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Similar Outcomes After Hospital-Based Same-Day Discharge vs Inpatient Total Hip Arthroplasty

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ABSTRACT

Background: There has been increasing interest in performing primary hip and knee replacement with same-day discharge (SDD). The purpose of this study is to compare patient-reported outcome (PRO) scores, pain scores, and readmissions in patients who underwent SDD total hip arthroplasty (THA) with those in patients who underwent traditional inpatient THA.
Methods: A retrospective study was conducted on 963 patients who underwent primary THA at our institution between September 2016 and December 2018. Two cohorts were established based on whether the patient underwent SDD or traditional inpatient THA. An electronic physical engagement application was used to collect PRO scores (Hip Disability and Osteoarthritis Outcome Score for Joint Replacement, Veterans Rand 12-Item Health Survey Physical Component Score, and Mental Component Score) and pain scores. To control for demographic variables, a multiple regression analysis of PRO scores was conducted.
Results: Four hundred fifteen (43.1%) patients in this study underwent the SDD protocol. There were significant differences between both cohorts with respect to sex, age, body mass index, American Society of Anesthesiologists score, and smoking status. The bivariate analysis revealed that the SDD cohort had a significantly greater change in the Veterans Rand 12-Item Health Survey Physical Component Score and had fewer readmissions. Both cohorts had equivalent decreases in pain scores. After controlling for demographic variables in a multivariable analysis, the SDD cohort was found to have higher PRO scores at all time points, but there were no significant differences in the change in PRO scores over time between both groups.
Conclusion: Patients in an SDD THA care pathway experienced similar improvements in PRO scores and clinically equal reduction in pain scores.
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Introduction

There has been increasing interest in performing primary hip and knee replacement with same-day discharge (SDD). Standardized clinical pathways that incorporate evidenced-based clinical practices to optimize all aspects of the care episode have dramatically decreased the length of stay (LOS) for these procedures [1,2]. Efforts to implement cost-containment measures have heavily relied on standardized pathways and have become more

widespread with the shift in reimbursement for total hip arthroplasty (THA) and total knee arthroplasty from fee-for-service to bundled-payment models [3,4]. Increased LOS is an important cost driver in total joint arthroplasty (TJA), and decreasing LOS with SDD as the ultimate goal has important implications for the costs of these care episodes [5]. Compared with traditional inpatient THA, SDD/outpatient THA has been shown to save approximately $4000-$7000 per case in the hospital-based setting [6,7]. If extrapolated to 30% of the entire population of patients who undergo THA annually, savings in reimbursements are estimated to be $87 million. This estimate may in fact be conservative, as the proportion of patients eligible for SDD may in fact be higher [6,8].

Favorable reports from several centers have been published over the past decade. A study on outcomes in 164 patients who

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underwent early SDD THA at our institution (from January 2015 to September 2016) was previously published [9]. Patients were analyzed against an inpatient cohort of 1315 patients with Risk for Readmission Assessment Tool scores ≤2. The SDD patients had significantly shorter average LOS (8.9 hours vs 55.2 hours), were more likely to be discharged home (100% vs 92.6%), and had lower 90-day readmission rates (0.6% vs 3.6%). In addition, a systematic review by Hoffman et al examined 10 publications with a total of 1009 patients and found that SDD patients had low complication rates, high satisfaction levels, and similar functional scores, range of motion, and visual analogue scale (VAS) pain scores as inpatient cohorts [10]. Despite these encouraging results, some studies raise concerns regarding the safety of SDD, citing an increased risk of postoperative complications and readmissions [11-13].

The purpose of this study is to compare the patient-reported outcome (PRO) scores, pain scores, and readmission rates in patients who underwent SDD THA with those of patients who required an overnight hospital stay or longer. Our hypothesis is that SDD patients would have similar outcomes to a traditional inpatient THA population.

