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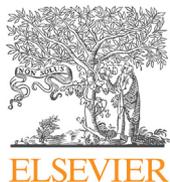Luke D. Wesemann

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Comparison of Area Deprivation Index, Socioeconomic Parameters, and Preoperative Demographics With Postoperative Emergency Department Visits After Total Knee Arthroplasty

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ABSTRACT

Background: This study aims to determine if socioeconomic (SE) parameters, primarily area deprivation index (ADI), relate to postoperative emergency department (ED) visits after total knee arthroplasty (TKA).
Methods: We retrospectively reviewed 2655 patients who underwent TKA in a health system of 4 hospitals. The primary outcome was an ED visit within 90 days, which was divided into those with and without readmission. SE parameters including ADI as well as preoperative demographics were analyzed. Univariable and multiple logistic regressions were performed determining risk of 90-day postoperative ED visits, as well as once in the ED, risks for readmission.
Results: 436 patients (16.4%) presented to the ED within 90 days. ADI was not a risk factor. The multiple logistic regression demonstrated men, Medicare or Medicaid, and preoperative ED visits were consistently risk factors for a postoperative ED visit with and without readmission. Preoperative anti-coagulation was only a risk factor for ED visits with readmission. Among patients who visited the ED, if the patient was Caucasian, a lower BMI, or higher American Society of Anesthesiologists score, they were likely to be readmitted.
Conclusion: The study demonstrated that the percentage of early ED returns after TKA was high and that ADI was not a predictor for 90-day postoperative ED visit. The only SE factor that may contribute to this phenomenon was insurance type. Once in the ED, race, preoperative ED visits, preoperative anti-coagulation, BMI, gender, and preoperative American Society of Anesthesiologists score contributed to a risk of readmission. The study supports hospitals' mission to provide equal access health care.

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Total knee arthroplasty (TKA) is the most common and effective treatment to reduce pain and improve functionality after failed conservative management for osteoarthritis [1]. The topic of improving care surrounding this procedure has significant financial and sociologic implications. The importance of value-based practice has become a priority for all health care-providers [2]. The Comprehensive Care for Joint Replacement (CJR) model by the Centers for Medicare and Medicaid Services, has driven value-based care to advance the goals of improving the cost efficiency and quality of care for joint replacement surgery and surrounding care from the initial hospitalization through recovery [3]. The CJR model tracks various performance measures related to both TKA and total hip arthroplasty, which begins on the day of admission and ends 90 days after discharge. Depending on whether these set target measures are met by an institution, there can be financial incentives or penalties to both hospitals and providers alike. The performance measures in the CJR model include postoperative care at the emergency department (ED), among other socioeconomic variables.

Unnecessary ED visits (ED visits without readmission) can be particularly burdensome on the overall cost of care for TKA. Specifically regarding postoperative care after TKA, the ED has been overused for complaints that may otherwise be managed as effectively and more cost efficiently in outpatient settings [4]. Because of

this burden of cost, considerable research has been performed to determine factors that do and do not correlate to a return ED visit [5–9].

Besides a patient's medical history, socioeconomic factors may play a role in postoperative ED visits. The area deprivation index (ADI) is a neighborhood-based composite measure used to quantify an individual's socioeconomic risk based on home location [10]. There is significant predictive power of the ADI for hospital readmission. Patients residing in more disadvantaged neighborhoods had significantly higher 30-day readmission risks even after accounting for individual-level factors [11], and about 20% of the variance on Centers for Medicare and Medicaid Services "Star" ratings for hospitals could be explained by a set of city-level characteristics such as poverty, employment, and crime [12]. The discovery of associations with the overall cost of care for TKA will open the door to various interventions, programs, and further understanding on both sides.

To date, no study has evaluated the predictive power of ADI on early postoperative ED visits after TKA. There has also been very limited literature that investigated other socioeconomic parameters as a preoperative risk factor for postoperative ED visits after a TKA [10]. The primary aim of this study is to determine if ADI relates to postoperative ED visits after TKA.

