# Health Services Research

# **Opioid Prescribing Patterns and Postprostatectomy Readmission: Data From a Statewide Quality Collaborative**

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OBJECTIVE	To explore whether post-radical prostatectomy (RP) opioid prescription is associated with
	hospital readmission, given that this may represent a potential means of reducing unplanned
	health service utilization.
METHODS	The Michigan Urological Surgery Improvement Collaborative registry was queried for patients
	undergoing RP between May 2018 and October 2024 who completed a questionnaire on number
	of post-RP opioid pills prescribed. Multivariable models were constructed to evaluate the re-
	lationship between either (1) the number of pills prescribed or (2) the provider's "default"
	prescribing practice and hospital readmissions.
RESULTS	Of 2656 patients with opioid prescription data, 77 were readmitted (rate: 2.9%). Unadjusted
	readmission rate by opioid prescription count was 2.1% for those receiving no pills, 3.0% for 1-6
	pills, and 4.2% for >6 pills. Multivariable models demonstrated a significant association of opioid
	prescription (overall P = .041; 0 pills [vs. > 6 pills]: odds ratio [OR] 0.45, 95% confidence interval
	[CI] 0.24-0.84, P = .012) and provider "default" prescribing practice (after switch to "opioid-free"
	[vs. before]: OR 0.53, 95% CI 0.29-1.00, exact $P = .0495$ ) with readmission.
CONCLUSION	Omission of post-RP opioid prescription is significantly associated with lower odds of read-
	mission; a change in prescribing habits to "opioid-free" is associated with a decrease in read-
	mission rate. Post-RP opioid prescription is an actionable target in the reduction of unplanned
	health service utilization. UROLOGY xx: xxx-xxx, xxxx. © 2025 Elsevier Inc. All rights are
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Junit nplanned post-operative healthcare utilization is associated with poor patient outcomes and increased costs.<sup>1</sup> The high nationwide annual volume of RP, furthermore, suggests that even incremental change has the potential to measurably impact population-level health outcomes and system costs. Despite this, there have been only limited efforts to identify specific actionable, generalizable targets for quality improvement and readmission reduction, and a prevailing trend in post-RP health service utilization is unclear.

Simultaneously, post-operative opioid prescription has been identified as a significant contributor both to post-operative complications as well as to the national opioid

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epidemic.<sup>2</sup> While most literature has connected large opioid prescriptions to opioid abuse disorder,<sup>3</sup> less work has explored the potential harms of smaller opioid prescriptions. The relationship between opioids and delayed gastrointestinal recovery suggests that unnecessary prescriptions may have modest but real impacts on population- and system-level outcomes, such as post-operative readmission.

With this in mind, we explored the relationship between post-operative opioid prescribing and hospital readmission amongst patients undergoing RP in the Michigan Urological Surgery Improvement Collaborative (MUSIC). Identification of opioid prescription as a possible driver of post-RP health service utilization provides an appealing opportunity to improve population-level outcomes and costs, particularly in light of established provider-oriented interventions to reduce prescribing.

# METHODS

#### Cohort

We reviewed patients undergoing RP in the MUSIC registry from May 2018 to October 2024, during which

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time opioid prescribing was self-reported by patients as part of prospectively collected patient-reported outcomes (PROs). MUSIC is a statewide quality improvement collaborative consisting of more than 250 urologists and 46 diverse practices; MUSIC PRO is a subprogram of MUSIC, in which practices can choose if they wish to participate and enroll their patients. Eighty-nine urologists from 32 sites participate in PRO collection. RP patients were included in the present study if they completed baseline and 1-month post-operative PRO questionnaires and answered an enclosed question on opioid prescription.

## **Endpoints and Covariates**

The primary study endpoint was hospital readmission within 30 days following RP. Readmissions are entered into the MUSIC registry by trained abstractors who routinely review charts of RP patients, recording date and reasons for readmission. Only the first readmission was recorded for each patient.

The primary study covariate of interest was post-RP opioid prescription. Number of pills prescribed was abstracted from patient-completed questionnaire items that asked about specific drug, dosage, and number of pills prescribed. These were converted into the equivalent number of 5 mg oxycodone pills via morphine milligram equivalent tables. These pill equivalent counts were categorized into 3 groups (none, 1-6, and > 6 pills), based on a MUSIC quality improvement initiative that advised limiting prescription to under 6 pills of oxycodone 5 mg after uncomplicated robotic or laparoscopic RP. Modeling opioid prescription through a more complex approach was considered but not pursued given the distribution of pill counts > 0—many pill counts fell exactly on the chosen category boundaries, likely due to these interval cutoffs being used in MUSIC quality improvement initiatives or default perioperative pathways-and the overall low event rate.