Material and methods

A retrospective study was conducted at a single, urban, academic, tertiary institution to assess outcomes before and after the implementation of a novel SDD protocol for THA. All primary THA surgeries included in this study were performed consecutively by the senior author (R.I.D.) between September 2016 and December 2018 using a direct anterior approach. Patients excluded from this study included those who completed only one or neither of the preoperative or 12-week postoperative outcome surveys. Patients were divided into 2 cohorts for comparison: (1) traditional THA protocol and (2) SDD protocol. Importantly, patients who were assigned to the SDD protocol but were not successfully discharged on the same day of surgery were included in the traditional THA protocol cohort. SDD meant that the patient was discharged before midnight on the day of surgery. LOS of 1 was deemed when a patient stayed overnight. The records and existing data are deidentified and are part of our institutional quality improvement program; therefore, the present study was exempted from human-subjects review by our institutional review board.

Same-day discharge protocol

To qualify for SDD, patients were required meet the following criteria: no active coronary artery disease or active arrhythmias, not currently on chronic anticoagulation, no active liver disease, no moderate or severe obstructive sleep apnea, blood hemoglobin ≥12 g/dL, body mass index (BMI) ≤40 kg/m^2, and have the ability to ambulate independently. Patients were required to undergo extensive preoperative education, which included a scheduled one-on-one encounter with a clinical care coordinator. Patients were also required to have a social support person who would attend all preoperative education sessions, escort the patient out of the hospital to be discharged to home, and remain at home for the first night after discharge.

On the day of surgery, a hydration protocol was initiated in which patients were encouraged to drink 32 ounces of clear fluid 2 hours before surgery. Owing to the institutional transition from aspirin 325 mg BID to 81 mg BID within the time frame of the study, thromboprophylaxis was achieved with either dosage, as well as mechanical compression devices for the first 2 postoperative weeks. Currently active smokers were given enoxaparin 40 mg daily for 4 weeks. A standardized intraoperative anesthesia protocol that included short-acting nonopiate spinal anesthetic, IV fentanyl, propofol, midazolam, dexamethasone, and acetaminophen was used. A periarticular

cocktail injection consisting of epinephrine, bupivacaine, and ketorolac was also used uniformly to reduce the need for postoperative narcotics. Blood conservation strategies such as IV tranexamic acid were used on every patient, whereas surgical sealants such as bone wax were used on occasion. Routine blood draws were not performed in the SDD cohort; however, they may have been performed in patients who required monitoring of hemoglobin/hematocrit (such as for known preoperative anemia, severe coronary artery disease, etc.) to determine the need for a blood transfusion in the inpatient cohort on a case-by-case basis only.

Postoperative pain management was accomplished using non-narcotic medications, such as oral acetaminophen and meloxicam. Patient-controlled analgesia and oral and intravenous opioid administration was strongly discouraged, except in situations of breakthrough pain. Patients were seen by physical therapists postoperatively on the day of surgery to assist with early ambulation and ensure the patient is safe for discharge home. On postoperative day (POD) 1, a clinical care coordinator nurse calls each patient to follow up on their recovery. The anesthesia and pain management protocols were uniform for both cohorts.

Data collection

Data were obtained from our electronic data warehouse Epic Caboodle (version 15, Verona, WI) using Microsoft SQL Server Management Studio 2017 (Redmond, WA). Descriptive patient characteristics (sex, age, BMI, race, American Society of Anesthesiologists [ASA] physical status classification system, smoking status), admission data (LOS and discharge disposition), and opioid administration data (medication administration date-time, medication name, dosage, and route) were extracted.

Patients

In total, 963 of 1104 (87.2%) patients underwent THA within the study period and completed both the preoperative and 12-week

Table 1
Baseline demographics, n (%), or mean (±SD).