Materials and Methods

We performed a retrospective cohort analysis of 2655 patients who underwent primary TKA by 12 surgeons in a health system of 4 hospitals from January 2014 to May 2018. Inclusion criteria consisted of primary TKA performed at Henry Ford Health System throughout the study period. The study excluded partial TKA, arthroplasty due to a traumatic event, total joint revision arthroplasty, and patients who underwent multiple joint replacements within the selected period.

After institutional review board approval, data were standardized and collected by the study institution for inclusion in the Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI). Through MARCQI, the patient demographics collected in the chart review included age, sex, body mass index (BMI), and preoperative American Society of Anesthesiologists' score (ASA). The primary outcome, an ED visit within 90 days, was aquired through MARCQI. ED visits were divided into those with and without readmission. The reason for a postoperative ED visit without or with readmission was collected via chart review performed by the authors. Regarding the patient-level socioeconomic parameters, the data are from a hospital-validated readmission table (Epic clarity table) created by an analytic team. They collected the socioeconomic parameters based on some flowsheet row information. The same health care system department aquired patient ADI and insurance type as a quality initiative.

During this period, the joint reconstruction groups at each of the 4 hospitals have similar, if not the same, preoperative and postoperative reconstruction protocols. Postoperatively, patients received 24 hours of antibiotic prophylaxis and were mobilized with physical therapy on postoperative day 0-1. Patients received postoperative venous thromboembolism prophylaxis per hospital protocol. The pain regimen after TKA included multimodal medications which consisted of oral acetaminophen, an anti-inflammatory, a muscle relaxer, and a narcotic.

Because ADI was a value provided by a separate database grounded on a patient's zip code, an initial analysis was performed to verify the cohort's socioeconomic demographics correlate to their ADI value, which was an important verification in a rapidly developing metropolitan area. Univariable analysis was used to interpret risk factors for ED visits within 90-day of the TKA. This

Table 1

List of Reasons for 90-D Postoperative ED Visits Resulting With or Without Readmission.

Emergency Department Visit With Readmission		
Diagnosis	N	Percentage (%)
General, other[a]	18	15.52
Sepsis, unknown source	16	13.79
GI bleed	13	11.21
Cellulitis	10	8.62
Pneumonia	9	7.76
Acute PJI	9	7.76
Cardiovascular	9	7.76
DVT	7	6.03
Anemia	6	5.17
GU, general	5	4.31
Chronic disease	5	4.31
PE	3	2.59
Syncope	2	1.72
Trauma	2	1.72
Wound complication	2	1.72
Total		116

Emergency Department Visit Without Readmission		
Diagnosis	N	Percentage (%)
Postoperative pain	106	33.13
General, other[b]	74	23.13
GI, general	30	9.38
Fall without LOC	26	8.13
Cellulitis	24	7.50
GU, general	19	5.94
Chronic disease	18	5.63
PONV	11	3.44
Wound complication	9	2.81
Trauma	3	0.94
Total		320

GI, gastrointestinal; PJI, prosthetic joint infection; DVT, deep venous thrombosis; GU, genitourinary; PE, pulmonary embolism; LOC, loss of consciousness; PONV, postoperative nausea and vomiting.

[a] "General, Other" includes dyspnea; upper respiratory tract infection; orthostatic hypotension; palpitations; chest pain, unspecified; headache; vertigo; intractable migraine; toe fracture; urticaria; rash; nonsurgical extremity pain; lymphedema; corneal abrasion; drug overdose; numbness & tingling; hypertensive urgency; sexual assault; angioedema; disfunction; allergic reaction; superficial thrombophlebitis; sinusitis; back pain.

[b] "General, Other" includes dizziness; gallstones; chest pain, unspecified; pulmonary disease, unspecified; dysphagia; mental status change; clonic muscle twitch; hemarthrosis; thyroid disease; cholecystitis; spine compression fracture; gastroenteritis; hypoxia; diverticulitis; rhabdomyolysis; hyperkalemia, chronic disease; myasthenia gravis crisis; small bowel obstruction.

was followed by a multiple logistic regression utilizing the results of the univariable analysis to compare ED visits postoperatively with the patients without an ED visit. Several subgroup analyses utilizing multiple logistic regression models to predict risky health and socioeconomic demographics of: (1) patients who visited the ED without readmission to the general cohort, (2) patients who visited the ED with readmission to the general cohort, and (3) patients who visited the ED with readmission to patients who visited the ED without readmission. Note for the first subgroup analysis the patients who visited the ED with a readmission were excluded because the authors want to compare this with a population without an ED visit.

