, with ACS-NSQIP URO rates being significantly higher; this persisted when selecting for IFTBR-specific complications. It may be that variation exists in institutional operative practices and decision-making protocols for reoperation, explaining our findings. A study on autologous breast reconstruction conducted using the National Inpatient Sample Healthcare Cost and Utilization Project has shown that high-volume centers have lower complications, with the volume-outcome relationship being more strongly associated with surgery-specific rather than systematic complications.

The literature for microsurgical breast reconstruction has reported lower flap loss rates and improved salvage rates associated with tissue oximetry, with decreased rate of re-exploitation over time per 100 flaps operated on.

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**Table 3. Institutional (Total and ≤ 30 Days) Versus the ACS-NSQIP (2012–2014) Categorized Unplanned Reoperations**

| Patient Outcomes | Institutional  | ACS-NSQIP  | P     |
|------------------|---------------|------------|-------|
|                  | n (%)         | n (%)      |       |
| URO              |               |            |       |
| Total            | 16 (5.3)      | 173* (9.5) | 0.025 |
| 30-d             | 11 (3.6)      | 173* (9.5) | <0.001|
| Flap complication|               |            |       |
| Total            | 5 (1.6)       | 40 (2.2)   | 0.675 |
| 30-d             | 5 (1.6)       | 40 (2.2)   | 0.675 |
| Infection        |               |            |       |
| Total            | 1 (0.3)       | 15 (0.8)   | 0.454 |
| 30-d             | 0 (0.0)       | 15 (0.8)   | 0.994 |
| WD               |               |            |       |
| Total            | 6 (2.0)       | 41 (2.2)   | 0.887 |
| 30-d             | 3 (1.0)       | 41 (2.2)   | 0.297 |
| Hemorrhage       |               |            |       |
| Total            | 1 (0.3)       | 5 (0.3)    | 0.865 |
| 30-d             | 1 (0.3)       | 5 (0.3)    | 0.865 |
| Hematoma         |               |            |       |
| Total            | 3 (1.0)       | 75 (4.1)   | 0.009 |
| 30-d             | 3 (1.0)       | 75 (4.1)   | 0.009 |
| Seroma           |               |            |       |
| Total            | 3 (1.0)       | 6 (0.3)    | 0.118 |
| 30-d             | 2 (0.7)       | 6 (0.3)    | 0.393 |

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**Table 4. Institutional (Total and ≤ 30 Days) Versus the ACS-NSQIP (2012–2014) Categorized Unplanned Readmissions**

| Patient Outcomes | Institutional  | ACS-NSQIP  | P     |
|------------------|---------------|------------|-------|
|                  | n (%)         | n (%)      |       |
| URA              |               |            |       |
| Total            | 14 (4.6)      | 60* (3.3)  | 0.061 |
| 30-d             | 7 (2.3)       | 60* (3.3)  | 0.714 |
| Flap complication|               |            |       |
| Total            | 1 (0.3)       | 6 (0.6)    | 0.526 |
| 30-d             | 1 (0.3)       | 6 (0.6)    | 0.526 |
| Infection        |               |            |       |
| Total            | 10 (3.3)      | 33 (1.8)   | 0.031 |
| 30-d             | 5 (1.6)       | 33 (1.8)   | 0.850 |
| WD               |               |            |       |
| Total            | 1 (0.3)       | 15 (0.8)   | 0.631 |
| 30-d             | 0 (0.0)       | 15 (0.8)   | 0.994 |
| Hematoma         |               |            |       |
| Total            | 1 (0.3)       | 4 (0.2)    | 0.714 |
| 30-d             | 1 (0.3)       | 4 (0.2)    | 0.714 |
| Seroma           |               |            |       |
| Total            | 1 (0.3)       | 1 (0.1)    | 0.294 |
| 30-d             | 0 (0.0)       | 1 (0.1)    | 0.995 |
| Postoperative pain|              |            |       |
| Total            | 1 (0.3)       | 2 (0.1)    | 0.806 |
| 30-d             | 1 (0.3)       | 2 (0.1)    | 0.806 |