Variable	SDD (n = 415)	Non-SDD (n = 548)	P-value[a,b]
Sex			<.01
Male	202 (48.6)	196 (35.9)	
Female	213 (51.5)	352 (64.1)	
Age			<.01
≤59 y	175 (42.3)	88 (15.8)	
60-64 y	81 (19.6)	76 (14.0)	
65-69 y	78 (18.6)	126 (23.0)	
70-91 y	81 (19.6)	258 (47.2)	
BMI (kg/m^2)			.01
Normal (<25)	127 (32.7)	152 (28.7)	
Overweight (25-29.9)	175 (44.9)	213 (40.0)	
Obese (≥30)	87 (22.4)	166 (31.3)	
Race			.11
White	386 (96.0)	489 (93.6)	
Non-white	16 (4.0)	34 (6.4)	
ASA			<.01
1, 2	393 (94.7)	365 (66.5)	
3, 4	22 (5.3)	183 (33.5)	
Smoking			<.01
Never smoked	254 (61.3)	286 (52.3)	
Current smoker	25 (6.1)	19 (3.5)	
Former smoker	135 (32.7)	243 (44.2)	
Discharge disposition			<.001
Home with self-care	309 (74.5)	291 (53.1)	
Home with health services	106 (25.5)	240 (43.8)	
Rehabilitation facility	0 (0.0)	17 (3.1)	

MME, morphine milligram equivalents; SD, standard deviation.
[a] Statistical tests were conducted on log-transformed surgical time and MME/day
[b] P-values are based on series of either t-tests or Fisher's exact test.

Table 2
Outcomes, n (%), or mean (±SD).

Outcome	SDD (n = 415)	Non-SDD (n = 548)	P-value[b]
ΔHOOS, JR. (12 weeks − baseline)	29.9 (±16.7)	31.3 (±16.7)	.29
ΔVR-12 PCS (12 weeks − baseline)	4.3 (±10.2)	6.1 (±11.1)	.04
ΔVR-12 MCS (12 weeks − baseline)	14.1 (±10.1)	14.4 (±8.8)	.65
Average MME/day[a]	16.6 (±15.3)	22.5 (±22.3)	<.01
ΔVAS pain score (12 weeks − baseline)	-4.8 (±2.2)	-5.1 (±2.3)	.05
Discharge disposition			<.01
Home with EPRA only	309 (74.5)	291 (53.1)	
Home with EPRA and home health services	106 (25.5)	240 (43.8)	
Skilled nursing facility or acute rehabilitation facility	0 (0.0)	17 (3.1)	
90-Day readmissions	4 (1.00)	20 (3.7)	.01

EPRA, electronic patient rehab application.
[a] Statistical tests were conducted on log-transformed surgical time and MME/day.
[b] P-values are based on series of either t-tests or Fisher's exact test.

postoperative outcome surveys. The mean age and BMI of the study sample were 65.1 ± 10.6 years and 27.6 ± 4.8 kg/m^2, respectively. Four hundred fifteen (43.1%) patients in this study underwent the SDD protocol, and 548 (56.9%) patients underwent traditional inpatient THA. There were significant differences between both cohorts with regard to several baseline patient characteristics, including sex, age, BMI, ASA, and smoking status (Table 1). The SDD cohort had a greater proportion of males (48.6% vs 35.9%; P < .01) and younger patients (≤59 years, 42.3% vs 15.8%; P < .01). Patients in the traditional protocol were more likely to have a BMI ≥30 kg/m^2 (31.3% vs 22.4%, P = .01) and an ASA score of 3 or 4, indicating more comorbidities (33.5% vs 5.3%; P < .01).

Electronic physical engagement application

All patients included in this study were registered at the time of surgical scheduling for an electronic physical engagement application (EPEA) (Force Therapeutics, New York, NY), which was used to collect PRO scores and VAS pain scores. Outcomes collected through the EPEA included the Hip Disability and Osteoarthritis Outcome Score for Joint Replacement (HOOS, JR.), Veterans Rand 12-Item Health Survey (VR-12) Physical Component Score (PCS), and Mental Component Score (MCS); surveys were pushed to the patient at predefined time intervals (1 week before surgery, and 12 weeks and 1 year postoperatively) via mobile- and web-based methods. HOOS, JR. scores are measured on a 100-point scale, with higher scores representing superior joint function [14]. The minimal clinically important difference (MCID) for the HOOS, JR. is estimated to be 14 points [15]. The average VR-12 PCS and MCS for the United States population are set at 50 points; higher scores

represent superior function, and each 10-point increment above or below the mean corresponds to one standard deviation [16]. The MCID for the VR-12 PCS and MCS is approximated at 5.0 [17]. On logging into the EPEA each day preoperatively and on PODs 1-90, patients are presented with a VAS for pain from 0 to 10, with higher scores indicating greater pain intensity or severity.

