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How Do Preoperative Medications Influence Outcomes After Total Joint Arthroplasty?



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ABSTRACT

Background: Recent health care policy changes require hospitals and physicians to demonstrate improved quality. In 2012, a prospective database was formed with the Blue Cross and Blue Shield of Michigan to improve quality of care. The purpose of this study was to analyze patient preoperative medication as predictors of outcomes after total joint arthroplasty.

Methods: Data were collected on patient's preoperative medications from 2012 to 2015 using a total joint arthroplasty database. Medications were categorized as antiplatelet, antimicrobial, anticoagulant, narcotic, steroid, insulin, or oral diabetes medication. Outcomes included hospital length of stay (LOS), discharge disposition/destination, and 90-day readmission. Univariate and multivariate regression analyses were performed.

Results: A total of 3959 patients were studied. Eighty percent (3163 patients) were discharged home. The remainder (795) went to an extended-care facility (ECF). Patients discharged to an ECF were taking more medications (1.13 vs 0.80 in total knee arthroplasty; 1.18 vs 0.83 in total hip arthroplasty; $P < .001$). Patients who were readmitted took more medications (1.0 vs 0.85; $P < .01$). There were more discharges to an ECF in narcotic, steroid, and diabetes medication users. Patients taking anticoagulants, narcotics, insulin, and antiplatelets had greater readmission rates. There was a significant correlation between the number of medications and an increased LOS.

Conclusion: Patients taking more medications were more frequently discharged to an ECF and had increased LOS and readmission rates. Narcotics and diabetic medications had the greatest influence. Category and quantity of preoperative medications can be used as predictors of outcomes after arthroplasty surgery.

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Total joint arthroplasty (TJA) is a safe and effective treatment for patients with debilitating arthritis [1–4]. As the US population grows older, the annual demand for TJA will increase. By 2030, it is predicted that over 3.4 million total knee arthroplasties (TKAs) will be performed each year [5]. The majority of these patients are

elderly. They often have several comorbidities requiring a variety of daily medications [1]. Managing complicated medical histories in the setting of an elective procedure creates additional challenges when caring for the arthroplasty patient. Recent changes to reimbursement models have placed increased pressure on surgeons and

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hospital systems to improve quality in the delivery of health care resources [6–9]. It has become increasingly important to identify patient parameters that require a higher level of care and/or resources [10–12]. Previous studies have looked at patient demographics and comorbidities to predict patient outcomes after arthroplasty surgery [6,13–15]. Although these have proven to be useful, additional insight is needed to effectively determine predictors of patient outcomes. In 2012, a group of Michigan hospital systems as well as a major insurance company came together to form the Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI). This initiative enabled hospitals to gather data for a quality-based total joint registry. This study utilized one of the participating hospital's data collection to evaluate preoperative medications as a predictor of patient outcomes. All data were collected prospectively by orthopedic nurses specifically trained to be data abstractors. The purpose of this study was to analyze preoperative medication quantity and category as predictors of outcomes after TJA. We hypothesized that an increased number of preoperative medications would lead to less-favorable outcomes after TJA.

Methods

After institutional review board approval, MARCQI data specific to our hospitals (2) were retrieved. The data extracted were from all elective primary TJA patients who underwent surgery from 2012 through 2015. Patients were excluded if they had revision surgery, TJA for a fracture, or had <90-day follow-up. In addition to patient demographics, data were collected on patient's preoperative medications. Preoperative medication was defined as any medication that the patient was taking within 30 days before surgery. Medications were categorized as antiplatelet, antimicrobial, anticoagulation, narcotic, steroid, insulin, and oral diabetes medications. Dose and frequency were not recorded. Outcome measures included hospital length of stay (LOS), discharge destination (home/extended-care facility [ECF]), and 90-day readmission to our hospital system.

All patients were admitted to the hospital on the day of surgery after undergoing the primary TJA. Postoperatively, each patient underwent a standardized hospital pathway protocol for pain control, deep venous thrombosis prophylaxis, physical therapy, and discharge planning. All patients were provided preoperative information about the hospital stay and expectations for discharge. They were encouraged to attend a preoperative total joint class (attendance exceeds 95%), and were seen preoperatively for medical clearance and presurgical testing.

