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Definitional differences in “outpatient” surgery can influence study outcomes related to total shoulder arthroplasty

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A R T I C L E I N F O

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Background: Numerous studies have investigated the outcomes of outpatient total shoulder arthroplasty (TSA). However, some patients originally planned for outpatient surgery may unexpectedly require inpatient hospital stay, which can obscure the distinction of “outpatient” and “inpatient” cases. Ultimately, this inconsistent classification of “outpatient” surgery may influence study results. The objectives of this study were (1) to characterize the differences in definition of “outpatient” surgery (hospital-defined outpatient [HDO] vs. same-day discharge [SDD]), and (2) to study the effect of different definitions on 30-day outcomes following TSA.

Methods: The American College of Surgeons National Surgical Quality Improvement Program database was queried for patients who underwent TSA between 2011 and 2021. HDO cases were identified based on the National Surgical Quality Improvement Program inpatient or outpatient variable, and SDD cases were identified based on length of stay = 0. Demographic and clinical characteristics were compared between HDO and SDD cohorts. Propensity score was utilized to match each HDO and SDD case with one inpatient case without replacement. Two distinct sets of multivariate analyses, using Poisson regressions with robust error variance, were performed to calculate the risks of readmission, reoperation, morbidity, and complications for HDO and SDD.

Results: A total of 30,458 patients met the inclusion criteria, including 6711 HDO and 4490 SDD cases. 3501 out of the 6711 (52.2%) HDO patients required at least one night of inpatient hospital stay (length of stay >0). Between 2011 and 2021, the annual incidence of HDO TSA rose from 4.1% to 61.6% of all TSA cases, and the incidence of SDD TSA increased from 2.0% to 34.1% of all TSA cases. Compared to SDD, HDO was associated with female sex, higher body mass index, functional dependence, diabetes, chronic obstructive pulmonary disease, congestive heart failure, hypertension, American Society of Anesthesiologists ≥3, longer operation time, and nonhome discharge. After controlling for potential confounders, inpatient TSA was associated with increased risk of 30-day readmission and reoperation compared with HDO cases, while morbidity and individual complication rates were similar. However, compared with SDD patients, inpatient TSA was associated with higher rates of readmission, reoperation, morbidity, pneumonia, pulmonary embolism, myocardial infarction, and deep venous thrombosis.

Conclusion: Definitional differences in “outpatient” surgery can lead to significantly different study outcomes related to TSA. Future investigations on this topic should maintain consistency in the definition of “outpatient” surgery. Accurate data on the risk factors for adverse events after TSA are critical for appropriate patient selection and improving surgical outcomes.

Shoulder arthroplasty is a surgical procedure often employed to address osteoarthritic pathologies of the glenohumeral joint.[18,36] Shoulder arthroplasty has been shown to be effective at restoring function, improving quality of life, and alleviating pain.[27] The volume of total shoulder arthroplasty (TSA) procedures has been growing rapidly, and advances in surgical technique, implants, and perioperative care have reduced complication rate and length of stay (LOS).[26] These improvements paired with changes in health policy have generated interest in outpatient TSA as a safe and costeffective alternative.[12]

No institutional review board or Ethical Committee approval was necessary for this study as it utilized a de-identified, publicly available national surgical database.

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Numerous studies have investigated the outcomes of outpatient versus inpatient TSA.[2,17,33,34] However, definitional differences in outpatient TSA may exist. Outpatient surgery typically involves a patient being discharged on the same day as the procedure. However, patients scheduled for an outpatient procedure may be held for "observation" yet still be coded as outpatients.[10] Furthermore, some patients originally planned for outpatient surgery may unexpectedly require inpatient hospital stay and stay overnight, which can obscure the distinction of "outpatient" and "inpatient" cases. Ultimately, this inconsistent classification of "outpatient" surgery may influence study results and interpretation of reported findings. An analysis of the National Surgical Quality Improvement Program (NSQIP) database by Bovonratwet et al showed that anterior cervical discectomy and fusion and lumbar discectomy cases recorded as "outpatient" often did not correlate with same day discharge (SDD).[9] Similarly, Gordon et al demonstrated that total hip arthroplasty "outpatient" procedures often did not correlate with SDD, as they noted over 20% of cases remaining in the hospital for at least 2 days.[20]