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*This value was determined after excluding any UROs not categorizable for comparison. Bold type signifies p-value has reached statistical significance.
Table 5. Timing of Complications Breakdown (Institutional)

| Patient Outcomes          | Overall     | 30-d (%) | 60-d (%) | 60-d+ (%) |
|---------------------------|-------------|----------|----------|----------|
| SSI                       | 16 (100.0)  | 11 (68.8) | 4 (25.0) | 1 (6.3)  |
| WD                        | 7 (100.0)   | 4 (57.1)  | 2 (28.6) | 1 (14.3) |
| URO                       | 16 (100.0)  | 11 (68.8) | 2 (12.5) | 3 (18.8) |
| Flap complication         | 5 (100.0)   | 5 (100.0) | 0 (0.0)  | 0 (0.0)  |
| Infection                 | 1 (100.0)   | 0 (0.0)   | 1 (100.0)| 0 (0.0)  |
| WD                        | 6 (100.0)   | 3 (50.0)  | 1 (16.7) | 2 (33.3) |
| Hemorrhage                | 1 (100.0)   | 1 (100.0)| 0 (0.0)  | 0 (0.0)  |
| Seroma                    | 3 (100.0)   | 3 (100.0)| 0 (0.0)  | 0 (0.0)  |
| URA                       | 14 (100.0)  | 7 (50.0)  | 1 (7.1)  | 6 (42.9) |
| Flap complication         | 1 (100.0)   | 1 (100.0)| 0 (0.0)  | 0 (0.0)  |
| Infection                 | 10 (100.0)  | 5 (50.0)  | 1 (10.0) | 4 (40.0) |
| WD                        | 1 (100.0)   | 0 (0.0)   | 0 (0.0)  | 1 (100.0)|
| Hemorrhage                | 1 (100.0)   | 1 (100.0)| 0 (0.0)  | 0 (0.0)  |
| Seroma                    | 1 (100.0)   | 0 (0.0)   | 0 (0.0)  | 1 (100.0)|
| Postoperative pain        | 1 (100.0)   | 1 (100.0)| 0 (0.0)  | 0 (0.0)  |

use of more than 1 venous outflow vessel may also prevent URO.41

When reviewing the causes for URO, hematoma appeared to contribute to the higher rates of URO in ACS-NSQIP, compared with institutional data. The lower rates found in our institutional data are supported by a previous review article outlining URO for hematomas in microvascular free tissue transfers, noting rates ranging from 0.2% to 9%.42 Halle et al.43 reported a 15% incidence of reoperations for hematomas in breast free flaps, highlighting the potential risk of antithrombotic use and importance of using drains. A study assessing risk factors for hematoma formation in 883 patients who underwent mastectomy and immediate reconstruction found no measurable preoperative, operative, or oncologic risk factors, citing that meticulous hemostasis may be 1 of the factors.44

It is important to note that a large percentage of SSIs, WDs, UROs, and URAs occurred after 30 days, highlighting the possibility of an underreported complication rate in ACS-NSQIP. More specifically, the majority of SSIs and WDs occurred within 60 days, whereas the majority of UROs and URAs occurred after the 60-day period. This could be due to several temporal factors, including time taken for clinical deterioration sufficient to warrant URO or URA, or time required to arrange for patient hospital admission. All UROs and readmissions for flap complications, hemorrhage, or hematoma occurred within 30 days. The majority of UROs and readmissions for infection, seroma, and WD occurred after 30 days. It may be that the later reoperations and readmissions occurred as a result of managing conservatively at first for these complications. Furthermore, late management of seromas may be linked to the pathophysiology of seroma formation, which requires time for fluid collection. A study on abdominal-based free tissue breast reconstruction complications by Duraes et al.37 also found that a large percentage of complications were late and inferred that the ACS-NSQIP 30-day follow-up may not be sufficient. The percentages of early 30-day and late infection complications found in our data differed from those reported by Duraes et al.37 (early, 68.8% versus 89.0%; late, 31.3% versus 11.0%). This finding may be due to the differing surgical teams, surgical technique, patient characteristics, or type of reconstruction. It may be prudent to extend the ACS-NSQIP follow-up period to up to 3 months, with further studies evaluating the optimum follow-up time for maximum capture of complications.

