An Investigation of the Relationship between State- and Person-Level Arthroplasty-Based Opioid Prescribing Habits and Opioid Abuse Prevalence

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INTRODUCTION:

Opioid abuse is a devastating issue facing many communities across different regions in the US. Research suggests that prescription opioid misuse may serve as a gateway to subsequent illicit opioid abuse, such as heroin. Considering the significant morbidity and mortality associated with this, it is vital to assess the degree to which orthopaedic-based prescriptions may contribute to heroin use. This study investigates multiple variables related to orthopaedic-based opioid prescriptions in the US, including regional variation in opioid prescription patterns, intra-regional variation in opioid prescription patterns over time, and the relationship between regional prescription patterns and heroin abuse prevalence.

METHODS:

In this retrospective analysis, pharmacy data from a large national commercial claims dataset containing de-identified information from patients with commercial health insurance coverage from 2014 to 2019 was analyzed. Our analysis included all prescriptions within the 90-day postoperative window for all member claims with a Current Procedural Terminology code of 27130 (Total Hip Arthroplasty) or 27447 (Total Knee Arthroplasty) and a cataloged pharmacy benefit. National Drug Codes were linked to the 2020 Centers for Disease Control morphine milligram equivalent conversion table. Total morphine milligram equivalent's prescribed over the 90-day postoperative window per claim, averaged for each state and year, served as the primary predictor. Regional variation was analyzed utilizing the intraclass correlation coefficient. Small area estimates for heroin use collected by the Substance Abuse and Mental Health Services Administration for each state and year served as the outcome of interest.

RESULTS:

A total of 188,017 patient claims were included in our analysis. National average prescribed 90-day opioids declined over the course of the study window for both Total Knee Arthroplasty and Total Hip Arthroplasty. Patients undergoing a Total Knee Arthroplasty are less likely to acquire an opioid misuse diagnosis following surgery than Total Hip Arthroplasty patients (OR=0.85, p=.005). Increases in the amount of opioids prescribed within the 90-day postoperative window resulted in a greater odds of subsequent opioid misuse diagnosis (OR=1.05, p<.001). Significant predictors of state-level heroin use include between- (B=-18.37, p=.03) and within-state (B=5.94, p<0.05) variation in provider 90-day prescribing habits post-procedure. None of the included predictors demonstrated a significant relationship with drug overdose deaths.

DISCUSSION AND CONCLUSION:

Amounts of opioids prescribed in the 90-day postoperative window generally decreased by more than half nationally for both Total Knee Arthroplasty and Total Hip Arthroplasty. Patients with higher amounts of opioids prescribed were at a higher likelihood of acquiring a subsequent opioid misuse diagnosis. At the state-level, within-state increases in opioids prescribed coincided with rises in state-level rates of heroin use, while between-state differences in opioids prescribed had the opposite effect in that states with higher average number of opioids prescribed demonstrated lower levels of state-level rates of heroin use. This relationship did not hold true for drug overdose deaths. The results suggest an association between orthopaedic-based opioid prescribing habits and opioid related morbidity. Efforts at reducing opioid prescribing habits seem to have borne fruit based on observed state and national trends. Unfortunately, drug overdose deaths continue to rise and further efforts are needed reduce illicit opioid use in the US.

Table 1. *National Variable Characteristics across Time*

	2014	2015	2016	2017	2018	2019	2020
TKA[1] MME's[2] (mean (SD))	1722.96 (1513.37)	1696.13 (1501.56)	1601.19 (1434.46)	1407.76 (1325.58)	1124.51 (1190.79)	934.85 (1069.78)	798.56 (968.41)
THA[3] MME's (mean (SD))	1113.68 (1244.33)	1107.11 (1250.69)	1033.06 (1186.83)	913.94 (1086.32)	711.89 (986.88)	584.01 (881.61)	490.51 (763.16)
Heroin Use[4] (mean (SD))	357.16 (177.16)	406.07 (265.25)	408.54 (163.75)	411.49 (159.20)	379.30 (152.57)	353.76 (116.30)	-
Drug Overdose Deaths[1] (mean (SD))	17.44 (6.70)	20.77 (9.41)	22.48 (10.89)	21.49 (9.99)	22.48 (10.19)	28.51 (13.77)	-

