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A Simple, Personalized Opioid Stratification Pathway Dramatically Reduces Opioid Utilization

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ABSTRACT

Orthopaedic surgeons account for the largest proportion of opioid prescriptions in the United States among surgical specialties. In total joint arthroplasty, increased opioid use has been associated with poorer clinical and functional outcomes. Despite an abundance of literature on opioid mitigation strategies, most fail to provide personalized prescriptions. Typically, most protocols prescribe the same opioid regimen regardless of patient factors or the extent of the planned procedure. We present a simple opioid stratification pathway that can be used by physicians and office staff as they prepare patients for arthroplasty. We have found this to be easy to implement, effective, and sustainable at a tertiary academic institution and allows for iterative improvements over time.

Introduction

After designation as a public health emergency in 2017, there has been a rapidly increasing awareness of opioid use and abuse in the United States [1]. Orthopaedic surgeons are the third-highest prescribers of opioid prescriptions among physicians, accounting for an estimated 7.7% of all opioid prescriptions in the United States, more than any other surgical specialty [2].

In addition to the societal health and financial burden, there have been documented associations between perioperative opioid use and poorer outcomes for patients undergoing total hip arthroplasty (THA) and total knee arthroplasty (TKA) [3-6]. In addition to higher reported revision rates with perioperative opioid use, as many as 15% of patients who are narcotic naïve before their elective hip or knee arthroplasty will become “chronic users” [3,6].

The American Academy of Orthopaedic Surgeons (AAOS) released an information statement for practitioners that says, in part, "a comprehensive opioid program is necessary to decrease opioid use, misuse, and abuse in the United States” [7]. In addition, the statement underscores the importance of physician leadership in imparting a cultural change to limit inappropriate uses of opioid pain medications [7,8].

Most current perioperative opioid-prescribing practices and recommendations provide little, if any, stratification based on the patient or procedure, and there are no formal guidelines as to the appropriate amount, dosing, or choice of agent. Typically, most protocols prescribe the same opioid regimen regardless of the extent of the planned procedure or patient factors. With this in mind, we present a practical and personalized protocol which “right-size” opioid utilization based on patient factors and patient expectations related to pain, opioid use, or avoidance.

In addition, we report our experience over a 5-year period related to a physician-led, institutional perioperative opioid mitigation strategy highlighted by this structured, stratified approach to prescribing practices for all patients undergoing THA and TKA.

Office tip

As part of an arthroplasty-based quality initiative, we implemented a comprehensive multidisciplinary pain control protocol with a focus on reducing opioid utilization (Fig. 1). In addition to widely accepted perioperative pain management strategies, one of

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Figure 1. Multidisciplinary pain management protocol.

the major tenets of this initiative was a more selective and personalized utilization of opioid prescriptions.

Patients were carefully interviewed at their initial and preoperative visits and stratified into one of 4 general consensus-derived prescribing categories based on preoperative opioid utilization, patient expectations related to opioid use or avoidance, and complexity of the planned procedure. Each category, although ultimately at the discretion of the operative surgeon, correlated with a structured postoperative opioid regimen. Table 1 shows the original protocol, and Table 2 shows the 2020 protocol. This pathway was quite straightforward to implement and modify based on patient and provider feedback as well as changes in state legislation. Similarly, we encourage iterative changes and modifications based on local practice patterns.

The planned pathway for each patient was documented before surgery and referenced throughout the perioperative course for

Table 1
Stratified opioid prescription pathway in 2017.

Medication	"Opioid sparing" (# tablets)	"Narcotic naïve" (# tablets)	"Standard" (# tablets)	"Long-term use" (# tablets)
Multimodal (Tylenol, NSAIDs, gabapentinoids)		X		
Tramadol (50-mg tablet)	30	56	56	56
Hydrocodone/ACAP (5-/325-mg tablet)	20 (Filled only if needed)	56	56	0
Oxycodone (5-mg tablet)	0	0	0	56
OME (daily/total)	15/150 (30/250 if hydrocodone used)	30/560[a]	45/560[a]	52.5/870

ACAP, acetaminophen.
Although patient stratification was ultimately at the discretion of the surgeon, "narcotic-naïve" and "opioid-sparing" protocols were typically used for primary arthroplasty cases, with the "opioid sparing" reserved for patients who were averse or allergic to traditional opioid narcotics. The "standard" protocol was typically used for complex primary cases (prior open surgery, post-traumatic arthritis, etc.), revisions, and patients who used occasional narcotics previously. The "long-term use" protocol was reserved for patients who met our criteria for chronic continuous opioid use.
Categorical patient stratification based on preoperative opioid use and postoperative opioid pain regimes.
"X" implies that all patients recieved this regardless of category.
[a] Both groups are prescribed the same number of tablets, but the standard group receives more frequent dosing daily.