Statistical Analysis

The primary variables of this study were the total number of preoperative medications and the categories of medication taken by patients. Data were interpreted using a Student 2-way *t* test for univariate analysis. Multivariate logistic regression analysis was used to identify individual medications as predictors of readmission and discharge destination. A linear regression model was used to correlate LOS and number of medications. Results were verified using SPSS statistical analysis software, version 22.0 (IBM Corporation, Armonk, NY). A *P* value of <.05 was considered statistically significant. Comparisons were made separately for TKA and THA populations.

Results

A total of 3959 patients fit our inclusion criteria (2741 TKAs and 1218 THAs). There were 2538 female and 1421 male patients.

Table 1
Demographics.

Demographics	Total Hip Arthroplasty	Total Knee Arthroplasty
Patients, n (%)	1218 (31)	2741 (69)
Age, mean (SD), y	65.57 (11.52)	66.91 (10.01)
Gender, female:male, n (%)	701 (58):517 (42)	1837 (67):904 (33)
Body mass index, mean (SD), kg/m ²	30.34 (6.25)	33.22 (7.23)
Length of stay, mean (SD), d	2.35 (1.28)	2.35 (1.75)
Discharge, home:ECF, n (%)	944 (78):274 (22)	2219 (81):521 (19)
90 Day readmissions, n (%)	68 (6)	138 (5)
Total preoperative medications, mean (SD)	0.91 (0.79)	0.86 (0.78)

ECF, extended-care facility; SD, standard deviation.

The average age of our patients was 66 years, and average LOS after arthroplasty was 2.34 days. Eighty percent (3162) of patients were discharge home after surgery, whereas the remainder went to an ECF. The average number of preoperative medications per patient was 0.88 (Table 1).

Table 2 shows the number and percent of patients taking each category of medication for THA and TKA. The most common medication used were antiplatelet drugs. Forty-two percent of THA patients and 44 percent of TKA patients were on an antiplatelet drug. Twenty-four percent of all patients were taking a narcotic preoperatively. Thirty-three percent of THA patients and 37 percent of the TKA patients were not on any preoperative medications.

TKA patients discharged to an ECF were taking significantly more medications (1.13 vs 0.80; *P* < .0001). The same relationship was true of THA patients (1.18 vs 0.83; *P* < .001; Table 3). THA patients taking antiplatelet drugs, narcotics, insulin, and oral diabetes medications were all discharged to an ECF at a higher rate than those who were not taking these medications. Similarly, TKA patients taking the same medications preoperatively, in addition to anticoagulants and steroids, also showed a greater chance of discharge to an ECF (Table 4). Antimicrobial use was not significant in either patient population. THA patients taking an antiplatelet had the highest rate of readmission, whereas TKA patients taking anticoagulants, narcotics, or insulin had the greatest rates of readmission (Table 5). Linear regression showed a significant correlation between the number of preoperative medications and an increased LOS in both the THA and TKA populations (Fig. 1). When readmitted, THA patients averaged 1.15 medications, whereas those without a readmission averaged 0.95 (*P* = .01). When readmitted, TKA patients averaged 1.02 medications, whereas those without a readmission averaged 0.85 (*P* = .01).

Discussion

TJA patients present unique challenges to the health care system. Since the care is very episodic, it has come under much scrutiny relative to cost and quality of care measures. The patients,

Table 2
Medication Usage Profile Among THA and TKA Patients.

Medication Classification	THA	TKA
Anticoagulant, patients (%)	49 (4.02)	138 (5.03)
Antimicrobial, patients (%)	39 (3.20)	69 (2.52)
Antiplatelet, patients (%)	512 (42.03)	1210 (44.14)
Narcotic, patients (%)	383 (31.44)	575 (20.98)
Steroid, patients (%)	37 (3.03)	66 (2.41)
Insulin, patients (%)	20 (1.64)	72 (2.63)
Oral diabetic medication, patients (%)	71 (5.83)	226 (8.25)
No preoperative medications, patients (%)	405 (33.25)	1037 (37.83)

THA, total hip arthroplasty; TKA, total knee arthroplasty.

Table 3

Average Total Preoperative Medication Usage vs Discharge Destination and 90-d Readmission for Both THA and TKA.

Procedure	DC to ECF		P Value	Readmission	No Readmission	P Value
	DC to Home	Home				
THA	1.19	0.83	<.001 ^a	1.15	0.90	.01 ^a
TKA	1.13	0.80	<.001 ^a	1.02	0.85	.01 ^a

ECF, extended-care facility; THA, total hip arthroplasty; TKA, total knee arthroplasty; DC, discharge.