Studies have also reported a large percentage of late complications within alloplastic breast reconstruction, with Luce et al.38 reporting that 65% of tissue expanders destined for loss were still in situ at 30 days, Sinha et al.40 reporting that 47–71% of SSIs were late (> 30 days), and Cohen et al.40 reporting that 50% of infections were late (> 30 days). Compared with these studies of alloplastic reconstruction, we found a lower rate of late complications. Similar findings were described by Mioton et al.47 in their report of 30-day complications, describing greater differences in autologous versus implant complications (infection, 5.46% versus 3.45%, P < 0.001; WD, 1.24% versus 0.44%, P < 0.001; reoperation, 9.59% versus 6.76%, P < 0.001). It may be interesting to assess the risk factors for early and late complications in autologous compared with implant reconstruction.

We acknowledge the limitations of our study. Retrospective chart reviews are at risk of human error in the data collection process. We were unable to assess certain parameters due to the presence of in-built variables in ACS-NSQIP, including radiotherapy and chemotherapy. For future reference, ACS-NSQIP may look to introduce these variables. We were also unable to subcategorize specific IFTBR procedures for comparison, such as deep inferior epigastric perforator, superior gluteal artery perforator, or free TRAM, due to limitations of CPT coding. The scope of the study was also limited to complications defined in ACS-NSQIP. As such, we could not analyze important outcomes such as donor versus recipient complications, mastectomy skin necrosis, fat necrosis, or abdominal hernia development. The inclusion of these variables may further surgical clinical outcomes’ research, with more targeted, inclusive data. Due to the single-center study comparison, and the uniqueness of the protocol at our high-volume center, this may have led to differences in the comparison of our outcomes versus those hospitals captured by the ACS-NSQIP, who may perform a lower number of free-tis-
sue breast reconstructions. Despite these, we believe that our study makes important contributions to the current literature, and to our knowledge, this is the first study to report a head-to-head comparison of outcomes between a single institution and a national database.

CONCLUSIONS

For complication monitoring and comparison studies, the ACS-NSQIP may reliably represent the general scope of SSIs, WDs, UROs, and URAs in institutional data for IF-TBR; however, it may not generally capture URAs for infection occurring after 30 days. There was also a significantly higher rate of UROs for ACS-NSQIP, which was due to the differences in UROs for hematomas. A large percentage of complications in our institutional database occurred after 30 days, and as such, clinicians and researchers should continue to exercise caution when reporting overall complication rates or assessing risk factors for future guidelines. An extension of the follow-up beyond 30 days should be considered.

