

# Opioid Prescribing Habits for Common Arthroscopic Procedures in Opioid Naïve Patients

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**Background:** With the opioid epidemic and the increasing number of opioid-related deaths, there is growing awareness in the medical community regarding the dangers of opioid overprescription. As a result, there is a willingness among physicians to abandon old norms and adopt new data-driven prescribing practices.

**Purpose:** To demonstrate patient-reported consumption data of opioid medications after anterior cruciate ligament (ACL) reconstructions (ACLRs), knee arthroscopies, and rotator cuff repairs to provide data-driven guidelines for prescribing opioids after these procedures.

**Study Design:** Case series; Level of evidence, 4.

**Methods:** Included in the study were 168 patients who underwent an ACLR, knee arthroscopy, or arthroscopic rotator cuff repair over a 17-month period. Patients were excluded if they had an opioid allergy, had preexisting opioid use, had an acute postoperative complication requiring further surgery, required hospitalization, exhibited drug-seeking behaviors, or were lost to follow-up. Medical records were reviewed to determine the number of opioid pills prescribed and the number of pills taken postoperatively. Prescribing was standardized in that 15 hydrocodone/acetaminophen pills (5/325 mg) were prescribed for all knee arthroscopy procedures and 40 hydrocodone/acetaminophen pills were prescribed for all ACL and rotator cuff procedures. The mean number of pills consumed and percentage of prescribed pills taken were analyzed in association with specific procedures and patient demographics.

**Results:** Overall, the mean ( $\pm$ SD) reported opioid consumption overall was  $13.5 \pm 13.0$  pills, with a utilization rate of 45.6% of the prescription. The mean reported opioid consumption for ACLRs, knee arthroscopies, and rotator cuff repairs was  $19.1 \pm 15.4$ ,  $7.2 \pm 5.4$ , and  $17.2 \pm 14.3$  pills, respectively ( $P < .001$ ). This represented a utilization rate of 48%, 47%, and 41%, respectively.

**Conclusion:** This study provides important information regarding opioid utilization after common arthroscopic procedures. For ACLRs, knee arthroscopies, and rotator cuff repairs, by respectively prescribing 20, 10, and 20 pills postoperatively, the amount of unused medications would decrease by 60%, 47%, and 64%, respectively. We recommend prescribing no more than 20, 10, and 20 hydrocodone/acetaminophen pills (5/325 mg) for ACLRs, knee arthroscopies, and arthroscopic rotator cuff repairs, respectively.

**Keywords:** opioid optimization; opioid consumption; pain management; arthroscopy

Led in part by the 2001 Joint Commission on Accreditation of Healthcare Organization's requirement of pain as the fifth vital sign, pain management has become an important part of health care decisions and patient management.<sup>12</sup> However, dependence on or frequent use of opioids has been associated with a 40-fold increased risk of dependence on or abuse of heroin.<sup>11</sup> With the opioid epidemic and an increasing number of opioid-related deaths,<sup>2</sup> there has been a

growing awareness in the medical community regarding the dangers of opioid overprescription.<sup>7</sup>

While the majority of individuals will not develop a dependence on opioid medications, it has previously been demonstrated that with prior prescribing habits, many patients were often left with extra medication that they did not dispose of.<sup>17</sup> The failure to properly dispose of opioids results in potential access to pills that can be abused by other members of the community.<sup>17</sup> In 2006, the National Survey on Drug Use and Health found that for the first time, young adults chose prescription opioid analgesics over marijuana as their primary initial drug of choice.<sup>9</sup> The

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study showed that nearly 71% purchased, stole, or received the medication for free from a friend or relative, and >90% of these opioid analgesics came from a legitimate physician prescription.<sup>9</sup> Another study suggests that 3 in 4 heroin users started by using prescription drugs.<sup>4</sup>

As a result of these opioid- and societal-related issues, there is a willingness among physicians to abandon old norms and adopt new data-driven prescribing practices, hence the need for research regarding the optimization of pain management.<sup>4,10,14,17</sup> Within orthopaedics, studies have been performed that specifically examine opioid consumption in foot and ankle procedures, along with several upper extremity surgeries, but research regarding common knee procedures has been scarce.<sup>10,14</sup>

The purpose of this study was to demonstrate patient-reported consumption data of opioid medications after anterior cruciate ligament (ACL) reconstructions (ACLRs), knee arthroscopies, and arthroscopic rotator cuff repairs in order to provide data-driven guidelines for prescribing opioids after these procedures. We hypothesized that with a standardized prescription regimen of 40, 15, and 40 hydrocodone/acetaminophen (5/325 mg) pills for ACLRs, knee arthroscopies, and arthroscopic rotator cuff repairs, respectively, there will be a low utilization rate and low refill rate, indicating fewer postoperative narcotics are required for optimal opioid stewardship associated with these procedures.