The purpose of this study was (1) to characterize the differences in definition of "outpatient" surgery (hospital-defined outpatient [HDO] vs. SDD) and (2) to study the effect of different definitions on 30-day outcomes following TSA. We hypothesize that there are significant discrepancies in the definitions of outpatient TSA and that such discrepancies will influence study results evaluating surgical outcomes. By highlighting this issue, we aim to bring more awareness of these potential differences to readers, especially regarding literature that utilizes the NSQIP database and compares inpatient vs. outpatient cohorts.

Materials and methods

Database and patient population

This is a retrospective review from the American College of Surgeons NSQIP (ACS-NSQIP) database. ACS-NSQIP is an outcomes-based registry containing data from more than 700 participating institutions, including academic and private, community and tertiary, and inpatient and outpatient medical centers.[28] Patient demographic information and 30-day postoperative outcomes are collected from the electronic medical record and undergo regular auditing by clinical reviewers to ensure data accuracy and validity.[5] Because NSQIP is a publicly available deidentified national database, patient consent and institutional review board approval were not required for the purposes of this study.

Patients who underwent primary TSA between 2011 and 2021 were identified using Current Procedural Terminology code 23472. The exclusion criteria included revision cases, hemiarthroplasty, infection, malignancy, emergency and nonelective cases, and missing LOS data. Outliers above the 99th percentile for LOS (5 days) were also excluded to avoid misrepresenting the data (N = 314).

Definitions of "outpatient" surgery

The first method of classification of "outpatient" surgery was HDO, which was identified based on the NSQIP-provided inpatient or outpatient variable. HDO refers to a distinct variable derived from each individual hospital's definition of inpatient and outpatient status. Among the identified HDO cases, postoperative LOS ranged from 0 to 30+ days; however, the outliers (LOS >5) were excluded as previously explained. The second method of classification of "outpatient" surgery was SDD, which was defined as LOS = 0. The SDD cohort includes only patients who did not have an overnight stay in the hospital following their surgery. The "inpatient" cohort was defined as either the hospital's individual definition of inpatient or as patients with LOS > 0, depending on the comparative group, HDO or SDD, in the statistical analyses. HDO cases were matched with hospital-defined inpatient cases, while SDD cases were matched with cases where LOS > 0.

Variables and outcomes studied

Demographic and perioperative variables were extracted from the NSQIP database for each patient, including age, sex, race, ethnicity, body mass index (BMI), operation time, LOS, and discharge disposition. Operative time was measured as minutes between initial incision and end of wound closure. LOS was measured as the number of calendar days from the index procedure to discharge. Comorbidities including diabetes mellitus, chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), hypertension, chronic steroid use, functional dependence, and American Society of Anesthesiologists (ASA) classification were recorded.

The primary postoperative outcomes analyzed were the incidences of 30-day readmission, reoperation, and morbidity. Individual complications were also recorded, including superficial surgical site infection, deep surgical site infection, pneumonia, pulmonary embolism, urinary tract infection, stroke, myocardial infarction, and deep venous thrombosis.

Statistical analyses

Statistical analyses were performed using SPSS version 28 (IBM Corp., Armonk, NY, USA). The level of significance was set at $P < .05$. Demographic and clinical characteristics were compared between HDO and SDD cohorts. Frequencies and proportions were recorded for each categorical variable, while medians and interquartile ranges (IQR) were recorded for each continuous variable.

To compare outpatient vs. inpatient cohorts based on the different definitions, propensity score matching was utilized to match "HDO" to "hospital-defined inpatient" and "SDD" to "LOS >0." Propensity score matching was utilized to minimize confounding effects due to differences in baseline patient characteristics.[23] In our analysis, each HDD and SDD case was matched with their respective inpatient counterparts, without replacement, with regard to age, sex, race, ethnicity, BMI, and comorbidities.