Second, we characterized changes in surgeon prescribing pattern to estimate the impact of converting to an "opioid-free" default strategy on readmissions. We created a provider-level variable that categorized default prescription practice into 1 of 5 categories: "always prescriber," "opioid prescriber prior to switching to opioidfree," "prior opioid prescriber now switched to opioidfree," "never prescriber," "stopped prescribing opioids but then resumed." This classification was based upon the mode of number of pills prescribed in a calendar year. To illustrate, a surgeon whose mode number of pills prescribed was 6 in 2018, 2019, and 2020, and 0 in each year following 2021, would be characterized as "opioid prescriber prior to switching to opioid-free" and "prior opioid prescriber now switched to opioid-free" before and after 2021, respectively. Additional study covariates included patient demographic, disease specific, and index hospitalization characteristics.

# Analysis

We hypothesized that post-RP opioid prescribing causes readmissions primarily through gastrointestinal complications. A competing hypothesis is that low patient pain threshold, patient-level psychological factors, or community support factors may lead to both post-RP opioid prescription and unplanned health service utilization. Therefore, 2 multivariable mixed effects logistic regression models were developed to explore the relationship between opioid prescription and readmission, with nested random intercepts with an unstructured covariance matrix accounting for within-practice/surgeon correlation. The first model explored the association between number of pills prescribed and readmission. The second explored the association between surgeon change in default prescribing practice (eg, historically prescribing more than 6 tablets then changing to a contemporary default of no opioid prescribing) and readmission. Default prescribing practice was operationalized as the mode number of pills prescribed by a given surgeon over a calendar year. This approach accounts for the competing hypothesis, since default prescription practice does not change in response to an individual patient's pain threshold. In other words, the only impact of default prescribing practice on readmission is through opioid prescription (not affected by patient pain threshold or health status). This approach is analogous to an interrupted time series investigating a within-provider policy change around opioid prescribing. Interrupted time series facilitates the isolation and estimation of downstream outcomes-in this case, a personal policy of opioid omission on readmission. The model was constructed only for the subset of patients whose surgeon changed from "opioid-prescribing" (mode number of pills >0 in a calendar year) to "opioid-free" (mode number of pills = 0 in a calendar year) during the study period; the model term specified whether a given RP took place after versus before the surgeon switched to "opioid-free." For both models, area under the curve (AUC) was calculated to summarize the performance of the models, with a 95% confidence interval generated from 2000 stratified (to ensure same case/control balance in each sample) bootstrap replicates. Complete case analysis was employed for modeling. P-values of < .05were deemed statistically significant; analysis was performed in R (v. 4.4.1) with the lme4 package used for model fitting.<sup>4</sup> Full model terms and readout are included in Supplement.

#### RESULTS

Of 2963 patients completing baseline and first post-operative questionnaire, 2656 (89.6%) completed the question on opioid prescription and comprised the study cohort. Baseline characteristics stratified by number of pills prescribed at discharge are shown in Table 1. Patients not prescribed opioids were had a shorter post-

