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Original Study

Association of Social Behaviors With Community Discharge in Patients with Total Hip and Knee Replacement



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A B S T R A C T

Keywords:

Social behavior
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knee arthroplasty

Objectives: Understand the association between social determinants of health and community discharge after elective total joint arthroplasty.

Design: Retrospective cohort design using Optum de-identified electronic health record dataset.

Setting and Participants: A total of 38 hospital networks and 18 non-network hospitals in the United States; 79,725 patients with total hip arthroplasty and 136,070 patients with total knee arthroplasty between 2011 and 2018.

Methods: Logistic regression models were used to examine the association among pain, weight status, smoking status, alcohol use, substance disorder, and postsurgical community discharge, adjusted for patient demographics.

Results: Mean ages for patients with hip and knee arthroplasty were 64.5 (SD 11.3) and 65.9 (SD 9.6) years; most patients were women (53.6%, 60.2%), respectively. The unadjusted community discharge rate was 82.8% after hip and 81.1% after knee arthroplasty. After adjusting for demographics, clinical factors, and behavioral factors, we found obesity [hip: odds ratio (OR) 0.81, 95% confidence interval (CI) 0.76–0.85; knee: OR 0.73, 95% CI 0.69–0.77], current smoking (hip: OR 0.82, 95% CI 0.77–0.88; knee: OR 0.90, 95% CI 0.85–0.95), and history of substance use disorder (hip: OR 0.55, 95% CI 0.50–0.60; knee: OR 0.57, 95% CI 0.53–0.62) were associated with lower odds of community discharge after hip and knee arthroplasty, respectively.

Conclusions and Implications: Social determinants of health are associated with odds of community discharge after total hip and knee joint arthroplasty. Our findings demonstrate the value of using electronic health record data to analyze more granular patient factors associated with patient discharge location after total joint arthroplasty. Although bundled payment is increasing community discharge rates, post-acute care facilities must be prepared to manage more complex patients because odds of community discharge are diminished in those who are obese, smoking, or have a history of substance use disorder.

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Health care policies, such as the Bundled Payment for Care Improvement Initiative and the Improving Medicare for Post-Acute Care Transformation (IMPACT) Act of 2014 have altered the delivery of health care in the United States.^{1,2} The implementation of Bundled Payments for Care Improvement provides prespecified payment for clinical episodes of care, including major joint replacements.³ This payment model results in profit if the hospital minimizes expenditures.⁴ Given the expense of post-acute care, Bundled Payments for Care Improvement incentivizes discharges to the community instead of more costly post-acute care settings.⁵ Furthermore, the 2014 IMPACT Act's site-neutral payment structure encourages community discharges and additionally strengthens uniform data collection across discharge sites.¹ Nonetheless, with an increasing number of community discharges after major joint replacement, the uniform data collection initiative overlooks the growing importance of data collection within the acute hospital setting and aims only to standardize data for post-acute care.

Uniformly collecting data on social determinants of health via electronic health records across the spectrum of care is a goal of the Institute of Medicine, now referred to as the National Academies Health and Medicine Division.⁶ Social determinants of health are broadly defined in 5 levels by the National Academies Health and Medicine Division's conceptual framework: sociodemographic, behavioral, psychological, individual-level, and community-level information.^{7,8} Previous research on total joint arthroplasty demonstrated a consistent association between community discharge and age, sex, race, and payor source.^{9–18} However, the National Academies Health and Medicine Division recommends collecting and analyzing electronic health record data to assess more nuanced social determinants of health, such as physical activity, tobacco use, and alcohol use, which are associated with behavioral risk reduction but are inaccessible in claims data.^{7,8,19}

Previous research on how modifiable social behaviors affect community discharge post-total joint arthroplasty is limited by the use of claims data or small samples from the electronic health record data. Patient factors such as postoperative pain, weight, and use of drugs or alcohol are readily available in electronic health record data and can be addressed by clinicians via pre- and postoperative interventions to maximize community discharge. Prior findings suggest that morbidly obese patients are at a greater risk of discharging to post-acute care rather than returning to the community after total joint arthroplasty.^{11,12,20,21} To our knowledge, research on how acute postoperative pain is associated with community discharge is limited.

Numerous models have been created to determine which patients are at risk of failure to discharge to the community after total joint arthroplasty.^{4,22–25} However, many models exclude the social determinants of health associated with behavioral risk reduction, such as smoking status, alcohol consumption, and substance use disorder. Although uniform data collection for post-acute care settings is improving secondary to the IMPACT Act, there is a gap in using the electronic health record data from the acute hospital setting to measure key social determinants of health that may influence successful community discharge.^{7,8} The granular nature of electronic health record data is conducive to exploring social determinants of health as predictors of the post-acute clinical course.

The purpose of this research is to assess the feasibility of using multisite, national, Optum de-identified electronic health record data to identify modifiable social and behavioral determinants of health that are associated with community discharge post-total joint arthroplasty. Our hypothesis is that modifiable social behaviors such as pain, body mass index (BMI), smoking status, alcohol consumption, and substance use disorder will be associated with postoperative community discharge.

Methods

Data Sources

The study used the Optum de-identified electronic health record dataset. This database includes records for more than 90 million patients from 38 hospital networks and 18 non-network hospitals in the United States. The database contains structured data, such as diagnosis, procedure codes, and lab results; and observations such as vital signs, blood pressure, pain, and BMI. It also includes unstructured data in the form of text information from clinical notes from office visits; consultation reports; discharge summaries; nursing records; and pathology, radiology, and cardiology reports. Using a natural language processing (NLP) system, unstructured data were extracted from the narrative notes of health care providers and organized into structured fields to obtain clinical measurements. NLP is an algorithm that accounts for variability in grammar and syntax, finds certain phrases or word combinations, and categorizes measurable data from free-text documentation.^{26,27} Clinical measurements included numeric fields from clinical notes such as blood pressure, pain, and BMI. This study was approved by the University Institutional Review Board.