Statistical Analysis

In comparing ADI with socioeconomic parameters, the authors used a one-way ANOVA on ranks and post hoc Dunn's test on multiple categorical variables, a Spearman rank-sum correlation on income, and a Mann-Whitney rank sum test for categorical variables. In regards to comparing socioeconomic and health

Table 2
Initial Analysis, Comparing Socioeconomic Parameters as Correlates of ADI.

Parameter	Class	N	ADI for the Class Median [IQR]	P-Value	Interpretation
Race[a]	Caucasian	1858	53 [34-71]	<.001	African-Americans and Hispanic Americans had significantly higher ADI scores than did whites and others
	African-American	592	83 [59-93.8]		
	Hispanic	18	84 [64.8-92.2]		
	Other	187	49 [27-74]		
Language[a,d]	English	2555	59 [36-79]	.377	No demonstrable effect of language on ADI
	Other European	21	72 [27-91]		
	South/SW Asian	25	61 [44.5-85.5]		
	Other/Decline/Do Not known	54	62.5 [42.8-84.5]		
Drug use[b]	Yes	31	86 [54-79]	<.001	Drug use associated with higher ADI
	No	2624	59 [36-79]		
Lives alone[b]	Yes	591	69 [48-85]	<.001	Living alone associated with higher ADI
	No	2064	55 [34-76]		
Depression[b]	Yes	285	61 [38.5-81]	.235	No demonstrable link between depression and ADI
	No	2370	59 [35-79]		
Medicaid/Medicare[b]	Yes	1718	61 [37-82]	<.001	Medicare/Medicaid associated with higher ADI
	No	937	54 [34-74]		
Dual insurance eligibility[b]	Yes	144	84 [59-95]	<.001	Dual insurance eligibility associated with higher ADI
	No	2511	58 [35-78]		
Income[c]	Correlation Coefficient	2655	−0.722	<.001	There is a negative correlation between income and ADI

ADI, area deprivation index; SW, Southwest.
[a] Statistical method was one-way ANOVA on ranks, post hoc Dunn's test.
[b] Statistical method was Mann-Whitney rank sum test.
[c] Statistical method was Spearman rank-sum correlation.
[d] Language: •"Other European" includes Albanian (3), ASL (5), Italian (2), Macedonian (1), Spanish (6), Polish (2), Russian (2). •"South/SW Asian" includes Arabic (14), Chaldean (2), Farsi (1), Gujarati (2), Hindi (4), Urdu (1) •"Other/Decline/Do Not Know" includes Chinese (1), Vietnamese (1).

demographic tables with the outcome of 90-day ED visits, the authors used a Mann-Whitney rank sum test for continuous variables and a chi-square analysis for categorical data. The authors performed a multiple logistic regression model utilizing core input variables that are commonly thought to be risk factors in orthopedic's outcomes research as well as input parameters determined by the univariable analysis to be potential risk factors for a 90-d postoperative ED visit. This analysis was ran as a backward stepwise logistic regression. The study used an alpha of 0.05 for main effects, 0.10 for interactions, and 0.05 for post hoc tests (Fisher's least significant difference tests). All analyses used SAS 9.4 (SAS Institute Inc, Cary, NC) and SigmaPlot 12.3 (Systat Software, San Jose, CA).

Results

A total of 3051 participants underwent knee arthroplasty during the study period. 87% met inclusion and exclusion criteria leaving 2655 patients. 436 (16.4%) patients presented to the ED within 90 days after their primary TKA. Hospitals 1-4 had a percentage of ED visit without readmission of 3.5% (15), 4.2% (23), 3.1% (37), and 7.8% (39), respectively. The hospitals had a percentage of ED visits with readmission of 12.1% (52), 11.4% (62), 11.7% (138), and 14.0% (70), respectively. Table 1 represenst the various reasons for patients' ED visits. Interestingly, postoperative pain stood as the highest (32%) of patients who visited the ED without a readmission. Medicare or Medicaid ($P < .001$) and dual insurance eligible patients ($P < .001$), race (African Americans and Hispanic Americans, $P < .001$), living alone ($P < .001$), and a history of drug use ($P < .001$) had a higher ADI (more economically deprived) within the cohort. ADI was inversely correlated with income ($P < .001$) (Table 2). Univariable analysis of these 436 patients demonstrated several risk factors for 90-day postoperative ED visits, which included older age ($P = .033$), higher preoperative ASA ($P = .015$), preoperative anticoagulation (P