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able 1. Baseline characteristics of the stu	ly cohort, stratified by the	he number of opioid pills	prescribed at discharge
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	P-value
0 pills 1-6 pills >6 pills	
Characteristic N = 1227 N = 791 N = 638	
Age 66 (61, 70) 65 (60, 69) 65 (60, 69)	< .001
BMI 28.7 (26.1, 31.8) 28.7 (26.1, 31.9) 28.9 (26.4, 32.3)	.5
Missing 94 51 31	
Race	.018
White     1054 (86%)     639 (81%)     522 (82%)	
African American     47 (3.8%)     43 (5.4%)     44 (6.9%)	
Other     23 (1.9%)     18 (2.3%)     12 (1.9%)       Utility     100 (0.000)     100 (0.000)     100 (0.000)	
Unknown 103 (8.4%) 91 (12%) 60 (9.4%)	050
	.056
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	
>=2 79 (6.9%) 48 (6.6%) 57 (9.6%)	
Missing 85 62 42	
Practice Type	< 001
Academic 447 (36%) 191 (24%) 77 (12%)	1.001
Community 217 (18%) 65 (8.2%) 227 (36%)	
Hybrid 563 (46%) 535 (68%) 334 (52%)	
Clinical T-Stage	.004
T1 896 (76%) 577 (77%) 486 (80%)	
T2 218 (18%) 151 (20%) 109 (18%)	
T3/T4 30 (2.5%) 12 (1.6%) 8 (1.3%)	
Tx 41 (3.5%) 10 (1.3%) 7 (1.1%)	
Missing 42 41 28	
Pre-Surgery PSA	.14
<10 958 (80%) 606 (78%) 521 (83%)	
10-20 187 (16%) 137 (18%) 87 (14%)	
> 20 60 (5.0%) 37 (4.7%) 21 (3.3%)	
Missing 22 II 9 Ultrageneration (clumps (co) 22 (20 E1) 20 (20 40) 28 (20 E0)	074
Microsoft 440 245 469 36 (30, 50)	.074
Riopey GG	2
1 123 (10%) 90 (11%) 92 (15%)	.2
2 587 (48%) 361 (46%) 286 (45%)	
3 309 (25%) 197 (25%) 142 (22%)	
4 124 (10%) 91 (12%) 73 (12%)	
5 77 (6.3%) 49 (6.2%) 41 (6.5%)	
Missing 7 3 4	
Surgical Approach	.087
Open     15 (1.2%)     20 (2.5%)     13 (2.0%)	
Laparoscopic/Robotic 1212 (99%) 771 (97%) 625 (98%)	
PLND 985 (81%) 614 (80%) 513 (83%)	.3
Missing 17 21 19	
Nerve Sparing	.059
None 166 (15%) 92 (14%) 88 (16%)	
Unilateral 149 (14%) 89 (14%) 98 (18%)	
$\begin{array}{cccc} \text{Dildefal} & 700 (71\%) & 472 (72\%) & 349 (65\%) \\ \text{Missing} & 152 & 128 & 103 \\ \end{array}$	
$\begin{array}{cccc} \text{Missing} & 152 & 138 & 103 \\ \text{Longth} & \text{f Stay} (\text{Days}) & 1 00 (100 \ 100) & 1 00 (100 \ 100) & 1 00 (100 \ 100) \end{array}$	< 001
Length of Stay (Days) 1.00 (1.00, 1.00) 1.00 (1.00, 1.00) 1.00 (1.00, 1.00)	< 001
Od $53 (43\%)$ $38 (48\%)$ $29 (45\%)$	×.001
1d 1061 (86%) 620 (78%) 494 (77%)	
2d 81 (6 %) 105 (13%) 95 (15%)	

Values are reported as median (interquartile range), or n (%) for continuous and categorical variables, respectively. *P-values indicate results* of *Kruskal-Wallis rank sum test and Pearson's Chi-squared test for continuous and categorical variables, respectively.* 

operative length of stay (86% 1d vs. 78% and 77%, P < .001) compared with those prescribed either 1-6 or > 6 pills; a higher proportion were Caucasian (86% vs 81% and 82%, P = .018) and underwent RP at academic practices (36% vs 24% and 12%, P < .001).

Seventy-seven readmissions (readmission rate: 2.9%) were recorded amongst the study cohort. Unadjusted readmission rate by opioid prescription count was 2.1% (26 readmissions) for those receiving no pills, 3.0% (24 readmissions) for 1-6 pills, and 4.2% (27 readmissions) for > 6 pills, suggesting that

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**Table 2.** Results of a multivariable mixed effects logistic regression model for patient readmission, with nested random intercepts with an unstructured covariance matrix for practice and surgeon, and with opioid prescription operationalized as (a) number of pills received by patient or (b) provider "default' prescribing practice at time of surgery.