Patient Cohort

This study sample came from a cohort from Optum's electronic health record database consisting of patients who underwent surgical procedures on a lower extremity bone or joint between January 1, 2011, and February 28, 2018, and were discharged from the hospital on or before February 28, 2018. From this cohort of patients, we selected those who had a total hip replacement or total knee replacement in an inpatient setting using International Classification of Diseases, Ninth and 10th Revision (ICD-9 and ICD-10) codes and Current Procedure Terminology (CPT) codes (Supplementary Table 1). Inpatient visits were created by Optum by aggregating encounters that constituted one continuous hospitalization.

We excluded surgeries that did not have complete admission or discharge data, those where the patient had more than 2 surgeries in the hospital admission, and those that were classified as revision surgeries. From these surgeries, we selected the first surgery per patient (either hip or knee) because simultaneous elective hip and knee arthroplasty is rare, but simultaneous bilateral knee arthroplasty is feasible for adults with adequate cardiovascular health.^{28,29} Patients who did not have a record of sex or were not at least 18 years old at the time of surgery were excluded. We then excluded those who did not have at least 1 numeric pain score while in the hospital or had who incomplete information on BMI, smoking status, and alcohol consumption. The final cohorts included 79,725 patients with total hip arthroplasty and 136,070 patients with total knee arthroplasty (Figure 1).

Outcome

The primary outcome variable in this study was discharge to the community. Patients who were discharged to home following surgery (with or without home health services) were categorized as being discharged to the community and patients who were discharged to all other locations were categorized as non-community. The discharge location was taken directly from the electronic health record recorded discharge status.

Primary Predictors

Our variables of interest were pain, BMI, smoking, alcohol use, and substance use. When these values were not available in observations,

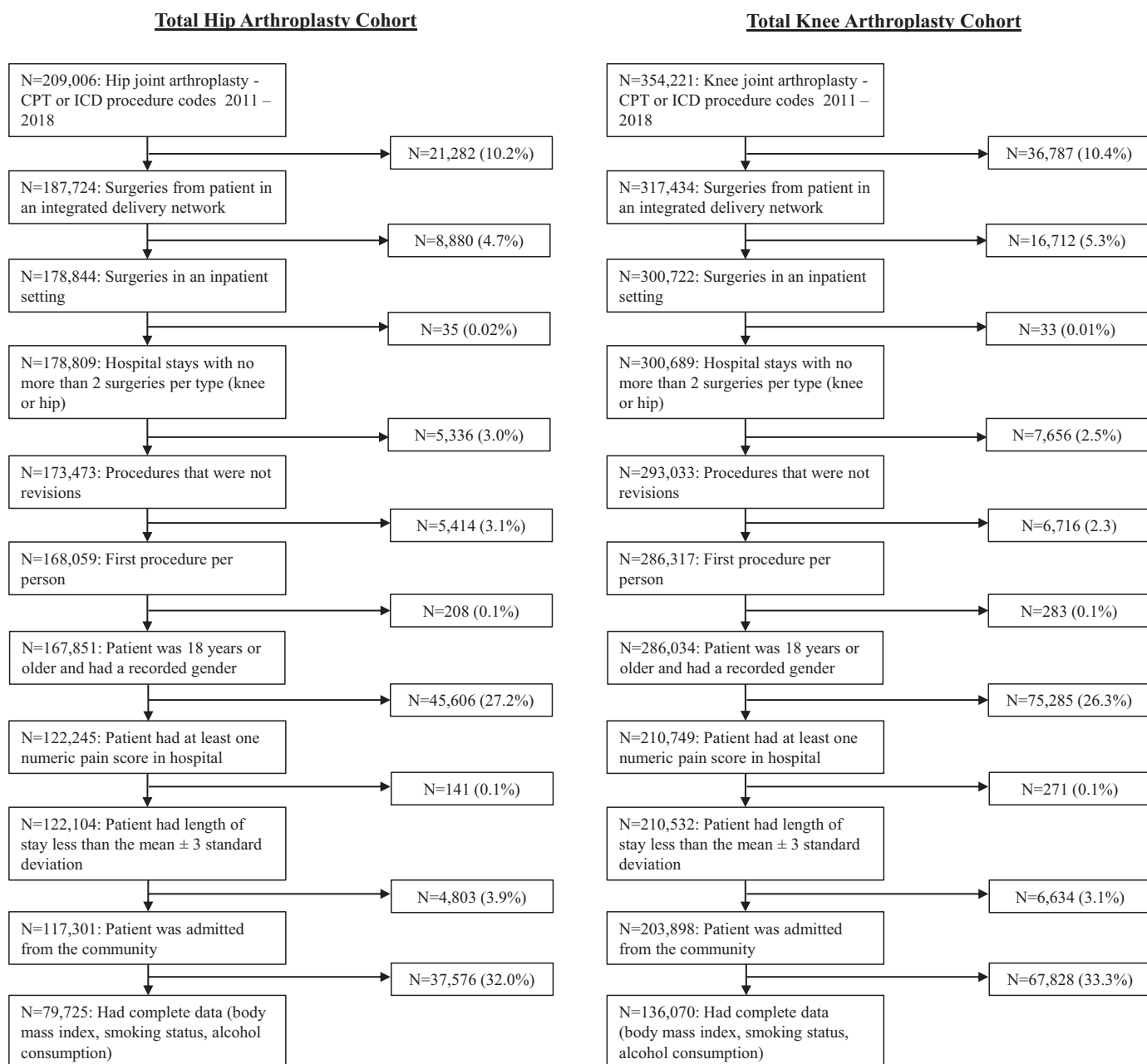


Fig. 1. Cohort flow diagram depicting inclusion and exclusion of patients with lower extremity joint replacement at each step.