Statistical analysis

Means and standard deviations were used to describe all continuous variables, and frequency distributions were used to describe categorical variables. Fisher's exact test and 2-sample t-tests were used to test for significance. To control for demographic variables, a hierarchical multiple regression analysis of PRO scores was conducted.

Results

Patient-reported outcomes

In an unadjusted, bivariate analysis of the mean change in HOOS, JR. scores between the preoperative and 12-week postoperative time points, the ΔHOOS, JR. score was 29.9 ± 16.7 for the SDD cohort and 31.3 ± 16.7 for the non-SDD cohort (Table 2). These differences were statistically equal between both groups (P = .29). The non-SDD cohort had a significantly greater ΔVR-12 PCS (4.3 ± 10.2 vs 6.1 ± 11.1, P = .04), and there was no difference in ΔVR-12 MCSs (14.1 ± 10.1 vs 14.4 ± 8.8, P = .65). Scores for all 3 PRO instruments over time are shown in Figures 1-3.

Demographic variables were controlled for in a multivariable analysis of PRO scores (Table 3). All 3 PRO measures significantly
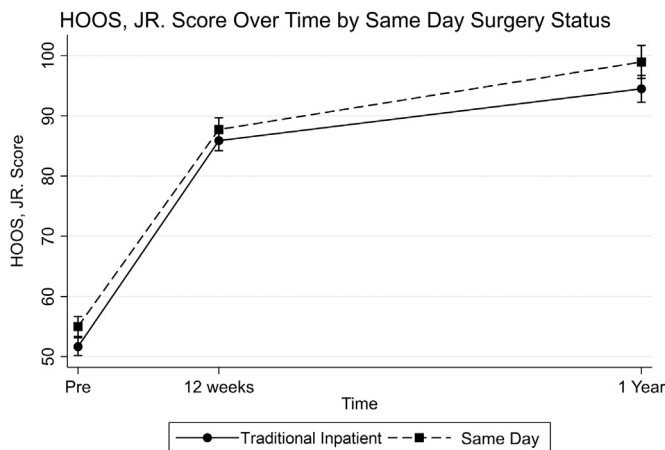
Figure 1. HOOS, JR. scores at preoperative and postoperative (12 weeks and 1 year) time points in patients undergoing SDD and traditional inpatient THA.
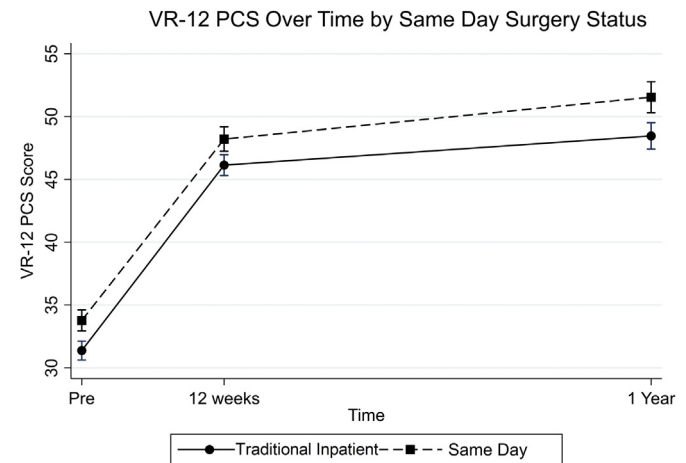
Figure 2. VR-12 PCSs at preoperative and postoperative (12 weeks and 1 year) time points in patients undergoing SDD and traditional inpatient THA.
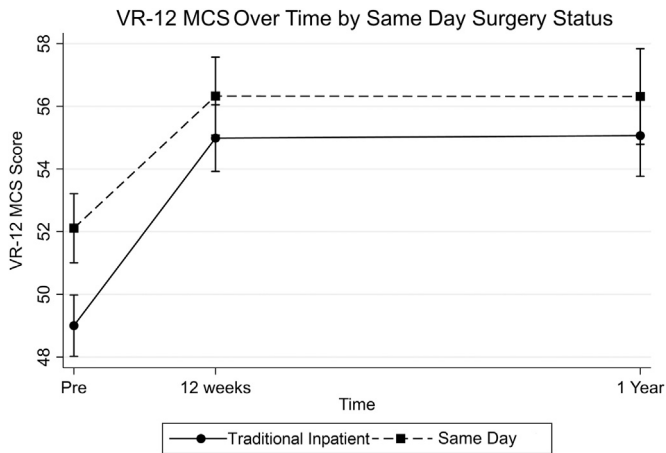
Figure 3. VR-12 MCSs at preoperative and postoperative (12 weeks and 1 year) time points in patients undergoing SDD and traditional inpatient THA.