(a)			
Characteristic	OR	95% CI	P-value
Intercept	0.004	0, 0.11	.001
Opioid Prescription (Reference: > 6 pills)			.041
1-6 pills	0.74	0.40, 1.37	.3
0 pills	0.45	0.24, 0.84	.012
Age (per 5 years)	1.00	0.82, 1.22	>.9
BMI (per 5 years)	1.36	1.06, 1.76	.016
Charlson Score (Reference: 0)			.7
1	1.09	0.55, 2.18	.8
>=2	1.44	0.63, 3.29	.4
Biopsy ISUP Grade Group (GG) (Reference: GG1)			>.9
GG2	1.14	0.49, 2.65	.8
GG3	1.13	0.45, 2.87	.8
GG4	0.87	0.28, 2.72	.8
GG5	1.47	0.46, 4.71	.5
PLND	0.86	0.44, 1.68	.7
Length of Stay (Per 1 day)	1.26	1.05, 1.51	.015
(b)			
Characteristic	OR	95% CI	P-value
Intercept	0.04	0, 1.87	.10
Surgeon Prescription Group (Reference: Before Switch to Opioid-free)			.0495
After Switch to Opioid-free	0.53	0.29, 1.00	.0495
Age (per 5 years)	0.84	0.67, 1.07	.2
BMI (per 5 years)	1.38	1.03, 1.87	.034
Charlson Score (Reference: 0)			.7
1	1.38	0.61, 3.11	.4
>=2	1.00	0.30, 3.37	> .9
Biopsy ISUP Grade Group (GG) (Reference: GG1)			.9
GG2	1.09	0.40, 2.96	.9
GG3	1.23	0.41, 3.73	.7
GG4	0.87	0.22, 3.42	.8
GG5	1.74	0.43, 7.03	.4
PLND	0.73	0.33, 1.63	.4
Length of Stay (Days)	1 1 8	0.87 1.59	3

305 of 2656 and 230 of 1978 patients were excluded due to missing values of covariates in (a) and (b), respectively. Age, BMI, and length of stay were modeled as continuous; receipt of PLND and surgeon prescription group as binary; and Charlson score, opioid prescription, and biopsy pathology as factor/ordinal variables.

Bold value indicates statistical significance (P < .05).

roughly 110 and 48 patients intended to receive 1-6 pills and > 6 pills, respectively, would need to be prescribed no pills to prevent one readmission.

A model exploring the relationship between prescription pill count and readmission is shown in Table 2a. After adjusting for demographic and clinicopathologic variables, the number of pills prescribed was significantly associated with readmission (overall P = .041; 0 pills [vs. > 6 pills]: odds ratio [OR] 0.45, 95% confidence interval [CI] 0.24-0.84, P = .012). Length of admission following RP (OR [per 1 day]: 1.26, 95% CI 1.05-1.51, P = .015) and body mass index (OR [per 5 kg/m<sup>2</sup>]: 1.36, 95% CI 1.06-1.76, P = .016) were also significantly associated with readmission. AUC of the model was 0.73 (95% CI: 0.67-0.79).

Regarding the default prescribing practice analysis, 1978 (74.5%) patients underwent RP with a surgeon whose prescribing pattern changed from "opioid-prescribing" to "opioid-free" during the study period. Five hundred and eighty-one (29.4%) and 1397 (70.6%) prostatectomies took place before and after a surgeon switched defaults, respectively. Unadjusted readmission rates were 4.0% (23 readmissions) prior to, compared with 2.3% (32 readmissions) following a switch to default "opioid-free." Unadjusted readmission rate amongst "always prescribers" was 4.5% (17 readmissions).

A model evaluating the association between change in default opioid prescription practice and readmission is shown in Table 2b. After adjusting for demographic and clinicopathologic variables, RP performed by a surgeon who switched to "opioid-free" was associated with a lower odds of readmission (after switch to "opioid-free" [versus before]: OR 0.53, 95% CI 0.29-1.00, P = .0495). AUC of the model was 0.71 (95% CI: 0.64-0.78).

Figure 1 shows the proportion of RP with readmissions attributed to a particular reason for admission, stratified by number of pills prescribed.



Figure 1. Proportion of radical prostatectomies with readmission attributed to a particular reason for admission, stratified by the number of pills prescribed.

# DISCUSSION

This study is among the first to demonstrate a strong association between opioid prescribing and hospital readmission in a statewide quality collaborative. A model for readmission incorporating provider "default" prescribing practice adjusts for important patient-level confounding (eg, low pain threshold, health status at discharge). Further, decreasing odds of readmission with decreasing pill categories suggests a "dose effect," arguing for the underlying hypothesis that opioid prescription causes readmission.