they were obtained from the NLP-created structured fields for clinical measurements. Pain was taken from the clinical observations nearest to the time of discharge, as 75% of patients had a pain score on the day of discharge. No limits were placed on establishing the time nearest discharge, because length of stay is typically short³⁰ and accrediting bodies such as The Joint Commission encourage hospitals to frequently screen and record pain.³¹ Because multiple records of pain could be recorded on the same day, an average pain score was calculated for the day nearest to discharge that had a pain record. BMI was also obtained from the clinical observations, when available, or from the NLP-created structured fields when not available in observations. BMI was taken from the nearest record to discharge, within 30 days before discharge. Remaining operational definitions were smoking status (never, former, current, other), alcohol consumption (none, ≤ 7 drinks/week, ≥ 8 drinks/week, other) and a diagnosis of

substance use disorder (yes, no).³² These values were obtained from clinical observations found in the electronic health record and were taken from the observation nearest to the day of discharge, up to 6 months before the date of discharge. When multiple recorded statuses were recorded for smoking, alcohol use, and substance use disorder, 6 months before discharge, we recorded the most severe category during the 6 months before discharge and defined the “other” category as the least severe (ie, current smoker, former smoker, never smoker, other).

Covariates

Patient characteristics included in the analysis were sex (male, female), race (White, African American, Asian, other), ethnicity (Hispanic, not Hispanic, unknown), age (<55, 55–64, 65–74, 75+ years),

pain (no pain, 1–3, 4–6, 7–10), BMI (underweight, normal, overweight, obese), year of surgery and insurance status (Medicare only, Medicaid only, commercial insurance only, 2 insurances, uninsured/unknown).

Analysis

We used multivariate logistic regression models to assess the association between smoking status and alcohol consumption and community discharge following hip or knee replacement surgery. We assessed the association using an adjusted model accounting for demographics (Model 1) and then an adjusted model adding the primary predictors listed above (Model 2). Each analysis was performed separately for hip and knee surgeries. A sensitivity analysis including only patients with a pain score on their discharge date was conducted to ensure bias was not introduced from pain scores taken prior to the day of discharge. All analyses were done using SAS statistical software version 9.4 (SAS Institute, Cary, NC).

Results

Cohort Characteristics

Table 1 presents the characteristics of the 79,725 patients with total hip arthroplasty and the 136,070 with total knee arthroplasty. The average age for patients with total hip and knee arthroplasty was 64.5 (SD, 11.3) and 65.9 (SD, 9.6) years, respectively. Most were women (hip: 53.6%, knee: 60.2%), from the Midwest (hip: 48.3%, knee: 49.8%), White (hip: 89.2%, knee: 88.2%), non-Hispanic (hip: 93.7%, knee: 93.6%), obese (hip: 46.7%, knee: 63.8%), not currently smoking (hip: 47.7%, knee: 49.9%), alcohol consumers (hip: 60.7%, knee: 55.7%), without a diagnosis for substance use disorder (hip: 95.3%, knee: 96.9%), and discharged to the community from the hospital (hip: 82.8%, knee: 81.1%).

Community Discharge

Tables 2 and 3 exhibit the odds ratios (ORs) for community discharge after total hip or knee arthroplasty respectively. Model 1 includes age, sex, region, race, ethnicity, insurance status, and surgical year. Model 2 adds clinical and behavioral social determinants of health to Model 1. Model 1 found increased odds of community discharge for total hip arthroplasty [OR 2.16; 95% confidence interval (CI) 2.03–2.31] and total knee arthroplasty (OR 1.86; 95% CI 1.78–1.95) in patients covered by commercial insurance compared with those covered by Medicare. Furthermore, there was an increase in community discharges since the implementation of Bundled Payments for Care Improvement in 2013.

In Model 1, women were less likely to discharge to the community after both total hip arthroplasty (OR 0.60; 95% CI 0.57–0.62) and total knee arthroplasty (OR 0.59; 95% CI 0.58–0.61). African American individuals were less likely than White individuals to discharge to the community post-total hip arthroplasty (OR 0.48; 95% CI 0.45–0.52) and post-total knee arthroplasty (OR 0.56; 95% CI 0.53–0.59). Patients in the Northeast census region versus the West census region were least likely to discharge to the community post-total hip arthroplasty (OR 0.68; 95% CI 0.62–0.74) when excluding the 1.5% in the unknown region. Patients after total knee arthroplasty in the Northeast were also least likely to discharge to the community (OR 0.53; 95% CI 0.50–0.58). For both surgery groups, the odds of discharging to a post-acute care facility instead of returning to the community increased with age.

After adjusting for clinical and behavioral factors, Model 2 shows that the OR for community discharge in current smokers versus those who have never smoked was 0.82 (95% CI 0.77–0.88) after total hip