increased over time relative to the baseline, and the SDD cohort, on average, had higher PRO scores at all time points. When protocol and time point were analyzed together, the magnitude of the change in scores over time was equal between cohorts at all time points, with the exception that SDD patients had slightly lower VR-12 MCSs at 12 weeks postoperatively ($\beta = -1.77$; $P = .03$). Preoperative factors that were found to influence PRO scores included age, sex, BMI, and ASA score. Female sex and overweight/obese BMI

negatively correlated with all 3 PRO measures, increasing age positively correlated with HOOS, JR. scores, and higher ASA scores negatively influenced VR-12 MCSs.

Pain scores

The non-SDD cohort had a significantly greater decrease in VAS pain scores between the preoperative and 12-week postoperative time points (-4.8 vs -5.1; $P = .05$).

Failure-to-launch rate, discharge disposition, and 90-day readmissions

Of the 415 patients in the SDD cohort, 43 patients required an overnight stay, resulting in a failure-to-launch rate of 10.4%. With regard to discharge disposition, a higher proportion of SDD patients were discharged home with EPEA only (309 [74.5%] vs 291 [53.1%]; $P < .001$), and a higher proportion of non-SDD patients were discharged to skilled nursing facilities or acute rehabilitation facilities (0 [0.0%] vs 17 [3.1%]; $P < .001$). The SDD cohort had significantly fewer 90-day readmissions than the non-SDD cohort (4/415 [1%] vs 20/548 [3.7%]; $P = .01$) (Table 2). The inpatient cohort had a mean LOS of 1.18 ± 0.63 days.

Discussion

Primary joint replacement with SDD has been shown to be associated with substantial cost reduction and high patient

Table 3
Multivariable regression—HOOS, JR.; VR-12 PCS; VR-12 MCS.