Table 2
Stratified opioid prescription pathway in 2020 following implementation of statewide mandatory e-prescribing and quantity restrictions.

Medication	"Opioid Sparing" (# tablets)	"Narcotic Naïve" (# tablets)	"Standard" (# tablets)	"Long-term use" (# tablets)
Multimodal (Tylenol, NSAIDs, gabapentinoids)		X		
Tramadol (50-mg tablet)	21	0[a]	0[a]	21[a]
Hydrocodone/ACAP (5-/325-mg tablet)	0[a]	28[a]	0[a]	0
Oxycodone (5-mg tablet)	0	0	28	28[a]
OME (daily/total)	15/105	20/140	30/210	45/315

"X" implies that all patients recieved this regardless of category.
[a] Prescription changes are indicated.

consistency. Inpatient and outpatient postoperative orders were modified to correspond to the patient's pathway "designation," automatically generating corresponding documentation, prescriptions, and orders via the electronic medical record. To facilitate compliance with these protocols, standardized discharge documentation (including patient education materials specific to each pathway) was also created to provide uniform messaging and encourage consistent medication use.

We implemented this pathway in 2015 for all procedures performed by 8 fellowship-trained arthroplasty surgeons and did not exclude any patients based on procedure or patient factors. We reviewed our experience with this pathway from 2014 to 2018 (including 1 year before implementation), which included 4133 patients undergoing 5046 primary and revision total joint arthroplasty (TJA) procedures (Table 3). It should be noted that as the total volume increased year over year, the relative proportion of revisions remained relatively unchanged. There was an overall significant 34.4% ($P < .001$) reduction in the average inpatient oral morphine equivalent (OME) consumption. On an outpatient basis, there was a 52.4% ($P < .001$) reduction in the average OME prescription (Fig. 2). During the same time period, the length of stay decreased from 4.5 days to less than 3 days, home discharge percentages increased from 60.7% to 71.8%, and there was a decrease in 90-day readmissions from 4.5% to 3.7%. The pain component of the Hospital Consumer Assessment of Healthcare Providers and Systems score increased from 73.3% to 81.0% during the same time period, with a higher score indicating better patient satisfaction with pain control.

Discussion

It has been previously reported that the presence of a physician-led strategy is critical to the success of any opioid mitigation initiative [9]. Moreover, the individual patient requirements of these medications after surgery are less understood and vary widely from physician to physician [10-12]. In our experience, a physician-led, comprehensive strategy highlighted by a personalized stratification pathway was very successful in reducing postoperative opioid utilization. Despite a little change in our patient population over time, we would be remiss not to acknowledge that this was just one component of a broader multifaceted initiative, and it is difficult to calculate the relative contributions of any one element. In addition, public awareness of opioid narcotics has grown during this same time period, which may have created population-level behavioral changes irrespective of any external strategies. However, we feel that our success was achieved in large part through this novel method of standardized stratification and patient engagement. More importantly, we feel that this simple modification is straightforward to implement in most practice settings and even has opportunity for applicability beyond arthroplasty.

There have been several recent reports demonstrating effective opioid management strategies for patients undergoing TJA (Table 4) [14-16]. Stepan et al. [16] demonstrated the success of prescriber education and development of surgeon consensus, procedure-specific institutional guidelines following outpatient upper extremity, and sports medicine procedures (not including TKA or THA). Wyles et al. [13] demonstrated the success of procedure-specific guidelines in limiting opioid prescriptions to a maximum of 400 OMEs after primary TJA procedures in opioid-naïve patients. We present a simple, personalized protocol that was applied for all patients undergoing TJA at a large tertiary center regardless of the surgeon, procedural complexity (including revision surgery), preoperative opioid usage, or chronic pain syndromes. Despite this, we observed a substantial decrease in OMEs both in the inpatient and outpatient settings. This confirms, on a larger scale with a more heterogeneous patient population, these previous reports that structured pathways are instrumental in decreasing opioid use.