Table 1
Patient Characteristics by Surgery Type

	Hip	Knee
	n (%)	n (%)
Total	79,725 (100)	136,070 (100)
Discharged to community	66,013 (82.80)	110,379 (81.13)
Sex		
Female	42,745 (53.62)	81,858 (60.16)
Male	36,980 (46.38)	54,212 (39.84)
Age		
<55	14,334 (17.98)	16,193 (11.90)
55–64	25,046 (31.42)	43,898 (32.26)
65–74	24,462 (30.68)	48,968 (35.99)
75+	15,883 (19.92)	27,011 (19.85)
Region		
Midwest	38,536 (48.34)	67,739 (49.78)
Northeast	7150 (8.97)	7980 (5.86)
Other	1204 (1.51)	1869 (1.37)
South	22,114 (27.74)	42,724 (31.40)
West	10,721 (13.45)	15,758 (11.58)
Race		
African American	5718 (7.17)	9924 (7.29)
Asian	261 (0.33)	710 (0.52)
White	71,072 (89.15)	120,008 (88.20)
Other	2674 (3.35)	5428 (3.99)
Ethnicity		
Hispanic	1529 (1.92)	3428 (2.52)
Not Hispanic	74,724 (93.73)	127,334 (93.58)
Unknown	3472 (4.35)	5308 (3.90)
Insurance		
Medicare only	26,057 (32.68)	46,314 (34.04)
Medicaid only	2643 (3.32)	3303 (2.43)
Supplemental insurance (2 or more)	11,939 (14.98)	24,314 (17.87)
Commercial/Other (1 insurance)	35,716 (44.80)	56,769 (41.72)
Unknown	3370 (4.23)	5370 (3.95)
Pain		
0	8573 (10.75)	11,150 (8.19)
1–3	41,823 (52.46)	63,760 (46.86)
4–6	25,165 (31.56)	52,743 (38.76)
7–10	4164 (5.22)	8417 (6.19)
Body mass index		
Underweight (<18.5)	661 (0.83)	276 (0.20)
Normal (18.5–24.9)	15,295 (19.18)	12,485 (9.18)
Overweight (25.0–29.9)	26,581 (33.34)	36,546 (26.86)
Obese (≥30.0)	37,188 (46.65)	86,763 (63.76)
Smoking status		
Current smoker	12,440 (15.60)	15,758 (11.58)
Never smoked	29,101 (36.50)	52,120 (38.30)
Not currently smoking	38,028 (47.70)	67,911 (49.91)
Other	156 (0.20)	281 (0.21)
Alcohol consumption		
Consumes alcohol	48,423 (60.74)	75,736 (55.66)
Does not consume alcohol	28,452 (35.69)	56,114 (41.24)
8 or more drinks/week	2081 (2.61)	2914 (2.14)
Other	769 (0.96)	1306 (0.96)
Substance use disorder		
No	75,959 (95.28)	131,887 (96.93)
Yes	3766 (4.72)	4183 (3.07)
Year		
2011	2070 (2.60)	4211 (3.09)
2012	6807 (8.54)	13,040 (9.58)
2013	10,532 (13.21)	19,368 (14.23)
2014	12,330 (15.47)	21,790 (16.01)
2015	14,469 (18.15)	24,349 (17.89)
2016	16,215 (20.34)	26,298 (19.33)
2017	15,134 (18.98)	24,052 (17.68)
2018	2168 (2.72)	2962 (2.18)

Data source: Optum de-identified electronic health record dataset.

arthroplasty and 0.90 (95% CI 0.85–0.95) after total knee arthroplasty. In comparing patients with substance use disorder versus those without, the OR for community discharge was 0.55 (95% CI 0.50–0.60) post-total hip arthroplasty and 0.57 (95% CI 0.53–0.62) post-total knee

Table 2
Community Discharge Odds Ratios Among Patients With Total Hip Arthroplasty

Effect	Community Discharge, %	Model 1	Model 2
		OR (95% CI)	OR (95% CI)
Sex			
Male	78.60	REF	REF
Female	87.66	0.60 (0.57–0.62)	0.63 (0.60–0.66)
Age category			
<55	94.13	REF	REF
55–64	91.52	0.60 (0.55–0.66)	0.55 (0.50–0.60)
65–74	82.87	0.41 (0.37–0.45)	0.32 (0.30–0.36)
75+	58.73	0.12 (0.11–0.14)	0.09 (0.09–0.10)
Region			
West	85.44	REF	REF
Midwest	82.08	0.76 (0.71–0.81)	0.73 (0.68–0.78)
Northeast	84.27	0.68 (0.62–0.74)	0.65 (0.59–0.71)
Other	79.73	0.56 (0.48–0.67)	0.59 (0.50–0.69)
South	82.46	0.82 (0.77–0.89)	0.89 (0.83–0.96)
Race			
White	83.08	REF	REF
African American	77.60	0.48 (0.45–0.52)	0.56 (0.52–0.60)
Asian	86.97	1.08 (0.73–1.59)	1.03 (0.69–1.54)
Other	86.20	0.94 (0.82–1.07)	0.97 (0.85–1.11)
Ethnicity			
Hispanic	85.35	REF	REF
Not Hispanic	82.60	1.14 (0.97–1.34)	1.11 (0.94–1.32)
Unknown	85.94	1.16 (0.96–1.40)	1.18 (0.98–1.43)
Insurance			
Medicare only	72.73	REF	REF
Commercial/Other (1 insurance)	93.10	2.16 (2.03–2.31)	1.95 (1.82–2.08)
Medicaid only	83.81	0.68 (0.60–0.77)	0.85 (0.75–0.96)
Supplemental insurance (2 or more)	73.52	0.90 (0.85–0.95)	0.93 (0.88–0.98)
Unknown	83.62	1.34 (1.21–1.49)	1.30 (1.17–1.44)
Year			
2011	77.78	REF	REF
2012	77.29	1.00 (0.88–1.14)	0.95 (0.83–1.08)
2013	79.01	1.09 (0.96–1.23)	1.04 (0.92–1.18)
2014	81.12	1.24 (1.09–1.40)	1.18 (1.04–1.33)
2015	82.18	1.35 (1.19–1.52)	1.27 (1.12–1.44)
2016	85.28	1.80 (1.59–2.04)	1.72 (1.52–1.96)
2017	87.07	2.17 (1.91–2.46)	2.05 (1.80–2.33)
2018	88.75	2.63 (2.19–3.16)	2.43 (2.02–2.93)
Pain			
0	80.91		REF
1–3	85.54		1.06 (0.99–1.14)
4–6	80.55		0.62 (0.58–0.67)
7–10	72.81		0.40 (0.36–0.44)
Body mass index			
Normal (18.5–24.9)	80.30		REF
Underweight (<18.5)	72.47		0.75 (0.62–0.92)
Overweight (25.0–29.9)	84.34		1.12 (1.06–1.19)
Obese (\geq 30.0)	82.91		0.81 (0.76–0.85)
Smoking status			
Never smoked	84.37		
Current smoker	85.39		0.82 (0.77–0.88)
Not currently smoking	80.79		0.85 (0.81–0.89)
Other	72.44		0.70 (0.47–1.06)
Alcohol consumption			
Does not consume alcohol	75.42		
Consumes alcohol	87.02		1.64 (1.57–1.71)
8 or more drinks/week	87.22		1.70 (1.48–1.96)
Other	78.54		1.16 (0.96–1.41)
Substance use disorder			
No	83.00		
Yes	78.86		0.55 (0.50–0.60)

Abbreviations: CI, confidence interval; OR, odds ratio.