^a Indicates significant finding.

who are often elderly, require an array of health care resources throughout their perioperative period. Furthermore, it is well-recognized among practitioners and researchers that not all arthroplasty patients are equal [16]. Some patients present unique challenges and complications while others do not. It would be quite valuable to the system to have an ability to predict which patients may present challenges or be at a higher risk for complications. As we move into the era of bundled reimbursement, it has become requisite to create systems to predict outcomes based on preoperative parameters [10,17–20]. In 2012, our prospective total joint registry database (MARCQI) was formed with Blue Cross Blue Shield of Michigan to improve quality of care within the state. The hope was that by identifying patterns of care and linking them with outcomes, we could change behavior among providers and achieve quality commonality across multiple hospital systems [15,21]. Herein, the database allowed us to identify which types of preoperative medication were associated with discharge to an ECF or a 90-day hospital readmission. In addition, we were able to use the total number of medications a patient is taking as a predictor of hospital LOS. With this information, we hope to project arthroplasty patient outcomes before their admission. We can hope to better counsel patients on expectations in regard to these parameters after their procedure [21,22].

Our study has several important findings. First, we demonstrated that the total number of preoperative medications negatively influenced discharge destination, LOS, and 90-day readmission rate. As the total number of medications increased, the probability of discharge to an ECF rises, as does readmission rate and LOS (Figs. 1 and 2). Clinically, this makes sense. We expect that patients taking more medications have more medical comorbidities and require a higher level of care. When we looked at the categories of medications, there were many significant findings as well. Antiplatelets were the most common medication used among our patients. This includes aspirin which is often used for cardiovascular protection in healthy individuals. Narcotics, antiplatelets, anticoagulants, steroids, and diabetic medications all negatively influenced outcomes. Narcotics and diabetic medications stood out as having the greatest overall influence. This finding is consistent

Table 4

Logistic Regression Models Comparing Categories of Preoperative Medication Use and Discharge to an Extended-Care Facility in THA and TKA.

Medication	THA			TKA		
	Odds Ratio	95% CI	P Value	Odds Ratio	95% CI	P Value
Anticoagulant	0.97	0.49-1.91	.918	1.35	0.90-2.02	.152
Antimicrobial	1.67	0.76-3.68	.205	1.47	0.78-2.74	.231
Antiplatelet	0.91	0.66-1.25	.543	1.07	0.86-1.33	.552
Narcotic	2.4	1.72-3.34	<.0001 ^a	2.20	1.7-2.86	<.0001 ^a
Steroid	0.95	0.40-2.26	.907	2.59	1.4-4.70	.002 ^a
Insulin	1.89	0.67-5.33	.228	4.02	2.23-7.23	<.0001 ^a
Oral diabetic medication	1.13	1.12-3.60	.019 ^a	1.54	1.07-2.20	.019 ^a

CI, confidence interval; THA, total hip arthroplasty; TKA, total knee arthroplasty.

^a Indicates significant finding.

Table 5

Logistic Regression Models Comparing Categories of Preoperative Medication Use and 90-d Readmission in THA and TKA.

Medication	THA			TKA		
	Odds Ratio	95% CI	P Value	Odds Ratio	95% CI	P Value
Anticoagulant	1.936	0.72-5.21	.191	2.041	1.15-3.63	.015 ^a
Antimicrobial	0.00	0.00-0.00	.998	0.595	0.14-2.47	.474
Antiplatelet	2.225	1.29-3.85	.004 ^a	0.880	0.61-1.26	.486
Narcotic	0.945	0.53-1.66	.845	1.583	1.06-2.36	.024 ^a
Steroid	0.889	0.20-3.94	.877	1.497	0.59-3.83	.400
Insulin	0.475	0.06-3.82	.485	2.353	1.05-5.27	.037 ^a
Oral diabetic medication	1.792	0.76-4.21	.181	0.976	0.52-1.82	.938

CI, confidence interval; THA, total hip arthroplasty; TKA, total knee arthroplasty.

^a Indicates significant finding.

with our previous study showing less-favorable outcomes after arthroplasty in chronic opiate users [22].