Two distinct sets of multivariable analyses, using Poisson regressions with robust error variance, were performed to calculate the risks of readmission, reoperation, morbidity, and complications for HDO and SDD compared to their inpatient counterparts. A backward stepwise approach was employed, in which all variables included in Table I were initially included in the model, and variables with the highest *P*-values were sequentially eliminated until only the statistically significant variables ($P < .05$) remained. Variables retained in the final multivariable regression models represented the adverse outcomes that are significantly more likely to occur following inpatient surgery compared to outpatient surgery.

Results

A total of 30,458 patients met the inclusion criteria, including 6711 HDO and 4490 SDD cases. 3501 out of the 6711 (52.2%) HDO patients required at least one night of inpatient hospital stay (LOS >0) (Fig. 1). Between 2011 and 2021, the annual incidence of HDO TSA rose from 4.1% to 61.6% of all TSA cases, and the incidence of SDD TSA increased from 2.0% to 34.1% of all TSA cases (Fig. 2).

Comparison of patient characteristics between outpatient definition cohorts

Compared to SDD, HDO was significantly associated with female sex (51.1% vs. 46.7%, $P < .001$) and higher median BMI (29.8 vs. 29.3, $P = .015$). In terms of comorbidities, the HDO cohort had higher proportions of functional dependence (1.2% vs. 0.5%, $P < .001$), diabetes (16.5% vs. 14.1%, $P < .001$), COPD (4.6% vs. 3.3%, $P < .001$), CHF (1.7% vs. 0.8%, $P < .001$), hypertension (61.6% vs. 57.9%, $P < .001$), and ASA ≥3 (51.6% vs. 45.5%, $P < .001$). For perioperative variables, HDO was associated with longer median operation time (108 vs. 98 minutes, $P < .001$) and higher frequencies of nonhome discharge (1.6% vs. 0.5%, $P < .001$) than SDD (Table I).

Effects of using different outpatient definitions on postoperative outcomes

In multivariable regression analyses, inpatient TSA was associated with significantly increased risk of 30-day readmission (odds ratio [OR] 1.406, $P = .004$) and reoperation (OR 1.658, $P = .002$) when compared with HDO cases, while morbidity and individual complication rates were similar ($P > .05$) (Table II). However, compared with SDD patients, inpatient TSA was associated with higher rates of readmission (OR 2.348, $P < .001$), reoperation (OR 2.754, $P < .001$), morbidity (OR 5.220, $P < .001$), pneumonia (OR 3.151, $P = .002$), pulmonary embolism (OR 3.545, $P = .009$), myocardial infarction (OR 4.080, $P = .001$), and deep venous thrombosis (OR 3.661, $P = .013$) (Table III).

Table I
Comparison of hospital-defined outpatient and same-day discharge cohorts.

Variables	HDO		SDD		*P*
	N	%	*N*	%	
Total cases	6711		4490		
Median age (IQR)	69 (13)		68 (12)		.624
Female sex	3452	51.1	2097	46.7	**<.001**
Black race	302	4.9	183	4.5	.405
Hispanic ethnicity	372	6.0	265	6.5	.292
Median BMI (IQR)	29.8 (8.3)		29.3 (7.8)		**.015**
Comorbidities					
Functional dependence	82	1.2	22	0.5	**<.001**
Diabetes	1115	16.5	633	14.1	**<.001**
COPD	313	4.6	147	3.3	**<.001**
CHF	118	1.7	36	0.8	**<.001**
Hypertension	4162	61.6	2601	57.9	**<.001**
Chronic steroid use	265	3.9	155	3.5	.197
ASA class ≥3	3481	51.6	2042	45.5	**<.001**
Perioperative variables					
Median operation time (IQR)	108 (51)		98 (47)		**<.001**
Nonhome discharge	109	1.6	23	0.5	**<.001**
HDO	6711	100.0	3254	72.5	**<.001**
Median LOS (IQR)	1 (1)		0 (0)		**<.001**

HDO, hospital-defined outpatient; *SDD*, same-day discharge; *IQR*, interquartile range; *BMI*, body mass index; *COPD*, chronic obstructive pulmonary disease; *ASA*, American Society of Anesthesiologists; *LOS*: length of stay; *CHF*: congestive heart failure.
Bold indicates statistical significance ($P < .05$).