Results are from logistic regressions using a sample of 79,725 patients with total hip arthroplasty between 2011 and 2018.

Data source: Optum de-identified electronic health record dataset.

arthroplasty. Alcohol consumption versus not consuming alcohol was associated with ORs of 1.64 (95% CI 1.57–1.71) post-total hip arthroplasty and 1.47 (95% CI 1.42–1.51) post-total knee arthroplasty. Compared with patients whose BMI qualified as normal, patients with an obese BMI had lower odds of community discharge post-total hip

arthroplasty (OR 0.81; 95% CI 0.76–0.85) and post-total knee arthroplasty (OR 0.73; 95% CI 0.69–0.77). Odds of community discharge were higher for patients with total hip arthroplasty with an overweight BMI (OR 1.12; 95% CI 1.06–1.19), but lower for patients with an underweight BMI (OR 0.75; 95% CI 0.62–0.92). Total knee arthroplasty

did not elicit significant associations when comparing community discharge for normal versus an overweight or underweight BMI.

A sensitivity analysis of 59,451 total hip and 101,449 total knee arthroplasty patients with pain scores documented on their discharge date demonstrates odds of community discharge were consistent

compared with those in our full cohort using the last documented pain score (Supplementary Tables 2 and 3). Compared with patients without pain, the odds of community discharge were lower with pain scores of 4 to 6 after total hip arthroplasty (OR 0.56; 95% CI 0.51–0.61) and total knee arthroplasty (OR 0.88; 95% CI 0.82–0.94). Pain scores of

Table 3
Community Discharge Odds Ratios Among Patients With Total Knee Arthroplasty

Effect	Community Discharge, %	Model 1	Model 2
		OR (95% CI)	OR (95% CI)
Sex			
Male	77.95	REF	REF
Female	85.94	0.59 (0.58–0.61)	0.62 (0.60–0.64)
Age category			
<55	91.72	REF	REF
55–64	89.02	0.66 (0.62–0.70)	0.63 (0.59–0.67)
65–74	80.47	0.46 (0.43–0.50)	0.40 (0.37–0.43)
75+	63.17	0.20 (0.18–0.21)	0.16 (0.15–0.17)
Region			
West	85.25	REF	REF
Midwest	80.79	0.69 (0.65–0.73)	0.69 (0.66–0.73)
Northeast	79.39	0.53 (0.50–0.58)	0.53 (0.50–0.58)
Other	79.24	0.60 (0.53–0.68)	0.61 (0.54–0.70)
South	80.57	0.74 (0.70–0.78)	0.80 (0.75–0.84)
Race			
White	81.50	REF	REF
African American	75.29	0.56 (0.53–0.59)	0.62 (0.59–0.65)
Asian	76.48	0.74 (0.62–0.89)	0.70 (0.58–0.85)
Other	84.29	1.05 (0.96–1.15)	1.09 (1.00–1.19)
Ethnicity			
Hispanic	82.53	REF	REF
Not Hispanic	81.01	1.14 (1.03–1.27)	1.08 (0.98–1.20)
Unknown	83.20	1.08 (0.95–1.22)	1.04 (0.92–1.18)
Insurance			
Medicare only	73.47	REF	REF
Commercial/Other (1 insurance)	90.17	1.86 (1.78–1.95)	1.73 (1.66–1.82)
Medicaid only	83.32	0.91 (0.82–1.01)	1.04 (0.93–1.15)
Supplemental insurance (2 or more)	74.06	0.93 (0.90–0.97)	0.95 (0.91–0.99)
Unknown	82.42	1.41 (1.31–1.53)	1.40 (1.29–1.51)
Year			
2011	74.42	REF	REF
2012	75.54	1.12 (1.03–1.22)	1.07 (0.98–1.16)
2013	76.93	1.20 (1.11–1.31)	1.15 (1.06–1.25)
2014	79.50	1.39 (1.28–1.51)	1.33 (1.22–1.44)
2015	81.07	1.58 (1.45–1.71)	1.50 (1.38–1.62)
2016	84.20	2.07 (1.91–2.25)	1.95 (1.79–2.12)
2017	86.15	2.49 (2.29–2.70)	2.36 (2.16–2.57)
2018	87.27	2.81 (2.46–3.22)	2.65 (2.31–3.03)
Pain			
0	77.57		REF
1–3	82.62		1.13 (1.07–1.19)
4–6	81.01		0.87 (0.82–0.92)
7–10	75.32		0.60 (0.56–0.64)
Body mass index			
Normal (18.5–24.9)	79.58		REF
Underweight (<18.5)	78.26		1.03 (0.75–1.40)
Overweight (25.0–29.9)	82.29		1.01 (0.96–1.07)
Obese (≥30.0)	80.88		0.73 (0.69–0.77)
Smoking status			
Never smoked	82.72		REF
Current smoker	84.52		0.90 (0.85–0.95)
Not currently smoking	79.17		0.82 (0.79–0.84)
Other	71.53		0.60 (0.45–0.80)
Alcohol consumption			
Does not consume alcohol	75.79		REF
Consumes alcohol	84.83		1.47 (1.42–1.51)
8 or more drinks/week	88.13		1.85 (1.64–2.09)
Other	80.32		1.41 (1.22–1.63)
Substance use disorder			
No	81.29		REF
Yes	76.21		0.57 (0.53–0.62)

Abbreviations: CI, confidence interval; OR, odds ratio.

Results are from logistic regressions using a sample of 136,070 patients with total knee arthroplasty between 2011 and 2018.

Data source: Optum de-identified electronic health record dataset.