Variable	HOOS, JR		VR-12 PCS		VR-12 MCS	
	β (95% CI)	P-value	β (95% CI)	P-value	β (95% CI)	P-value
Time point						
Preoperative	1.00	—	1.00	—	1.00	—
12 weeks	34.21 (32.29, 36.14)	c	14.77 (13.84, 15.70)	c	5.99 (4.94, 7.03)	c
1 year	42.83 (40.40, 45.26)	c	17.09 (15.95, 18.23)	c	6.07 (4.77, 7.36)	c
Protocol						
Non-SDD	1.00	—	1.00	—	1.00	—
SDD	3.35 (1.05, 5.64)	b	2.40 (1.23, 3.57)	c	3.11 (1.56, 4.65)	c
Protocol# time point						
SDD #12 weeks	−1.49 (−4.42, 1.43)		−0.32 (−1.74, 1.09)		−1.77 (−3.37, −0.17)	a
SDD #1 year	1.11 (−2.69, 4.90)		0.68 (−1.06, 2.42)		−1.86 (−3.84, 0.12)	
Sex						
Male	1.00	—	1.00	—	1.00	—
Female	−2.93 (−4.72, −1.14)	c	−2.26 (−3.18, −1.33)	c	−2.13 (−3.44, −0.83)	c
BMI						
Normal (<25)	1.00	—	1.00	—	1.00	—
Overweight (25-29.9)	−2.05 (−4.08, −0.01)	a	−1.44 (−2.49, −0.40)	b	−0.82 (−2.29, 0.66)	.277
Obese (≥30)	−4.87 (−7.19, −2.54)	c	−3.82 (−5.01, −2.62)	c	−1.85 (−3.54, −0.16)	a
Race						
White	1.00	—	1.00	—	1.00	—
Non-white	1.52 (−2.40, 5.43)		1.48 (−0.55, 3.52)		0.02 (−2.86, 2.90)	.991
Smoking Status						
Never smoker	1.00	—	1.00	—	1.00	—
Current smoker	−0.74 (−4.99, 3.52)		−1.55 (−3.72, 0.63)		−2.57 (−5.61, 0.48)	.099
Former smoker	−1.07 (−2.81, 0.67)		0.24 (−0.65, 1.13)		0.22 (−1.04, 1.48)	.727
ASA						
1, 2	1.00	—	1.00	—	1.00	—
3, 4	−1.73 (−3.91, 0.45)		−0.86 (−1.99, 0.26)		−2.20 (−3.79, −0.60)	b
Age						
≤59 y	1.00	—	1.00	—	1.00	—
60-64 y	1.77 (−0.84, 4.39)		−0.10 (−1.45, 1.25)		0.77 (−1.13, 2.66)	
65-69 y	2.56 (0.13, 4.99)	a	−0.11 (−1.36, 1.14)		1.63 (−0.13, 3.40)	
70 + y	4.30 (2.01, 6.59)	c	−0.09 (−1.27, 1.09)		0.87 (−0.79, 2.53)	

CI, confidence interval.
  [a] $P < .05$.
  [b] $P < .01$.
  [c] $P < .001$.

satisfaction. However, there are few studies directly comparing outcomes in patients undergoing THA with SDD as opposed to traditional inpatient THA. In the present study, we investigated the impact of an SDD protocol on PROs administered via an EPEA at preoperative (1 week) and postoperative (12 weeks and 1 year) time points.

As reimbursement for TJA becomes increasingly value-based and centered around pay for performance, the Centers for Medicare and Medicare Services has mandated that hospitals meet a minimum composite quality score to collect savings earned by outperforming episode target prices [18]. Because PRO data directly influence the composite quality score, it has become crucially important for healthcare institutions to gain a nuanced understanding of the factors that influence these scores. To our knowledge, this is the first study to examine PRO scores of an SDD cohort and compare them against those of a traditional inpatient THA cohort. The results demonstrate that carefully selected patients in a mature outpatient arthroplasty program may experience similar early functional gains, as indicated by similar PRO score improvements from baseline. A multivariable regression analysis revealed that patients in the SDD protocol, on average, were more likely to have higher scores at any given time point. This may be due to SDD patients being healthier at baseline, as evidenced by lower ASA scores and having met the criteria required to qualify as a surgical candidate. However, both the unadjusted and adjusted analyses largely revealed that improvements over time, regardless of the baseline score, were equal between groups. Some minor differences were noted, namely that the SDD cohort had a significantly greater change between preoperative and 12-week VR-12 PCSs than the non-SDD cohort in the unadjusted analysis and that SDD patients had lower 12-week VR-12 MCSs in the adjusted analysis. However, these differences likely have little clinical significance as both are less than the MCID for their respective PRO instruments.

In addition, the SDD cohort was found to use approximately half of the amount of opioids used by the non-SDD cohort per day. This result may have been expected, given that patients in the SDD cohort had hospital stays shorter than one full day. Despite this, both cohorts experienced clinically equal reductions in pain scores between the preoperative and 12-week time points. Patients undergoing SDD may therefore receive less opioids after TJA but experience clinically similar long-term reductions in pain. Our institution has instituted a multimodal analgesia protocol designed to avoid the unnecessary exposure of opioid-naïve THA patients to the addictive potential and side effects of narcotic medications for postoperative pain management. This protocol takes advantage of multiple medications, including nonsteroidal anti-inflammatory drugs (NSAIDs), selective cyclooxygenase-2 (COX-2) inhibitors, acetaminophen, and glucocorticoids, that exert their mechanisms of action on different targets of the pain pathway. Intraoperative intravenous acetaminophen and a periarticular cocktail injection containing liposomal bupivacaine have been demonstrated to result in a reduced need for postoperative opioids and fewer postoperative complications after TJA [19-29]. Postoperatively and on discharge, a standing dose of 1 g of oral acetaminophen every 6-8 hours was used for preemptive analgesia. Oral meloxicam was also used once daily beginning on POD 2. Oral tramadol was only to be used for breakthrough pain in either the hospital or postdischarge settings. Our institutional opioid-sparing protocol was found to significantly reduce the amount of opioids used and provide equivalent pain management and improvements in PROs during the 90-day THA episode of care relative to a traditional opioid-based regimen [30].