$< .001$), preoperative ED visits within the last 364 days ($P < .001$) or within the last 89 days ($P < .001$), depression ($P < .001$), Medicaid or Medicare ($P < .001$), and dual eligible insurance ($P = .015$) (Table 3).

A multiple logistic regression was performed to further describe demographic risk factors of patients who presented to the ED 90 days postoperatively after a TKA (Table 4). Table 4 demonstrated that men ($P = .005$) and patients who visited the ED preoperatively ($P < .001$ [90 days], $P < .001$ [365 days]) were more likely to visit the ED postoperatively. ADI demonstrated no statistically significant risk for ED visit postoperatively. A socioeconomic parameter that was a risk factor was patients on Medicare or Medicaid ($P = .007$). Depression trended toward a risk factor of postoperative ED visits ($P = .084$).

Several subgroup analyses were performed with the first comparing patients who visited the ED and were not readmitted to the hospital (Table 5). In this population, preoperative ED visits ($P < .001$ [<365], $P < .001$ [<90]) and Medicare or Medicaid ($P = .02$) continued to be a risk factor. Men ($P = .064$) trended toward statistical significance. The second subgroup analysis examined the patients with a 90-day postoperative ED visit, which resulted in a hospital readmission (Table 6). Their demographic risk factors included decreased BMI ($P < .001$), patients on preoperative anticoagulation ($P < .001$), a history of preoperative ED visits ($P < .001$ [<365], $P < .001$ [<90]), and Medicaid or Medicare patients ($P = .004$). Men ($P = .06$) and patients with increased preoperative ASA scores ($P = .09$) trended toward a risk. Finally comparing the patients who had a 90-day ED visit, there were several interesting demographics that were significant risk factors in those who were readmitted compared with those not readmitted (Table 7). Caucasians ($P = .007$) were more likely to be readmitted to hospital compared with other races who also presented to the ED within 90 days. Patients with a lower BMI ($P < .001$) were more likely to be readmitted if they presented to the ED postoperatively. If you visited the ED preoperatively within 90 days of the TKA ($P = .03$) as

Table 3
Analysis of Patients' Health and Socioeconomic Demographics as Predictors of 90-D Postoperative ED Visit.