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REFERENCES

1. Kamali P, Koolen PG, Ibrahim AM, et al. Analyzing regional differences over a 15-year trend of one-stage versus two-stage breast reconstruction in 941,191 postmastectomy patients. Plast Reconstr Surg 2016;138:1e–14e.
2. Ibrahim AM, Shuster M, Koolen PG, et al. Analysis of the National Surgical Quality Improvement Program database in 19,100 patients undergoing implant-based breast reconstruction: complication rates with acellular dermal matrix. Plast Reconstr Surg 2013;132:1057–1066.
3. Ogunleye AA, de Blacam C, Curtis MS, et al. An analysis of delayed breast reconstruction outcomes as recorded in the American College of Surgeons National Surgical Quality Improvement Program. J Plast Reconstr Aesthet Surg 2012;65:289–294.
4. Pien I, Caccavale S, Cheung MC, et al. Evolving trends in autologous breast reconstruction: is the deep inferior epigastric artery perforator flap taking over? Ann Plast Surg 2016;76:489–493.
5. Habermann EB, Thomsen KM, Hicken TJ, et al. Impact of availability of immediate breast reconstruction on bilateral mastectomy rates for breast cancer across the United States: data from the nationwide inpatient sample. Ann Surg Oncol. 2014;21:3290–3296.
6. Wexelman B, Schwartz JA, Lee D, et al. Socioeconomic and geographic differences in immediate reconstruction after mastectomy in the United States. Breast J. 2014;20:339–346.
7. Tuggle CT, Patel A, Broer N, et al. Increased hospital volume is associated with improved outcomes following abdominal-based breast reconstruction. J Plast Surg Hand Surg. 2014;48:382–388.
8. Masoomi H, Clark EG, Paydar KZ, et al. Predictive risk factors of free flap thrombosis in breast reconstruction surgery. Microsurgery. 2014;34:589–594.
9. Albornoz CR, Bach PB, Mehrara BJ, et al. A paradigm shift in U.S. breast reconstruction: increasing implant rates. Plast Reconstr Surg. 2013;131:15–23.
10. Cemal Y, Albornoz CR, Disa JJ, et al. A paradigm shift in U.S. breast reconstruction: Part 2. The influence of changing mastectomy patterns on reconstructive rate and method. Plast Reconstr Surg. 2015;131:329e–329e.
11. Frasier LL, Holden S, Holden T, et al. Temporal trends in post-mastectomy radiation therapy and breast reconstruction associated with changes in National Comprehensive Cancer Network Guidelines. JAMA Oncol. 2016;2:95–101.
12. Lang JE, Summers DE, Cui H, et al. Trends in post-mastectomy reconstruction: a SEER database analysis. J Surg Oncol. 2013;108:163–168.
13. Agarwal S, Pappas L, Neumayer L, et al. An analysis of immediate postmastectomy breast reconstruction frequency using the surveillance, epidemiology, and end results database. Breast J. 2011;17:352–358.
14. Fischer JP, Wes AM, Tuggle CT, et al. Mastectomy with or without immediate implant reconstruction has similar 30-day perioperative outcomes. J Plast Reconstr Aesthet Surg. 2014;67:1515–1522.
15. Nwoagui I, Yan Y, Margenthaler JA, et al. Venous thromboembolism after breast reconstruction in patients undergoing breast surgery: an American College of Surgeons NSQIP analysis. J Am Coll Surg. 2015;220:886–893.
16. Chung CU, Wink JD, Nelson JA, et al. Surgical site infections after free flap breast reconstruction: an analysis of 2,899 patients from the ACS-NSQIP datasets. J Reconstr Microsurg. 2015;31:434–441.
17. Silva AK, Lapin B, Yao KA, et al. The effect of contralateral prophylactic mastectomy on perioperative complications in women undergoing immediate breast reconstruction: a NSQIP analysis. Ann Surg Oncol. 2015;22:5474–5480.
18. Kamali P, Curiel D, van Veldhuisen CL, et al. Trends in immediate breast reconstruction and early complication rates among older women: a big data analysis. J Surg Oncol. 2017;115:870–877.
19. Kamali P, Zettervall SL, Wu W, et al. Differences in the reporting of racial and socioeconomic disparities among three large national databases for breast reconstruction. Plast Reconstr Surg. 2017;139:795–807.
20. Kamali P, Paul MA, Ibrahim AMS, et al. National and regional differences in 32,248 postmastectomy autologous breast reconstruction using the updated national inpatient sample. Ann Plast Surg. 2017;78:717–722.
21. de Blacam C, Ogunleye AA, Momoh AO, et al. High body mass index and smoking predict morbidity in breast cancer surgery: a multivariate analysis of 26,988 patients from the national surgical quality improvement program database. Ann Surg 2012;255:551–555.
22. Bleicher RJ, Ruth K, Sigurdson ER, et al. Time to surgery and breast cancer survival in the United States. JAMA Oncol. 2016;2:330–339.
23. Fischer JP, Wes AM, Kovach SJ. The impact of surgical resident participation in breast reduction surgery—outcome analysis from the 2005-2011 ACS-NSQIP datasets. J Plast Surg Hand Surg. 2014;48:315–321.
24. Nelson JA, Fischer JP, Chung CU, et al. Obesity and early complications following reduction mammoplasty: an analysis of 45,45 patients from the 2005-2011 NSQIP datasets. J Plast Surg Hand Surg. 2014;48:334–339.
25. Kim K, Mella JR, Ibrahim AM, et al. Is there an association between component separation and venous thromboembolism? Analysis of the NSQIP. Plast Reconstr Surg Glob Open. 2013;1:e49.
26. Kim K, Ibrahim AM, Koolen PG, et al. Analysis of morbidity and mortality in patients undergoing skull base reconstruction. J Craniomaxillofac Surg. 2013;26:135–140.
27. Koolen PG, Ibrahim AM, Kim K, et al. Patient selection optimization following combined abdominal procedures: analysis of 4925 patients undergoing panniculectomy/abdominoplasty.
with or without concurrent hernia repair. *Plast Reconstr Surg.* 2014;134:539e–550e.