Previous researchers have looked at patient demographics and comorbidities as predictors of outcomes after arthroplasty [6,13–15]. Although these metrics are helpful, there are limitations. For example, having a diagnosis of diabetes does not provide insight into the severity of one's disease process. There can be a vast difference in treatment depending on the stage of one's comorbidity. By looking at medications directly, we gain additional insight into a patient's disease state and treatment. Dietrich et al [23] designed a study to correlate prehospital medications to a poor outcome after THA. They concluded that both the number and the type of medications could be used to predict outcomes. Specifically, the risk of an extended hospital LOS beyond 7 days increased by a factor of 1.15 with each additional medication. Platelet inhibitors and oral anticoagulants were found to increase the risk for an early morbidity. Similarly, Olthof et al [24] studied LOS after THA and found that medication count was a better predictor of LOS than the American Society of Anesthesiologists score. Ben-Ari et al [25] evaluated long-term opiate use within the Veterans Affairs system and found that this was an independent risk factor for early revision surgery after TKA. Our study supports these previous claims that both quantity and category of preoperative medications can be used to predict outcomes after arthroplasty. We demonstrated a higher probability of discharge to an ECF with each additional medication (Fig. 2). We also found that readmission rate and LOS were influenced by the quantity of preoperative medications.

Recent literature has shown that discharge to an ECF after arthroplasty is associated with a poorer outcome compared with those discharged home [26]. Furthermore, ECFs represent an additional cost associated with treatment. One of the goals of any

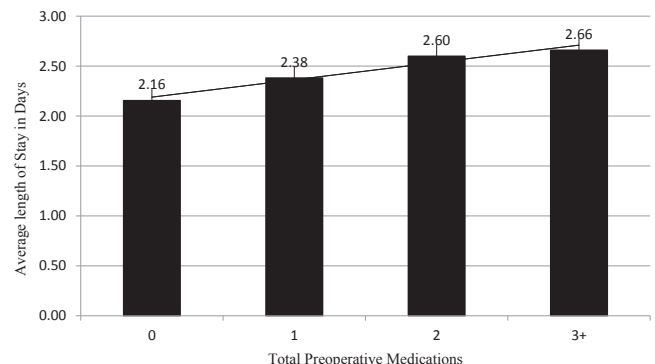


Fig. 1. Total number of preoperative medications and hospital length of stay after TJA.

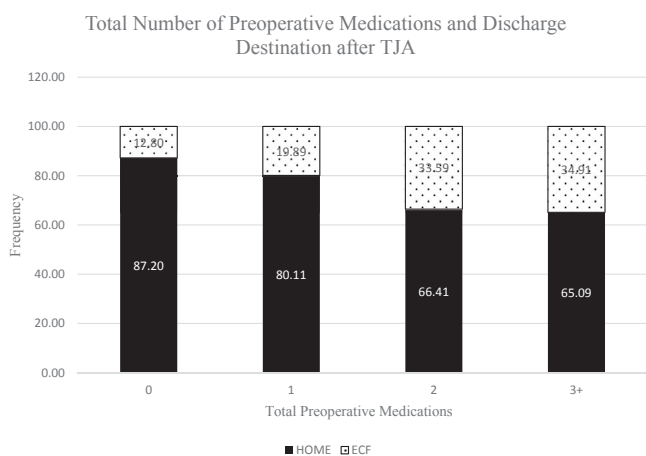


Fig. 2. Probability of discharge to extended-care facility (ECF) or home vs total number of preoperative medications. TJA, total joint arthroplasty.

arthroplasty surgery should be to provide patients an improved level of independence as quickly as possible. Discharge to an ECF has been shown to be associated with age, race, insurance, and comorbidities [11]. Our study is the first to link preoperative medications to discharge destination.

Our study has several limitations. First, we are limited by the inherent design of a database analysis. The medications included in our study were only the ones recorded by our orthopedic data extractors as defined by the MARCQI protocols. It is quite possible that patients were taking additional medications that were not included within our defined categories. As a result, we are likely underestimating the total number of preoperative medications. In addition, we did not include dose or frequency of medication use. Those variables may influence outcomes as well. Finally, our data represent outcomes at 2 hospitals. Although, we have a diverse patient population, our outcomes may differ from other regions and hospital systems. Despite these limitations, these data provide a useful framework for physicians and health care networks to risk stratify patients. Additional research is needed to develop better predictive tools. It is our hope to expand the data collection to include all the MARCQI hospitals which would capture 95% of all arthroplasty cases performed within our state.

Conclusions

THA and TKA patients taking a greater number of preoperative medications were discharged to an ECF more frequently. They showed an increased LOS and 90-day readmission rate. Narcotics and diabetic medications had the greatest influence. Quantity and category of preoperative medications can be used as predictors of outcome after arthroplasty surgery.

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