Parameter	90-d Postoperative ED Visit (N = 436)	No 90-d Postoperative ED Visit (N = 2219)	P-Value	Interpretation
Body mass index (kg/m^2)[a]	32.2 [28.1-37.3]	32.6 [28.7-37.7]	.31	No demonstrable effect of BMI
Age (y)[a]	67 [59-74]	66 [60-72]	.03	Older patients were more likely to have 90-d postoperative ED visits.
Income (US Dollars)[a]	55,598 [44,205-68,099]	54,438 [44,153-66,036]	.26	No demonstrable effect of income
OR time (minutes)[a]	95 [83-112]	96 [81-112]	.54	No demonstrable effect of OR time
ADI (as a continuous variable)[a]	59 [35-80]	59 [36-79]	.58	No demonstrable effect of ADI
Race (Caucasian, African-American, Hispanic, other)[b]	313 (71.7%) 97 (22.2%) 4 (0.9%) 22 (5.0%)	1545 (69.6%) 495 (22.3%) 14 (0.6%) 165 (7.4%)	.30	No demonstrable effect of race
Gender (Female)[b]	249 (57.1%)	1286 (60.0%)	.79	No demonstrable effect of gender
Diabetes[b]	105 (24.1%)	533 (24.0%)	.97	No demonstrable effect of diabetes
Preoperative anticoagulation[b]	45 (10.3%)	127 (5.7%)	<.001	Patients with preoperative anticoagulation therapy are more likely to have a 90-d postoperative ED visit.
Preoperative antiplatelet[b]	158 (36.2%)	841 (37.9%)	.55	No demonstrable effect of preoperative antiplatelet therapy.
Preoperative ED visit within 365 d[b]	382 (87.6%)	800 (36.1%)	<.001	Patients with a preoperative ED visit in the last 365-d were more likely to have a 90-d postoperative ED visit.
Preoperative ED visit within 90 d[b]	200 (45.9%)	333 (15.0%)	<.001	Patients with a preoperative ED visit in the last 90-d were more likely to have a 90-d postoperative ED visit.
Preferred language (English)[b]	423 (97.0%)	2132 (96.3%)	.42	No demonstrable effect of Language.
Drug use[b]	7 (1.6%)	24 (1.1%)	.49	No demonstrable effect of drug use.
Lives alone[b]	98 (22.5%)	493 (22.2%)	.96	No demonstrable effect of living alone.
Depression[b]	70 (16.1%)	215 (9.7%)	<.001	Patients with depression were more likely to have a 90-d postoperative ED visit.
Insurance type (Medicare/Medicaid)[b]	323 (74.1%)	1395 (62.9%)	<.001	Patients on Medicare/Medicaid were more likely to have a 90-d postoperative ED visit.
Dual eligibility[b]	35 (8.0%)	109 (4.9%)	.01	Patients with dual eligibility were more likely to have a 90-d postoperative ED visit.
Preoperative ASA score [as a categorical variable] (1, 2, 3, 4)[b]	1 (0.2%) 141 (32.3%) 282 (64.7%) 113 (2.8%)	34 (1.5%) 840 (37.9%) 1285 (57.9%) 571 (2.7%)	.02	Possible effect of preoperative ASA on 90-d postoperative ED visit[c]

Kg, kilograms; m, meters; US, United States; OR, operative room; ADI, area deprivation index; ED, emergency department; ASA, American Society of Anesthesiology.
  [a] Statistical method was Mann-Whitney rank sum test with values presented as mean [IQR].
  [b] Statistical method was Chi-square analysis.
  [c] Note: Preoperative ASA (categorical) as a predictor of 90-d postoperative ED visits. The overall chi-square analysis (P = .015) suggests that preoperative ASA is indeed a significant predictor of 90-d postoperative ED visits, as does the Mann-Whitney analysis using ASA as a continuous variable (an analysis that makes its decision, P = .007, based on differing variability in the two groups). However, when the Bonferroni correction is used in the chi-square analysis (essentially dividing alpha by the number of comparisons to be made, here a minimum of 3, thus alpha = 0.016), along with a division of comparisons (ASA1 vs ASA2, ASA1 vs ASA3, ASA1 vs ASA4, ASA2 vs ASA3, ASA2 vs ASA4, ASA3 vs ASA4), we find that none of the comparisons yield a P-value less than the modified alpha.

well as had higher preoperative ASA score (p .04), both were significant risk factors for readmission when comparing the patient population who visited the ED postoperatively within 90 days.

Discussion

Disparities among patients are common across a health care system; however, with equal access health care systems, these disparities are expected to not affect patient care [13]. This novel study used a socioeconomic parameter known as ADI to determine if it was a significant risk factor for postoperative ED visit within a 90-day period from a primary TKA. The logistic regression demonstrated that ADI was not a risk for postoperative ED visit and supports the study's hospitals' mission to provide equal access health care.

The primary concern with socioeconomic parameters and their risk for postoperative complications is that many are not reversible before an elective joint arthroplasty such as a patient's modifiable comorbidities. Even so, the hospitals designated to care for patients with socioeconomic disparities have equal consequences for 90-day postoperative outcomes [14,15]. Therefore, the first step to reconcile these hospital differences is to determine and recognize the socioeconomic risk factors to build protocols that may reduce the risk of the complication [14,16]. There was no linear relationship between increasing ADI and risk of ED visits; however, there was another socioeconomic parameter not used in the calculation of ADI that demonstrated a risk factor for an early postoperative ED visit. Most noteably, this study reported that patients with Medicaid or Medicare insurance are at risk for an ED visit within 90 days postoperatively. This compliments Finnegan et al. findings

Table 4
Multiple Logistic Regression Predicting Patients With an ED Visit Within 90 d of Surgery (N = 2655).