Rates and risk factors associated with post-RP readmission have been described previously.<sup>5,6</sup> We update these figures in a contemporary, well-annotated, all-payer dataset capturing surgery and complications across diverse practice settings in Michigan. Thirty-day post-robotic RP readmission rates have been estimated at 3%-4% in large national samples,<sup>5,7,8</sup> and appear to be relatively static in the post-robotic adoption era. Our rate of 2.9% is consistent with these estimates, and a slight outperformance of the national average may reflect the quality improvement interests of participating practices. Here, we confirm that variables such as index hospitalization length of stay and patient health status factors (eg. body mass index) are important predictors of post-RP readmission; our findings sit within a broader context that has also identified operative and hospital-level variables as predictors of readmission.<sup>5-8</sup> Among risk factors previously identified, no work to date has specifically probed opioid prescribing-a highly modifiable provider behavior-as a correlate of post-RP readmission.

Existing studies investigating the relationship between opioid receipt and risk of unplanned readmission come

largely from fields outside of urology. Work in the orthopedic<sup>10</sup> and general surgery<sup>11</sup> literature has correlated pre-operative opioid use with increased chance of readmission (and longer index hospitalization), though in these cases, opioid receipt may serve as a surrogate for disease severity, distinct from prostate cancer and RP. In contrast, post-operative opioid prescription was protective for readmission in a large, statewide, general surgery cohort, though no difference in ED visits or composite adverse events was observed.<sup>12</sup> Our results diverge from these findings, possibly due to the significant heterogeneity of case mix, lower rates of opioid-free surgery, and the inclusion of surgeries that are more morbid and more painful than robotic prostatectomy. By investigating a non-bowel surgery where the primary condition is not associated with pain or opioid use, the present study is well positioned to isolate and estimate the impact of new opioid prescriptions on readmission risk, and our findings could generalize to other comparable surgical procedures.

Our work should be interpreted within the context of its limitations. First, not all patients undergoing RP within MUSIC participate in MUSIC PRO, though among participants, the rate of those reporting opioid prescription data is high. Second, reliance on patient reporting of prescribed pill count is subject to recall bias; our findings could be corroborated in a claims dataset that includes medication prescription data. Third, the second model showed an association only narrowly below the statistical significance threshold and should be interpreted thoughtfully. Fourth, functional recovery data and patient-reported data on attitudes towards opioid prescription, which may inform more detailed models, were not available. More detailed reasons for readmission (eg, abdominal pain, ileus, constipation) were not available. Fifth, complete case analysis may create bias given that patients with missing covariates may have different opioid use and readmission characteristics from the rest of the cohort. Finally, while pill prescription counts were reported, actual opioid consumption by patients—both inpatient and outpatient/post-operative—was not available and may better reflect the true relationship between opioids and readmission, though this would also bias our results towards the null by creating clinical heterogeneity within pill subgroups.

These limitations considered, our results highlight a robust association between readmissions and opioid prescriptions, pushing opioid prescription reduction interventions to the forefront of actionable and generalizable readmission reduction strategies. Individual surgeons or organizations looking to improve their readmission rates may investigate and address opioid prescribing patterns as a target for reducing unplanned healthcare utilization. Additionally, these findings further support the notion that limiting the amount of postoperative opioids prescribed is beneficial to patients, given the impact of readmissions on patient health status. Further work will elucidate precise mechanisms by which opioids cause unplanned health service utilization.

# **CRediT Authorship Contribution Statement**

Patrick Lewicki: Writing – review & editing, Writing – original draft, Project administration, Investigation, Conceptualization. Kevin Ginsburg: Writing - review & editing, Supervision, Conceptualization. Sabir Meah: Writing – review & editing, Visualization, Investigation, Formal analysis, Data curation. Corinne Labardee: Resources, Project administration, Funding acquisition, Data curation. Anna Johnson: Supervision, Resources, Project administration, Funding acquisition. Firas **Abdollah:** Writing – review & editing, Supervision, Investigation. Jason Hafron: Writing - review & editing, Supervision, Project administration, Conceptualization. Alice Semerijan: Writing – review & editing, Supervision, Project administration, Conceptualization. Brian R. Lane: Writing - review & editing, Supervision, Investigation, Funding acquisition, Conceptualization. Tudor Borza: Writing - review & editing, Writing - original draft, Supervision, Project administration, Investigation, Funding acquisition, Conceptualization.

# **Declaration of Competing Interest**

The authors declare the following financial interests/ personal relationships which may be considered as potential competing interests: all authors reports financial support was provided by Blue Cross Blue Shield of Michigan. Other authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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# **Appendix A. Supporting Information**

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.urology. 2025.05.063.

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