Discussion

This study assesses the difference between HDO and SDD defined patient cases reported from US hospitals and analyzes the effects of these definitions on 30-day outcomes post-TSA. Between 2011 and 2021, the annual incidence of HDO TSA and SDD TSA has significantly increased. However, over half of patients classified as HDO spent at least one night in the hospital, marking a clear discrepancy between the number of patients booked for ambulatory surgery and the number ultimately discharged in ambulatory fashion. Given the increase in outpatient TSA in recent years, it is important for the definition of "outpatient" to be standardized and consistent across all studies on surgical outcomes in the outpatient setting. These results suggest that the intuitive definition that "outpatient" surgery refers to SDD cannot be assumed to be equivalent to the hospital-recorded "outpatient" status in the national surgical databases. Furthermore, this assumption may lead to inconsistent conclusions on differences in surgical outcomes and recovery between inpatient and outpatient cohorts. Thus, firmly establishing the designation of outpatient TSA is important for studies to provide the most accurate analyses regarding the efficacy and outcomes of these procedures.

This study showed a marked increase in the growth of both HDO and SDD TSA between 2011 and 2021. Previous literature supports this finding, as outpatient TSA has become increasingly common secondary to lower complication rates and healthcare costs.[6,13,14,26] Notably, the data from 2020 and 2021 demonstrates how the COVID-19 propagated the rise of outpatient surgeries and impacted the trend toward ambulatory shoulder arthroplasty observed in this study. The proportion of patients who were scheduled for HDO jumped from around 20% in 2020 to over 60% in 2021, accounting for a large amount of the increase observed in HDO TSA. Many other studies have assessed this marked increase in outpatient surgeries across different surgical specialties and across various procedures within the field of orthopedic surgery.[8,22,25,31,32] For TSA specifically, around 32% of TSAs was performed in the outpatient setting during the COVID-19 pandemic, increasing from 4.5% prior to this period.[29] The increased burden on hospital resources during the pandemic necessitated the shift toward outpatient orthopedic procedures, and the spike of cases in 2021 may represent the national backlog of delayed procedures.[3,7,15,35] These findings primarily support the clear shift toward outpatient TSA in the wake of COVID-19, underscoring the necessity of properly classifying what is regarded as "outpatient" to better understand how to make TSA safer and more effective in this setting.

The discrepancy between the definition of "outpatient" used by US hospitals and LOS = 0 can potentially be explained by the existence of an "observation" status, where patients who undergo an outpatient procedure may stay in the hospital overnight for one or more days yet still be classified as "outpatient."[30] The labeling of patients placed under overnight observation as "outpatient" cases can be misleading. Significant differences were found in this study between the HDO and SDD groups. Compared to SDD, HDO cases were associated with the female sex, higher BMI, functional dependence, diabetes, COPD, CHF, and hypertension. They also differed in perioperative factors, with HDO cases associated with ASA ≥3, longer operation time, and nonhome discharge. A recent study by Ling et al with TSA data from NSQIP published similar findings, evaluating outcomes in cohorts of LOS = 0, 1, 2, and LOS > 2 days. They found that COPD was a major readmission factor, and longer LOS was associated with various factors, including advanced age, female sex, high BMI, dependent functional status, ASA ≥3, diabetes, CHF, and hypertension.[24] As outpatient procedures become more widespread, patients with these demographic and perioperative factors should be evaluated more carefully in the patient selection process for outpatient surgery in order to minimize adverse events. Patient selection is one of the most critical factors in predicting the success of outpatient TSA, and many computational tools built on databases like NSQIP exist to aid surgeons in stratifying risk and determining a patient's eligibility for outpatient TSA.[4,11,19,34] Thus, it is important for outpatient status to be defined correctly in the context of improving our tools for patient selection.