Independent Variable	Model 1[a]			Model 2[b]			Interpretation
	Odds Ratio	95% Confidence Interval	*P*-Value	Odds Ratio	95% Confidence Interval	*P*-Value	
Constant	0.04	0.01-0.14	<.001	0.03	0.02-0.04	<.001	The base risk of a 90d postoperative ED visit is less than 1.00.
Body mass index	0.99	0.97-1.01	.16	-	-	-	No demonstrable difference
Age	1	0.98-1.02	.97	-	-	-	No demonstrable difference
Gender	0.74	0.58-0.93	.01	0.72	0.57-0.91	.005	Being male was associated with an increased risk.
Diabetes	0.92	0.70-1.21	.55	-	-	-	No demonstrable difference
Preoperative ASA	1.05	0.84-1.31	.70	-	-	-	No demonstrable difference
Preoperative anticoagulation therapy	1.35	0.90-2.03	.15	-	-	-	No demonstrable difference
Preoperative ED visit within <365 d before surgery	10.05	7.32-13.80	<.001	9.88	7.22-13.53	<.001	A preoperative ED visit within <365d before surgery was associated with an increased risk.
Preoperative ED visit within <90 d before surgery	1.97	1.54-2.52	<.001	2.00	1.57-2.55	<.001	A preoperative ED visit within <90d before surgery was associated with an increased risk.
Depression	1.34	0.97-1.85	.08	1.33	0.96-1.83	.08	Trend: Depression was associated with an increased risk.
Insurance type	1.52	1.12-2.05	.007	1.64	1.27-2.11	.007	Having Medicare/Medicaid was associated with an increased risk.
Dual insurance eligibility	1.32	0.83-2.11	.25	-	-	-	No demonstrable difference
ADI	1.00	0.99-1.01	.73	-	-	-	No demonstrable difference

kg, kilograms; m, meters; ED, emergency department; ASA, American Society of Anesthesiology; ADI, area deprivation index.
 [a] Model 1: All parameters ran in the logistic regression.
 [b] Model 2: All parameters with *P* > .1 were dropped from the analysis, and the analysis rerun.

that both Medicaid and Medicare were increased risk for isolated ED visits after joint reconstruction surgery [17]. Sivasundaram et al. determined Medicaid and Medicare as independent risk factors for 90-day ED visit after a hip arthroscopy [18] and it was also demonstrated after hand surgery [19]. Differentiating between ED visits with and without readmission, this study is unique because both scenarios demonstrated Medicaid or Medicare patients increased risk.

Table 5
Multiple Logistic Regression Predicting Patients With an ED Visit Within 90 D of Surgery Without Readmission (N = 2540).

Independent Variable	Model 1[a]			Model 2[b]			Interpretation
	Odds Ratio	95% Confidence Interval	*P*-Value	Odds Ratio	95% Confidence Interval	*P*-Value	
Constant	0.03	0.01-0.11	<.001	0.02	0.02-0.04	<.001	The base risk of a 90d postoperative ED visit without readmission is less than 1.00.
Body mass index	1.00	0.98-1.02	.86	-	-	-	No demonstrable difference
Age	0.99	0.98-1.02	.90	-	-	-	No demonstrable difference
Gender	0.78	0.60-1.01	.06	0.79	0.61-1.02	.07	Trend: Males had a higher risk.
Diabetes	0.87	0.64-1.18	.36	-	-	-	No demonstrable difference
Preoperative ASA	0.96	0.75-1.22	.74	-	-	-	No demonstrable difference
Preoperative anticoagulation therapy	0.97	0.59-1.60	.91	-	-	-	No demonstrable difference
Preoperative ED visit within <365 d before surgery	11.39	7.85-16.51	<.001	11.12	7.71-16.05	<.001	Preoperative ED visit within <365d before surgery was associated with an increased risk.
Preoperative ED visit within <90 d before surgery	1.63	1.24-2.14	<.001	1.67	1.28-2.19	<.001	Preoperative ED visit within <90d before surgery was associated with an increased risk.
Depression	1.33	0.93-1.90	.11	-	-	-	No demonstrable difference
Insurance type	1.358	0.97-1.89	.07	1.37	1.04-1.81	.02	Medicare/Medicaid patients were associated with a higher risk.
Dual insurance eligibility	1.498	0.90-2.50	.12	-	-	-	No demonstrable difference
ADI	1.000	0.99-1.01	.97	-	-	-	No demonstrable difference