Note: [1]Total Knee Arthroplasty. [2]Morphine Milligram Equivalents. [3]Total Hip Arthroplasty. [4]per 100,000 residents

Table 2. *Patient-level Characteristics Stratified by Subsequent Opioid Misuse Diagnosis*

	Opioid Misuse Diagnosis			
	No	Yes	*p*	SMD[1]
n	186674	1349		
Sex[2] = *Male* (%)	88382 (47.3)	639 (47.4)	>.999	<0.001
Age (mean (SD))	58.23 (7.06)	55.33 (7.81)	**<0.001**	0.389
Procedure[3] = *TKA* (%)	108834 (58.3)	813 (60.3)	0.152	0.040
Elixhauser Comorbidity Index (%)			**<0.001**	0.338
0	35634 (19.1)	147 (10.9)		
1-4	135108 (72.4)	961 (71.2)		
≥5	15932 (8.5)	241 (17.9)		
90-day MME's[4] Prescribed (mean (SD))	1092.70 (1229.00)	2812.30 (2197.84)	**<0.001**	0.966

Note: Univariate tests across opioid misuse diagnosis include independent samples t-tests for continuous variables and chi-square tests for categorical variables. [1]Standardized Mean Differences. [2]Referent: Female. [3]Referent: Total Hip Arthroplasty. [4]Morphine Milligram Equivalents.

Table 3. *Patient-level Multivariate Binary Logistic Regression Predicting Opioid Misuse*

	DV: Subsequent Opioid Misuse Diagnosis		
Predictors	Odds Ratios	95% CI[1]	*p*
(Intercept)	0.002	0.002 - 0.002	**<0.001**
Sex[2]: *Male*	1.029	0.922 - 1.148	0.611
Age	0.962	0.955 - 0.968	**<0.001**
ECI[3]: *1-4*	1.714	1.441 - 2.052	**<0.001**
ECI[3]: *≥5*	3.224	2.610 - 3.993	**<0.001**
Procedure[4]: *TKA*	0.849	0.757 - 0.952	**0.005**
90-day MME's[5] Prescribed	1.047	1.045 – 1.049	**<0.001**
Observations	188,017		
R^2 Tjur	0.018		

Note: [1]95% Confidence Interval. [2]Referent: Female. [3]Elixhauser Comorbidity Index Referent: 0. [4]Referent: Total Hip Arthroplasty. [5]Morphine Milligram Equivalents (x100).

Table 4. *Multivariate Mixed Effects Model Investigating Predictors of Regional Heroin Use*

	DV: Heroin Use			DV: Drug Overdose Deaths		
Predictors	B	95% CI[1]	*p*	B	95% CI[1]	*p*
(Intercept)	383.92	326.29 – 441.55	**<0.001**	17.88	15.72 – 20.04	**<0.001**
Year	4.958	-5.77 – 15.68	0.365	1.75	1.27 – 2.22	**<0.001**
MME_{within}[2]	5.94	0.08 – 11.79	**0.047**	0.03	-0.16 – 0.22	0.762
$MME_{between}$[3]	-18.37	-34.83 – -1.91	**0.029**	-0.30	-1.35 – 0.76	0.579
Procedure: *TKA* x MME_{within}[4]	-0.58	-5.814 – 4.66	0.829	0.01	-0.16 – 0.18	0.950
Procedure: *TKA* x $MME_{between}$[5]	-1.46	-8.88 – 5.95	0.699	-0.01	-0.25 – 0.23	0.942
N_{state_code}	51			51		
Observations	612			612		
Marginal R^2 / Conditional R^2	0.044 / 0.756			0.074 / 0.932		

Note: [1]95% Confidence Interval. [2]Within-State/District centered 90-day prescribing habits. [3]Between-State/District centered 90-day prescribing habits. [4]Interaction term between procedure type and within-State/District 90-day prescribing habits. [5]Interaction term between procedure type and between-State/District 90-day prescribing habits.