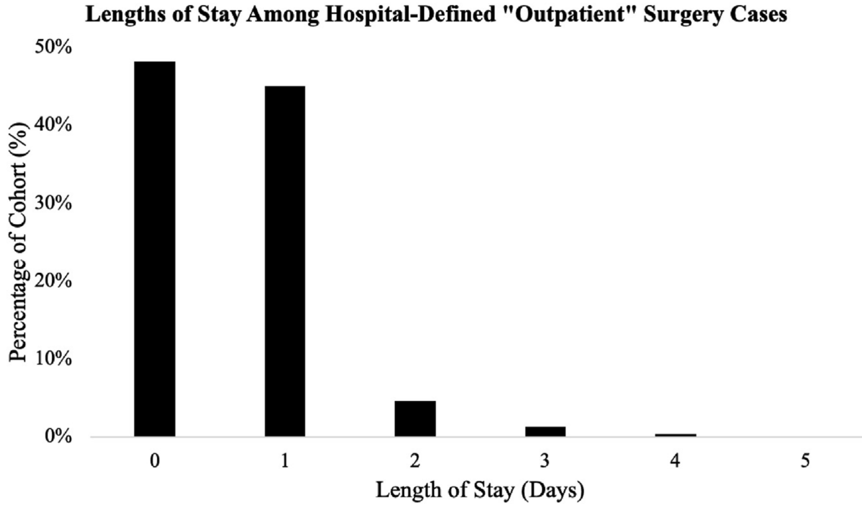

Figure 1 Lengths of stay among hospital-defined outpatient (HDO) cases.

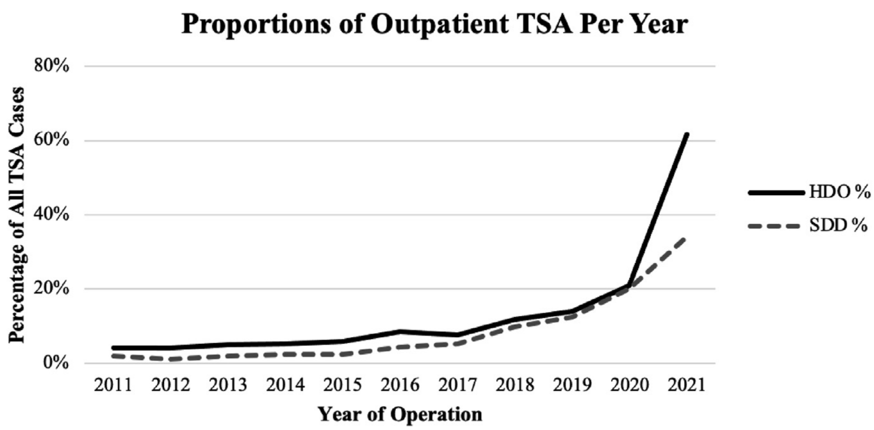

Figure 2 Proportions of outpatient total shoulder arthroplasty per year. *TSA*, total shoulder arthroplasty; *HDO*, hospital-defined outpatient; *SSD*, same-day discharge.

Table II
Risk of 30-day adverse events following inpatient total shoulder arthroplasty compared to matched hospital-defined outpatient (HDO) cohort.

Outcome	Odds ratio	95% CI	*P*-value
Readmission	1.406	1.112 - 1.777	**.004**
Reoperation	1.658	1.227 - 2.241	**.002**
Morbidity	0.795	0.615 - 1.028	.080
Individual complications			
Superficial SSI	0.553	0.272 - 1.124	.102
Deep SSI	1.454	0.627 - 3.373	.383
Pneumonia	0.660	0.307 - 1.418	.287
Pulmonary embolism	0.974	0.425 - 2.233	.950
Urinary tract infection	0.700	0.442 - 1.107	.127
Stroke	0.702	0.217 - 2.267	.554
Myocardial infarction	0.558	0.192 - 1.624	.285
Deep venous thrombosis	1.203	0.560 - 2.585	.636

CI, confidence interval; *SSI*, surgical site infection.
Bold indicates statistical significance ($P < .05$).