The presence of a simple, structured pathway has allowed for seamless incremental updates and adaptations based on feedback from patients or the surgical team, as well as legislative policies regarding prescription practices. Our team found it straightforward to maintain and update this pathway several times over the review period simply because it had been "protocolized." With the introduction of prescription limits and electronic prescription mandates in 2020, our group has updated the pathway from a "bulk supply" prescription for the entire postoperative period to a targeted "on demand" weekly prescription. Our most recent protocol is outlined in Table 2. We anticipate this will further reduce prescriptions and especially wasted or surplus opioids. In addition, leveraging

Table 3
Procedural volume by year.

	2014	2015	2016	2017	2018	Total
Patients (No.)	461	666	839	1009	1158	4133
Primary TJA (No.)	495	637	787	896	958	3773
Revision TJA (No.)	161	227	279	290	316	1273
Procedures (No.)	656	864	1066	1186	1274	5046

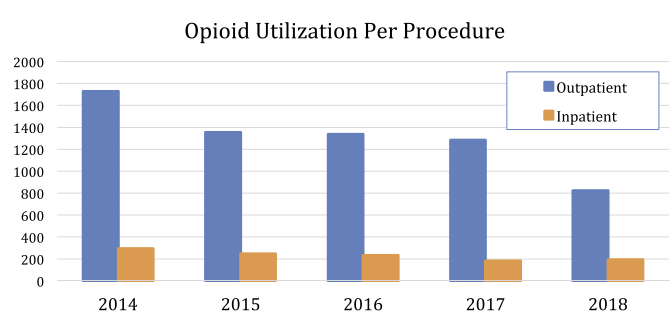

Figure 2. Opioid utilization before and after implementation. Reported in OME (averaged totals per procedure) by year. Inpatient values represent OME consumed during hospitalization. Outpatient values represent OME prescriptions associated with that procedure.

Table 4
Summary of recent publications on opioid reduction strategies for total knee arthroplasty and total hip arthroplasty.

Study	Procedures (before/after intervention)	Intervention	Procedure	All surgeons	Inpatient/ outpatient opioid use	Chronic opioid users	Opioid time period	Preintervention/ postintervention study period	OME decrease
Wyles et al. 2018 [13]	2573 (1822/751)	Institutional prescribing limit	Primary TKA and THA	No	Outpatient	No	Within 30 d	12 mo/5 mo	48%
Holte et al. 2019 [14]	399 (282/117)	Institutional prescribing limit	Primary TKA and THA	No	Outpatient	No	Within 90 d	7 mo/2 mo	51%
Reid et al. 2020 [15]	1125 (555/570)	Legislative prescribing limit	Primary TKA and THA	Yes	Outpatient	No	Within 90 d	6 mo/6 mo	30%
Current series	5046 (656/4390)	Comprehensive multifaceted strategy	Primary and revision TKA and THA	Yes	Inpatient and Outpatient	Yes	No time limit	12 mo/48 mo	52%

technology to look at consumption (eg, smart pill bottles, interactive smartphone applications, and patient-tracking platforms) rather than prescriptions will also be invaluable information for optimizing prescribing practices.

Summary

Opioid awareness and an active management strategy highlighted by structured, personalized prescription pathways has been highly effective in drastically decreasing opioid utilization in both the inpatient and outpatient settings, while maintaining patient satisfaction and improving quality metrics. In addition, this pathway has increased awareness and personalized opioid prescription practices by surgeons, fellows, residents, and advanced practice providers in our practice. We feel this stratification can be effectively implemented into any arthroplasty practice and can be updated incrementally with iterative improvements.