kg, kilograms; m, meters; ED, emergency department; ASA, American Society of Anesthesiology; ADI, area deprivation index.
 [a] Model 1: All parameters ran in the logistic regression.
 [b] Model 2: All parameters with *P* > .1 were dropped from the analysis, and the analysis rerun.

Table 6
Multiple Logistic Regression Predicting Patients With an ED Visit Within 90 d of Surgery Plus Readmission (N = 2655).

Independent Variable	Model 1[a]			Model 2[b]			Interpretation
	Odds Ratio	95% Confidence Interval	P-Value	Odds Ratio	95% Confidence Interval	P-Value	
Constant	0.02	0.002-0.16	<.001	0.02	0.01-0.09	<.001	The base risk of a 90d postoperative ED visit with readmission is less than 1.00.
Body mass index	0.94	0.90-0.97	<.001	0.94	0.91-0.97	<.001	Increased BMI was associated with decreased risk.
Age	1.00	0.98-1.03	.87	-	-	-	No demonstrable difference
Gender	0.68	0.45-1.01	.06	0.68	0.46-1.02	.06	Trend: Being male was associated with an increased risk.
Diabetes	1.12	0.71-1.76	.63	-	-	-	No demonstrable difference
Preoperative ASA	1.36	0.93-1.98	.11	1.39	0.95-2.03	.09	Trend: Increased preoperative ASA was associated with an increased risk.
Preoperative anticoagulation therapy	2.67	1.55-4.61	<.001	2.66	1.56-4.56	<.001	Preoperative anticoagulation therapy was associated with an increased risk.
Preoperative ED visit within <365 d before surgery	5.50	3.10-9.75	<.001	5.49	3.09-9.73	<.001	Preoperative ED visit within <365d before surgery was associated with an increased risk.
Preoperative ED visit within <90 d before surgery	2.53	1.67-3.85	<.001	2.54	1.68-3.85	<.001	Preoperative ED visit within <90d before surgery was associated with an increased risk.
Depression	1.13	0.64-2.00	.67	-	-	-	No demonstrable difference
Insurance type	2.09	1.17-3.74	.01	2.15	1.27-3.63	.004	Medicare/Medicaid was associated with an increased risk.
Dual insurance eligibility	0.89	0.40-1.99	.77	-	-	-	No demonstrable difference
ADI	1.00	0.99-1.01	.50	-	-	-	No demonstrable difference

kg, kilograms; m, meters; ED, emergency department; ASA, American Society of Anesthesiology; ADI, area deprivation index.
[a] Model 1: All parameters ran in the logistic regression.
[b] Model 2: All parameters with P > .1 were dropped from the analysis, and the analysis rerun.

Another patient demographic that presented as a 90-day postoperative ED visit risk factor was a patient's sex. Even when this study isolated patients who were readmitted versus those who were not readmitted, men consistently trended toward significant risk for an ED visit. This directly contradicts Finnegan et al. who in their analysis demonstrated women were more at risk for a 90-day

Table 7
Multiple Logistic Regression Among the Postoperative ED Visit Population Predicting ED Visit With Readmission (N = 435).