Table III
Risk of 30-day adverse events following inpatient total shoulder arthroplasty compared to matched same-day discharge (SDD) cohort.

Outcome	Odds ratio	95% CI	*P*-value
Readmission	2.348	1.766 - 3.121	**<.001**
Reoperation	2.754	1.794 - 4.229	**<.001**
Morbidity	5.220	4.010 - 6.796	**<.001**
Individual complications			
Superficial SSI	1.412	0.532 - 3.748	.489
Deep SSI	2.781	0.961 - 8.046	.059
Pneumonia	3.151	1.549 - 6.411	**.002**
Pulmonary embolism	3.545	1.363 - 9.216	**.009**
Urinary tract infection	1.266	0.781 - 2.053	.338
Stroke	1.060	0.359 - 3.132	.917
Myocardial infarction	4.080	1.752 - 9.498	**.001**
Deep venous thrombosis	3.661	1.318 - 10.169	**.013**

CI, confidence interval; *SSI*, surgical site infection.
Bold indicates statistical significance ($P < .05$).

Some past studies have utilized the unclear definition of “inpatient” vs. “outpatient” in the NSQIP database instead of LOS > 0 vs. LOS = 0.[21,33] In our study, comparing “inpatient” status vs. HDO status only showed higher risk of readmission and reoperation for the inpatient group. However, when “inpatient” status was compared to SDD designation, the inpatient cohort had higher relative risk for readmission, reoperation, pneumonia, pulmonary embolism, myocardial infarction, and deep venous thrombosis. These results suggest that patients who are planned for outpatient surgery but are ultimately not discharged on the same day may face a complication risk profile more akin to those labeled “inpatient,” even though they may be marked as “outpatient” in the recorded data. Support for this hypothesis exists in the literature, with several studies demonstrating a difference in the risk of adverse outcomes when SDD and HDO cohorts were separately compared to the same inpatient cohort.[9,10,20] There are variations in how studies report differences between outpatient and inpatient in terms of complications and risk factors due to the variations in the definition of these terms, which emphasizes the significance of clearly defining “inpatient” and “outpatient” status. Additionally, only studies that utilize the same definitions should be compared to maintain consistency within the interpretation of the results.

There are limitations to consider in this study. First, the database was queried using the Current Procedural Terminology code 23472, which encompasses both anatomic and reverse TSA, and analysis could not be stratified based on the specific type of shoulder arthroplasty. The NSQIP database only provides 30 days of postoperative data, which may not provide a comprehensive overview of a patient’s recovery and excludes events beyond the 30-day period. Additionally, the amount of time spent in the hospital was reported in days instead of hours, so cases where LOS $= 0$ have limited resolution. In this study, patients with LOS $= 0$ were considered to have been discharged from the hospital on the same day postoperation, and those with LOS > 0 were considered to have stayed at least one night in the hospital. Since the majority of patients had LOS < 2, more granular data may have provided more profound insight into the recovery for different groups of patients. There may also be a question of the accuracy of data provided by NSQIP, though trained reviewers populate this database, and it has been shown to have high interrater reliability, with an overall disagreement rate of around 2%.[1] This study was conducted retrospectively, and as such, a statistical power analysis was not performed. Posthoc power analyses have been demonstrated to be flawed and analytically misleading.[16,37] Instead, the confidence intervals were provided.

Conclusion

This study underscores the necessity for a standardized definition of "outpatient" status in TSA, revealing significant discrepancies between intended outpatient procedures and actual discharge statuses. The marked increase in HDO and SDD TSAs, particularly during the COVID-19 pandemic, highlights the impact of external factors on healthcare practices and a clear shift toward outpatient procedures in orthopedic surgery. By demonstrating the risks associated with inconsistent “outpatient” classification and the importance of accurate patient selection, this research advocates for uniform reporting standards and the use of risk stratification tools to optimize patient outcomes. Further refinement in the categorization of “outpatient” status is necessary to improve safety and enhance the quality of care for patients undergoing TSA.

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