7 to 10 continued to produce the lowest odds of community discharge after total hip arthroplasty (OR 0.34; 95% CI 0.30–0.38) and total knee arthroplasty (OR 0.57; 95% CI 0.52–0.63).

Discussion

There is a gap in the literature using electronic health record data to create a comprehensive predictive model accounting for the association between granular social determinants of health and community discharge. Claims-based models capture broad social determinants of health but overlook more nuanced social behaviors associated with community discharge.^{24,25} The Veterans Affairs prediction model for complications post-total joint arthroplasty attempts to address these problems by connecting Veterans Affairs Surgical Quality Improvement Program (VASQIP) active surveillance data to the VA Corporate Data Warehouse (CDW), which includes electronic health record data. However, the VASQIP-CDW prediction model emphasizes surgical complications and does not address discharge location.³³ The American College of Surgeons National Surgical Quality Improvement (ACS-NSQIP) database has similarly been connected to a single institution's electronic health record data to examine post-acute care utilization, but is limited by sample volume.^{34,35} The goal of our current study was to demonstrate the feasibility of using a large sample of national Optum electronic health record data to explore the association between social determinants of health and community discharge after elective joint arthroplasty.

Our study is the first to use the Optum de-identified electronic health record dataset to model the community discharge rates previously reported from Medicare claims, VASQIP-CDW, ACS-NSQIP or small single institute studies. Our analysis demonstrated a community discharge rate of 82.8% for patients with total hip arthroplasty and 81.1% for patients with total knee arthroplasty. These community discharge rates are higher than the 74% rate reported via Medicare claims data at hospitals participating in the Comprehensive Care for Joint Replacement Model.^{36,37} However, our community discharge rates are in alignment with smaller studies using single institute electronic health record data, which also have higher community discharge rates than reports of Medicare beneficiaries under the Comprehensive Care for Joint Replacement Mode.^{4,13,38} Optum and single institution electronic health record participants are consistently younger than Medicare beneficiaries, which is important to note considering our finding that post-acute care utilization increases with age.^{4,13}

A strength of our analysis was the use of Optum electronic health record data, which enabled us to create variables for social determinants of health. We found that modifiable clinical and social factors contribute to the odds of community discharge. We found decreased odds of community discharge when pain scores exceeded 4 of 10, while previous research suggested that patients discharged to the community have lower levels of postoperative pain than those discharged to skilled nursing facilities.³⁹ Consistent with prior literature, obese patients exhibited the lowest odds of community discharge.^{11,12,20,21}

Our new findings suggest an association between community discharge and smoking, alcohol consumption, and substance use disorder. Compared with nonsmokers, smokers had lower odds of community discharge. Although our finding is consistent with literature addressing smoking and negative outcomes, we are the first to address community discharge.^{34,40} The positive association between alcohol use and community discharge, as well as the negative association between substance use disorder and community discharge, are supported by previous studies using the National Hospital Discharge Survey, which ceased data collection before the implementation of Bundled Payments for Care Improvement.^{22,23}

The National Academies Health and Medicine Division recommends capturing social determinants of health in electronic health

record data.^{7,8} More importantly, this shared responsibility throughout the continuum of care will result in practice and policy implications secondary to a growing awareness that social determinants of health affect the quality of medical care.⁶ As preoperative rehabilitation becomes more frequent, clinicians can treat modifiable social behaviors such as BMI, smoking status, or drug and alcohol use via wellness programs or surgical risk screening.^{36,41–43} Although policies such as Bundled Payments for Care Improvement and the Centers for Medicare and Medicaid Services' Comprehensive Care for Joint Replacement Model reduce postoperative expenses, a systematic review of preoperative rehabilitation for total joint arthroplasty reported a gap in studies measuring whether such an intervention results in cost savings.⁴⁴

Our electronic health record analysis is consistent with findings from non-electronic health record databases and serves to further validate the feasibility of using electronic health record data in large sample research. Research using the Truven Health Analytics MarketScan inpatient claims database found similar results as our study in demonstrating the Northeast census region as that with the highest odds for discharge to post-acute care instead of home.⁴⁵ Similarly, smoking status has been considered as an increased risk for hospital readmission, but has received minimal attention with respect to its association with community discharge, despite being a readily available covariate from the ACS-NSQIP surgical risk calculator.^{34,40} The ACS-NSQIP surgical risk calculator does not include alcohol or substance use, yet patients with substance use disorder are more likely to require post-acute care.²³ An interesting finding from our study is that patients with alcohol misuse are more likely to return to the community, which may be confounded by a generally superior health status that permits alcohol misuse.²² The interaction between community discharge and a comprehensive list of modifiable social behaviors has not been decisively analyzed to refine predictive surgical risk models within this patient population, largely due to limitations in data acquisition that can now be overcome using electronic health records.

The strengths of our study include a large sample size using the Optum electronic health record data and the addition of granular patient factors accessible from the electronic health record data, which help explain community discharge variability. Our sample size of 123,364 elective joint arthroplasties is a meaningful addition to electronic health record research addressing community discharge since the inception of bundled payment, and enables comparisons with similarly sized Medicare analyses.^{4,36,37} Some limitations in claims data were overcome using the Optum electronic health record data, which permitted more granular analysis than previously possible using social determinants of health to explain the odds of community discharge.^{6–8}

Limitations

There are several limitations of our study. One is that the nonwhite patient populations were smaller than the US census averages in both surgical groups. Because of the differences in clinical documentation of health care providers and health care systems, not all data were available across all provider sources. Methodological limitations included the need to use an average pain score, as we were unable to identify the last filed pain score before discharge. Although our sensitivity analysis demonstrated our method to measure pain was robust, caution should be used in applying this method to nonsurgical pain. Future studies would benefit from sensitivity analysis on variables such as pain or BMI, to identify best methods for data collection, in addition to testing mediated models and goodness-of-fit with a more comprehensive selection of the National Academies Health and Medicine Division's social and behavioral domains.