Independent Variable	Model 1[a]			Model 2[b]			Interpretation
	Odds Ratio	95% Confidence Interval	P-Value	Odds Ratio	95% Confidence Interval	P-Value	
Constant	0.16	0.01-2.30	.18	0.44	0.09-2.17	.31	No demonstrable difference
Body mass index	0.94	0.90-0.98	.001	0.93	0.90-0.97	<.001	Patients with higher BMI were less likely to be readmitted from the ED
Age	1.01	0.99-1.04	.30	-	-	-	No demonstrable difference
Gender	0.74	0.46-1.18	.20	-	-	-	No demonstrable difference
Race (Caucasian/Non-Caucasian)	2.51	1.40-4.51	.002	2.11	1.22-3.62	.01	White patients were more likely to be readmitted from the ED
Diabetes	1.33	0.78-2.26	.30	-	-	-	No demonstrable difference
Preoperative ASA Score	1.21	0.96-2.38	.08	1.60	1.03-2.48	.04	Patients with higher ASA score were more likely to be readmitted in the ED.
Preoperative ED visit within <365 d before surgery	0.88	0.42-1.82	.72	-	-	-	No demonstrable difference
Preoperative ED visit within <90 d before surgery	1.57	0.97-2.53	.07	1.66	1.06-2.61	.03	Patients with a preoperative ED visit in the 90 d before surgery were more likely to be readmitted in the ED.
Depression	0.96	0.51-1.90	.90	-	-	-	No demonstrable difference
Dual insurance eligibility	0.77	0.32-1.90	.58	-	-	-	No demonstrable difference
ADI (as a continuous variable)	1.01	0.99-1.02	.24	-	-	-	No demonstrable difference

kg, kilograms; m, meters; ED, emergency department; ASA, American Society of Anesthesiology; ADI, area deprivation index.
[a] Model 1: All parameters ran in the logistic regression.
[b] Model 2: All parameters with P > .1 were dropped from the analysis, and the analysis rerun.

ED visit [17]. However, it compliments the study carried out by Ross et al. who demonstrated men to be at risk for postoperative ED visits [20]. This establishes that between genders there was a disconnect postoperatively with their utilization of the ED. This study again was unique in that it demonstrated men trend toward a risk factor in both ED visits with and without readmission.

Novel to other joint reconstruction literature on postoperative ED visits, this study also compared just the patients who visited the ED postoperatively to determine if those readmitted were different to those who were not readmitted. Here, some interesting findings revealed that Caucasian patients as well as patients with lower BMI's were more likely to be readmitted if they visited the ED postoperatively. This can also be described as non-Caucasian patients and higher BMI patients were more likely to visit the ED but not be readmitted. In addition, patients on preoperative anticoagulation as well as patients with higher ASA scores were more likely to have an ED visit with readmission only. There have been previous studies that determined race can affect postoperative outcomes such as ED visits, length of stay, or patient-reported outcomes [9,21,22]. This study contradicts multiple studies which demonstrated that high BMI increased 90-day postoperative complications including readmission [23,24]. No study to these authors knowledge has discussed preoperative anticoagulation as a risk factor for ED visits with readmission.

Despite the large sample size, this review did come with the usual limitations presented in retrospectively reviewed registry data. The collected information could not be verified for accuracy, which is based on the health professional who recorded the information. However, each ED visit was verified by the author's thorough chart review. There were also potential further confounding variables among the patients, such as chronic medical comorbidities, which could predispose them to postoperative ED visits. The authors did try to control this by including preoperative ASA into the logistic regression model but there could be different chronic comorbidities that preoperative ASA did not consider. There could also be a concern for possible bias in regard to the race category in the analysis. Because this is registry collected data, it was not possible to separate out all races and therefore some were placed in the category of "Other." This being a generalized category, there exist possible bias when comparing this group with specific races. Along with verification, the ADI was a zip code-based socioeconomic parameter. As the area develops, especially Detroit, Michigan, zip code economic numbers can change for the better or worse, which can disagree with the study's assumption that a higher ADI means more economically deprived patients.

Conclusion

This study demonstrates that the percentage of early ED returns after TKA is high (16.4%) and that most SE-related factors, including ADI, did not contribute to this phenomenon. This supports the study's hospital mission to providing equal access health care. There did exist significant health and biologic demographics among patients who visited the ED postoperatively; even more when comparing the patient who went to the ED but were not admitted versus patients who visited the ED and were readmitted. However, SE factors continued to not demonstrate risk. Future studies that use targeted resource allocation, which may include proper education and more communication immediately postoperatively as well as increased access to information from the surgical team to address patient postoperative concerns may reduce at-risk groups from early postoperative ED visits.

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