Conflict of interests

A.P. Boezaart receives royalties from Teleflex for stimulating and nonstimulating peripheral nerve block catheters and receives royalties, financial, or material support from Kindle publishers, Elsevier, and McGraw-Hill for textbooks; C.F. Gray has stock holdings in ROMTech and is a member of the board for the AAOS Examinations and Assessments Committee; H.K. Parvataneni is an editorial board member for *Arthroplasty Today* and is a program committee member of the AAOS, AAHKS, American College of Perioperative Medicine, and Florida Orthopaedic Society; H.A. Prieto is a program committee member for Florida Orthopaedic Society; J.T. Deen is a member of the Board of Directors of Florida Orthopedic Society and the AAHKS Quality Measures Committee—CPG for perioperative pain management in total joint arthroplasty; all other authors declare no potential conflicts of interest.

References

[1] Https://www.hhs.gov/about/news/2017/10/26/hhs-acting-secretary-declares-public-health-emergency-address-national-opioid-crisis.html.
[2] Volkow ND, McLellan TA, Cotto JH, Karithanom M, Weiss SR. Characteristics of opioid prescriptions in 2009. JAMA 2011;305(13):1299.
[3] Goesling J, Moser SE, Zaidi B, et al. Trends and predictors of opioid use after total knee and total hip arthroplasty. Pain 2016;157(6):1259.
[4] Inacio MC, Pratt NL, Roughead EE, Paxton EW, Graves SE. Opioid use after total hip arthroplasty surgery is associated with revision surgery. BMC Musculoskelet Disord 2016;17:122.
[5] Rozell JC, Courtney PM, Dattilo JR, Wu CH, Lee GC. Preoperative opiate use independently predicts narcotic consumption and complications after total joint arthroplasty. J Arthroplasty 2017;32(9):2658.
[6] Zywiel MG, Stroh DA, Lee SY, Bonutti PM, Mont MA. Chronic opioid use prior to total knee arthroplasty. J Bone Joint Surg Am 2011;93(21):1988.
[7] American Academy of Orthopaedic Surgeons. Information statement: opioid use, misuse, and abuse in orthopaedic practice. American Academy of Orthopedic Surgeons; 2015. Available at, https://www.aaos.org/uploadedFiles/PreProduction/About/Opinion_Statements/advistmt/1045%20Opioid%20Use,%20Misuse,%20and%20Abuse%20in%20Practice.pdf.
[8] Ring D. Pain relief: what can we do? AAOS now: American Academy of orthopaedic surgeons. Available at, https://www.aaos.org/AAOSNow/2015/Jan/research/research2/; 2015. [Accessed 1 March 2019].
[9] Wetzel M, Hockenberry J, Raval MV. Interventions for postsurgical opioid prescribing: a systematic review. JAMA Surg 2018;153(10):948.
[10] Sabatino MJ, Kunkel ST, Ramkumar DB, Keeney BJ, Jevsevar DS. Excess opioid medication and variation in prescribing patterns following common orthopaedic procedures. J Bone Joint Surg Am 2018;100(3):180.
[11] Raneses E, Secrist ES, Freedman KB, Sohn DH, Fleeter TB, Aland CM. Opioid prescribing practices of orthopaedic surgeons: results of a national survey. J Am Acad Orthop Surg 2019;27(4):e166.
[12] Thiels CA, Anderson SS, Ubl DS, et al. Wide variation and overprescription of opioids after elective surgery. Ann Surg 2017;266(4):564.
[13] Wyles CC, Hevesi M, Trousdale ER, et al. The 2018 Chitranjan S. Ranawat, MD Award: developing and implementing a novel institutional guideline strategy

reduced postoperative opioid prescribing after TKA and THA. Clin Orthop Relat Res 2019;477(1):104.
[14] Holte AJ, Carender CN, Noiseux NO, Otero JE, Brown TS. Restrictive opioid prescribing protocols following total hip arthroplasty and total knee arthroplasty are safe and effective. J Arthroplasty 2019;34(7S):S135.
[15] Reid DBC, Shapiro B, Shah KN, et al. Has a prescription-limiting law in Rhode Island Helped to reduce opioid use after total joint arthroplasty? Clin Orthop Relat Res 2020;478(2):205.
[16] Stepan JG, Lovecchio FC, Premkumar A, et al. Development of an institutional opioid prescriber education program and opioid-prescribing guidelines: impact on prescribing practices. J Bone Joint Surg Am 2019;101(1):5.