Conclusions and Implications

This study found demographic, clinical, and social behaviors that result in an increased likelihood of discharge to a post-acute care setting instead of returning to the community post-total joint arthroplasty. Notably, social determinants of health, such as obesity, smoking status, and substance use disorder were associated with decreased odds of discharge to the community. Clinical implications of these findings include shifting care “upstream”⁴⁶ to preventively address social disparities on the front-end of elective and planned procedures. Success of preoperative interventions will require collaboration among practitioners, administrators, and researchers to develop time-efficient documentation on key social determinants of health.

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Appendix

Supplementary Table 1

ICD-9, ICD-10, and CPT Codes for Identifying the Study Subjects

ICD-9	ICD-10	CPT
81.51	0SR90J9, Replacement of Right Hip Joint with Synthetic Substitute, Cemented, Open Approach 0SR90JA, Replacement of Right Hip Joint with Synthetic Substitute, Uncemented, Open Approach 0SR90JZ, Replacement of Right Hip Joint with Synthetic Substitute, Open Approach 0SRB0J9, Replacement of Left Hip Joint with Synthetic Substitute, Cemented, Open Approach 0SRB0JA, Replacement of Left Hip Joint with Synthetic Substitute, Uncemented, Open Approach 0SRB0JZ, Replacement of Left Hip Joint with Synthetic Substitute, Open Approach	27130, Arthroplasty, acetabular and proximal femoral prosthetic replacement (total hip arthroplasty), with or without autograft or allograft
81.54	0SRC07Z, Replacement of Right Knee Joint with Autologous Tissue Substitute, Open Approach 0SRC0JZ, Replacement of Right Knee Joint with Synthetic Substitute, Open Approach 0SRC0KZ, Replacement of Right Knee Joint with Nonautologous Tissue Substitute, Open Approach 0SRC0LZ, Replacement of Right Knee Joint with Medial Unicondylar Synthetic Substitute, Open Approach 0SRD07Z, Replacement of Left Knee Joint with Autologous Tissue Substitute, Open Approach 0SRD0JZ, Replacement of Left Knee Joint with Synthetic Substitute, Open Approach 0SRD0KZ, Replacement of Left Knee Joint with Nonautologous Tissue Substitute, Open Approach 0SRD0LZ, Replacement of Left Knee Joint with Medial Unicondylar Synthetic Substitute, Open Approach 0SRT07Z, Replacement of Right Knee Joint, Femoral Surface with Autologous Tissue Substitute, Open Approach 0SRT0JZ, Replacement of Right Knee Joint, Femoral Surface with Synthetic Substitute, Open Approach 0SRT0KZ, Replacement of Right Knee Joint, Femoral Surface with Nonautologous Tissue Substitute, Open Approach 0SRU07Z, Replacement of Left Knee Joint, Femoral Surface with Autologous Tissue Substitute, Open Approach 0SRU0JZ, Replacement of Left Knee Joint, Femoral Surface with Synthetic Substitute, Open Approach 0SRU0KZ, Replacement of Left Knee Joint, Femoral Surface with Nonautologous Tissue Substitute, Open Approach 0SRV07Z, Replacement of Right Knee Joint, Tibial Surface with Autologous Tissue Substitute, Open Approach 0SRV0JZ, Replacement of Right Knee Joint, Tibial Surface with Synthetic Substitute, Open Approach 0SRV0KZ, Replacement of Right Knee Joint, Tibial Surface with Nonautologous Tissue Substitute, Open Approach 0SRW07Z, Replacement of Left Knee Joint, Tibial Surface with Autologous Tissue Substitute, Open Approach 0SRW0JZ, Replacement of Left Knee Joint, Tibial Surface with Synthetic Substitute, Open Approach 0SRW0KZ, Replacement of Left Knee Joint, Tibial Surface with Nonautologous Tissue Substitute, Open Approach	27447, Arthroplasty, knee, condyle and plateau; medial AND lateral compartments with or without patella resurfacing (total knee arthroplasty)

Supplementary Table 2

Patients With Total Hip Arthroplasty With a Pain Score Available on Day of Discharge