28. Kim K, Ibrahim AM, Koolen PG, et al. Trends in facial fracture treatment using the American College of Surgeons National Surgical Quality Improvement Program database. *Plast Reconstr Surg.* 2014;133:627–638.

29. Kim K, Ibrahim AM, Koolen PG, et al. Analysis of the NSQIP database in 676 patients undergoing laryngopharyngectomy: the impact of flap reconstruction. *Otolaryngol Head Neck Surg.* 2014;150:87–94.

30. Khuri SF. The NSQIP: a new frontier in surgery. *Surgery.* 2005;138:837–843.

31. American College of Surgeons. American College of Surgeons national surgical quality improvement program. Available at http://site.acsnsqip.org/participants/. Accessed February 1, 2015.

32. Johnson C, Campwala I, Gupta S. Examining the validity of the ACS-NSQIP risk calculator in plastic surgery: lack of input specificity, outcome variability and imprecise risk calculations. *J Investig Med.* 2017;65:722–725.

33. O’Neill AC, Bagher S, Barandun M, et al. Can the American College of Surgeons NSQIP surgical risk calculator identify patients at risk of complications following microsurgical breast reconstruction? *J Plast Reconstr Aesthet Surg.* 2016;69:1356–1362.

34. Luce EA, Pierce CE. Lack of validity of the American College of Surgeons national surgical quality improvement program database for alloplastic immediate postmastectomy reconstruction. *Plast Reconstr Surg.* 2015;136:296e–300e.

35. Sinha I, Pusic AL, Wilkins EG, et al. Late surgical-site infection in immediate implant-based breast reconstruction. *Plast Reconstr Surg.* 2017;139:90–98.

36. Cohen JB, Carroll C, Tenenbaum MM, et al. Breast implant-associated infections: the role of the national surgical quality improvement program and the local microbiome. *Plast Reconstr Surg.* 2015;136:921–929.

37. Duraes EF, Schwarz G, Durand P, et al. Complications following abdominal-based free flap breast reconstruction: is a 30 days complication rate representative? *Aesthetic Plast Surg.* 2015;39:694–699.

38. Albornoz CR, Cordeiro PG, Hishon L, et al. A nationwide analysis of the relationship between hospital volume and outcome for autologous breast reconstruction. *Plast Reconstr Surg.* 2013;132:192e–200e.

39. Lin SJ, Nguyen MD, Chen C, et al. Tissue oximetry monitoring in microsurgical breast reconstruction decreases flap loss and improves rate of flap salvage. *Plast Reconstr Surg.* 2011;127:1080–1085.

40. Ricci JA, Vargas CR, Lin SJ, et al. A novel free flap monitoring system using tissue oximetry with text message alerts. *J Reconstr Microsurg.* 2016;32:415–420.

41. Ricci JA, Vargas CR, Ho OA, et al. Evaluating the use of tissue oximetry to decrease intensive unit monitoring for free flap breast reconstruction. *Ann Plast Surg.* 2017;79:42–46.

42. Koolen PG, Vargas CR, Ho OA, et al. Does increased experience with tissue oximetry monitoring in microsurgical breast reconstruction lead to decreased flap loss? The learning effect. *Plast Reconstr Surg.* 2016;137:1093–1101.

43. Unukovych D, Gallego CH, Aineskog H, et al. Predictors of reoperations in deep inferior epigastric perforator flap breast reconstruction. *Plast Reconstr Surg Glob Open.* 2016;4:e1016.

44. Glass GE, Nanchalal J. Why haematoma cause flap failure: an evidence-based paradigm. *J Plast Reconstr Aesthet Surg.* 2012;65:905–910.

45. Halle M, Docherty Skogh AC, Friberg A, et al. Breast free flap complications related to haematoma formation—do the risks of multiple antithrombotics outweigh the benefits today? *J Plast Surg Hand Surg.* 2016;50:197–201.

46. Seth AK, Hirsch EM, Kim JY, et al. Hematoma after mastectomy with immediate reconstruction: an analysis of risk factors in 883 patients. *Ann Plast Surg.* 2013;71:20–23.

47. Mioton LM, Smetona JT, Hanwright PJ, et al. Comparing thirty-day outcomes in prosthetic and autologous breast reconstruction: a multivariate analysis of 13,082 patients. *J Plast Reconstr Aesthet Surg.* 2013;66:917–925.