The SDD cohort also had significantly fewer readmissions than the non-SDD cohort. These findings support the results of previous studies also demonstrating low rates of complications and readmissions in an outpatient arthroplasty population, helping to further mitigate early concerns regarding the safety of SDD. A systematic review of all publications on outpatient arthroplasty from 2000 to 2016 was performed by Hoffman et al [10] and was composed of 10 studies with a total of 1009 patients. All of the described institutional protocols required patients to undergo extensive preoperative counseling regarding the surgery, and the majority specifically required patients to meet with a physical therapist preoperatively, as in our protocol. All pain management protocols used opioid medications for immediate postoperative pain management and after discharge. Rates of postoperative complications were low; overall, it was found that 94.7% of patients were discharged as planned on the day of surgery, 2% visited the ED and/or were readmitted within 90 days, and an additional 2% required a reoperation of any kind. Two of the included studies directly compared outcomes with an inpatient TJA cohort, both of which found no difference in complication rates, functional scores, range of motion, and VAS pain scores between groups at the latest follow-up [31,32]. It was concluded that SDD may be a safe and effective procedure for carefully selected patients, with experienced surgeons in major centers.

Although SDD saves considerably on hospital costs, a substantial percentage (nearly 40% by some estimates) of the expenditures associated with TJA may be accounted for by postdischarge and rehabilitation costs. At our institution, we have had success with an EPEA that facilitates home rehabilitation by providing patients with physical therapy exercise and education videos and allows for messaging with clinic providers. A study was previously published analyzing PRO scores in 268 THA recipients who were assigned to receive either the EPEA with home health services or the EPEA alone, and the results showed that scores and complication rates were similar between both cohorts [33]. The use of the EPEA alone resulted in an estimated savings of approximately $4200 USD per episode of care, equating to more than $400,000 USD total in savings over the study duration.

This study is not without limitations. There may be inherent biases that have arisen owing to the single-site, single-surgeon, and retrospective nature of this study. Furthermore, the failure-to-launch rate for SDD patients in this study was 10.4%, which represents an improvement over rates in the early years of our SDD program but is nonetheless not insignificant [9]. Pain, nausea, and hypotension have been cited as the most common reasons for a longer-than-expected hospital stay in an outpatient arthroplasty population [10]. These conditions are anticipated and prophylactically treated against in our perioperative medication regimen, but greater vigilance may be required to identify at-risk patients. Interest in SDD must be tempered by the knowledge that a consensus on ideal patient selection criteria has not yet been reached, although several attempts to identify patients at risk of postoperative complications and readmission have been made [34-36]. In addition, outpatient opioid consumption relied on self-reporting, which may be subject to biases and inaccuracies. Despite these limitations, these results are valuable and encouraging, especially for healthcare institutions tasked with exploring methods of cost reduction to remain profitable under alternative payment models.

Conclusions

The experience at our institution adds to a growing body of literature that the use of an institutional SDD TJA care pathway can produce results with equivalent or better short-term outcomes than that of traditional inpatient THA. However, success is dependent on a number of factors: multidisciplinary care team coordination, standardized perioperative protocols, discharge planning,

and careful patient selection. This requires a significant investment of time and institutional resources over the course of several years. Future, larger studies are needed, but these results support the notion that outpatient arthroplasty is feasible and effective.

Conflict of interest

The authors declare there are no conflicts of interest.

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