Effect	Community Discharge %	Model 1	Model 2
		OR (95% CI)	OR (95% CI)
Sex			
Male	88.7	REF	REF
Female	80.1	0.59 (0.56–0.62)	0.62 (0.59–0.66)
Age category			
<55	94.5	REF	REF
55–64	92.2	0.61 (0.55–0.67)	0.55 (0.50–0.61)
65–74	83.9	0.41 (0.37–0.46)	0.32 (0.28–0.35)
75+	60.3	0.12 (0.11–0.14)	0.09 (0.08–0.10)
Region			
West	87.5	REF	REF
Midwest	83.0	0.69 (0.64–0.75)	0.67 (0.62–0.73)
Northeast	85.6	0.65 (0.58–0.72)	0.63 (0.57–0.71)
Other	80.1	0.51 (0.42–0.62)	0.51 (0.42–0.62)
South	84.1	0.85 (0.77–0.93)	0.87 (0.79–0.96)
Race			
Caucasian	84.3	REF	REF
African American	78.7	0.47 (0.43–0.52)	0.56 (0.51–0.61)
Asian	89.4	1.18 (0.74–1.89)	1.16 (0.71–1.87)
Other	87.5	0.93 (0.80–1.09)	0.99 (0.85–1.16)
Ethnicity			
Hispanic	86.8	REF	REF
Not Hispanic	83.9	1.09 (0.90–1.32)	1.06 (0.87–1.29)
Unknown	87.2	1.10 (0.88–1.37)	1.12 (0.90–1.40)
Insurance			
Medicare only	74.1	REF	REF
Commercial/Other (1 insurance)	85.4	2.19 (2.02–2.37)	1.97 (1.82–2.13)
Medicaid only	84.4	0.66 (0.57–0.76)	0.81 (0.70–0.94)
Supplemental insurance (2 or more)	75.1	0.89 (0.83–0.95)	0.92 (0.86–0.98)
Unknown	93.7	1.43 (1.26–1.62)	1.37 (1.21–1.56)
Year			
2011	58.7	REF	REF
2012	78.3	2.26 (1.46–3.49)	2.23 (1.44–3.46)
2013	80.2	2.51 (1.63–3.88)	2.53 (1.64–3.92)
2014	82.6	2.90 (1.88–4.46)	2.90 (1.88–4.49)
2015	83.8	3.21 (2.08–4.95)	3.20 (2.07–4.95)
2016	86.1	4.11 (2.67–6.33)	4.18 (2.70–6.46)
2017	88.1	5.12 (3.32–7.89)	5.15 (3.33–7.98)
2018	89.8	6.49 (4.10–10.27)	6.48 (4.08–10.31)
Pain			
0	82.4		REF
1–3	86.6		1.00 (0.92–1.08)
4–6	81.5		0.56 (0.51–0.61)
7–10	72.8		0.34 (0.30–0.38)
Body mass index			
Normal (18.5–24.9)	76.1		REF
Underweight (<18.5)	82.6		0.75 (0.59–0.97)
Overweight (25.0–29.9)	85.6		1.08 (1.00–1.16)
Obese (≥30.0)	83.7		0.74 (0.69–0.79)
Smoking status			
Never smoked	85.4		REF
Current smoker	86.7		0.84 (0.77–0.91)
Not currently smoking	82.1		0.84 (0.80–0.89)
Other	77.8		0.81 (0.35–1.86)
Alcohol consumption			
Does not consume alcohol	76.9		REF
Consumes alcohol	87.8		1.65 (1.56–1.73)
8 or more drinks/week	88.7		1.88 (1.59–2.22)
Other	80.1		1.24 (1.01–1.53)
Substance use disorder			
No	84.2		REF
Yes	81.8		0.61 (0.54–0.68)

Note. 59,451 patients with total hip arthroplasty received a pain score on day of discharge.

Supplementary Table 3

Patients With Total Knee Arthroplasty With a Pain Score Available on Day of Discharge

Effect	Community Discharge, %	Model 1	Model 2
		OR (95% CI)	OR (95% CI)
Sex			
Male	86.4	REF	REF
Female	78.5	0.59 (0.57–0.61)	0.62 (0.60–0.64)
Age category			
<55	91.7	REF	REF
55–64	89.2	0.67 (0.62–0.72)	0.63 (0.58–0.68)
65–74	80.9	0.49 (0.46–0.53)	0.42 (0.39–0.45)
75+	63.9	0.21 (0.19–0.23)	0.17 (0.15–0.18)
Region			
West	86.7	REF	REF
Midwest	81.4	0.66 (0.62–0.71)	0.67 (0.62–0.71)
Northeast	80.0	0.52 (0.48–0.57)	0.52 (0.48–0.57)
Other	79.4	0.57 (0.50–0.66)	0.59 (0.51–0.68)
South	80.6	0.70 (0.66–0.75)	0.75 (0.70–0.80)
Race			
Caucasian	82.1	REF	REF
African American	75.0	0.54 (0.51–0.58)	0.61 (0.57–0.65)
Asian	77.4	0.74 (0.60–0.91)	0.71 (0.57–0.87)
Other	84.9	1.08 (0.98–1.19)	1.12 (1.02–1.24)
Ethnicity			
Hispanic	82.7	REF	REF
Not Hispanic	81.6	1.17 (1.04–1.31)	1.08 (0.96–1.22)
Unknown	83.6	1.04 (0.91–1.20)	1.00 (0.87–1.15)
Insurance			
Medicare only	73.8	REF	REF
Commercial/Other (1 insurance)	85.2	1.95 (1.85–2.06)	1.80 (1.71–1.90)
Medicaid only	83.9	0.96 (0.85–1.08)	1.09 (0.97–1.23)
Supplemental insurance (2 or more)	74.6	0.95 (0.91–1.00)	0.98 (0.94–1.03)
Unknown	90.4	1.66 (1.51–1.83)	1.64 (1.48–1.80)
Year			
2011	44.6	REF	REF
2012	76.2	5.12 (4.00–6.55)	5.27 (4.10–6.76)
2013	77.2	5.47 (4.28–7.00)	5.67 (4.43–7.27)
2014	80.1	6.43 (5.03–8.22)	6.68 (5.22–8.57)
2015	81.7	7.40 (5.79–9.45)	7.65 (5.97–9.81)
2016	84.8	9.55 (7.47–12.21)	9.86 (7.69–12.64)
2017	86.3	11.09 (8.66–14.19)	11.50 (8.96–14.75)
2018	87.2	12.20 (9.28–16.05)	12.70 (9.63–16.74)
Pain			
0	77.0		REF
1–3	83.2		1.16 (1.09–1.25)
4–6	81.4		0.88 (0.82–0.94)
7–10	75.3		0.57 (0.52–0.63)
Body mass index			
Normal (18.5–24.9)	81.1		REF
Underweight (<18.5)	80.6		1.24 (0.85–1.80)
Overweight (25.0–29.9)	83.0		1.01 (0.94–1.08)
Obese (≥30.0)	81.3		0.71 (0.67–0.76)
Smoking status			
Never smoked	83.2		REF
Current smoker	85.2		0.92 (0.86–0.98)
Not currently smoking	79.6		0.80 (0.77–0.83)
Other	73.5		0.68 (0.39–1.16)
Alcohol consumption			
Does not consume alcohol	76.0		REF
Consumes alcohol	85.2		1.50 (1.45–1.56)
8 or more drinks/week	89.2		2.17 (1.89–2.49)
Other	80.0		1.38 (1.18–1.60)
Substance use disorder			
No	81.8		REF
Yes	77.4		0.59 (0.54–0.65)

Note: 101,449 patients with total knee arthroplasty received a pain score on day of discharge.