## METHODS

This retrospective review was performed at a single institution and received approval by an institutional review board. Information was gathered from the medical records of a single orthopaedic surgeon (M.M.T.) whose standard practice has been to prescribe a set number of opioids based on the procedure and record the usage thereof postoperatively. This allowed for an anonymous review of the records to obtain data.

### Participants

Overall, 168 patients were included in the study. All patients in this surgeon's practice who underwent 1 of the following procedures—ACLR, knee arthroscopy, or arthroscopic rotator cuff repair—between June 2017 and November 2018 were included. Preoperatively, a discussion was had with each patient regarding postoperative pain control, including the use of narcotics on an as-needed basis and their risk of addiction. Written instructions were also

provided to patients postoperatively that additionally recommended the use of ice and ibuprofen up to 800 mg 3 times daily unless the patient had a medical contraindication or was placed on aspirin for deep vein thrombosis prophylaxis. Patients were excluded if they had an opioid allergy, were already on opioids before the procedure, had an acute postoperative complication requiring further surgery, required hospitalization, exhibited drug-seeking behaviors characterized by the filling of multiple prescriptions from different doctors postoperatively, or were lost to follow-up.

The knee arthroscopy group consisted of minor knee procedures, including partial meniscectomy, meniscal repair, microfracture/abrasion arthroplasty, synovectomy, chondroplasty, and loose body removal. No regional nerve blocks were used preoperatively for these procedures; however, 0.5% bupivacaine was injected at incision sites and intra-articularly. The ACL group included arthroscopic ACLRs with hamstring autograft, bone–patellar tendon–bone autograft, and allograft. Some patients included in the ACL group had concurrent minor meniscal and cartilage procedures. For all ACL procedures, patients received a preoperative femoral nerve block. The rotator cuff repair group consisted of all arthroscopic shoulder procedures in which rotator cuff repair was performed, excluding superior capsule reconstruction and open procedures. All patients undergoing a rotator cuff repair received a preoperative interscalene nerve block.

### Data Collection

Blinded retrospective review of the medical records was performed. Demographic data that were collected included age and sex. Also gathered was information regarding the number of opioid pills prescribed and the total number of pills taken postoperatively as well as the total number of days the pills were taken. At standard 2-week and 6-week postoperative visits, the amount and duration of opioid pill usage was routinely recorded in the medical records, as were any prescription refills. The number of unused pills was determined by subtracting the number of pills reported as taken by patients from the total prescription amount. All patients received instructions on proper pill disposal in accordance with standard Food and Drug Administration guidelines. The opioid used in this study was hydrocodone/acetaminophen at a dosage of 5/325 mg. Prescribing in this surgeon's practice was standardized in that 15 hydrocodone/acetaminophen pills were prescribed for all knee arthroscopy procedures and 40 hydrocodone/

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Ethical approval for this study was waived by University of Maryland Baltimore (HP-00085952).

TABLE 1  
Opioid Consumption by Patient Characteristics and Procedure Type<sup>a</sup>

Category	No. of Patients	No. of Pills Taken	No. of Days Pills Were Taken	Percentage of Prescribed Pills Taken
Age group, y				
0-17	10	10.7 ± 14.8	4.3 ± 4.5	28.4 ± 36.5
18-35	50	16.2 ± 14.7	6.1 ± 5.6	45.9 ± 36.7
36-54	62	10.9 ± 11.2	6.2 ± 4.6	48.1 ± 36.0
≥55	46	14.3 ± 12.3	6.0 ± 5.3	46.0 ± 31.6
Sex				
Female	71	15.0 ± 12.2	6.5 ± 5.5	54.9 ± 33.4
Male	97	12.1 ± 14.0	5.0 ± 4.7	38.0 ± 34.6
Procedure type				
ACL reconstruction	51	19.1 ± 15.4	7.3 ± 6.0	47.5 ± 38.1
Knee arthroscopy	72	7.2 ± 5.4	4.1 ± 3.4	47.3 ± 35.2
Rotator cuff repair	45	17.2 ± 14.3	6.3 ± 5.6	41.0 ± 31.3

<sup>a</sup>Data are reported as mean ± SD unless otherwise indicated. ACL, anterior cruciate ligament.

acetaminophen pills were prescribed for all ACL and rotator cuff procedures.

### Statistical Analysis

The data were analyzed using descriptive statistics. The mean number of pills consumed and the mean number of days they were used were calculated based on patient demographics (age and sex), procedure performed, and ACLR with autograft versus allograft. The percentage of the total prescription used was calculated by dividing the number of pills taken by the total number of pills prescribed for each patient. Single-factor analysis of variance was used to assess statistical significance ( $P < .05$ ) between the continuous variables. The mean medication utilization between sex and ACLR using autograft versus allograft was assessed for statistical significance via the Student  $t$  test ( $P < .05$ ).

## RESULTS

A total of 168 patients (97 male patients and 71 female patients) with a mean age of 42 years (range, 14-78 years) were included in the study (Table 1). Of the initial 176 patients, 8 were excluded from the study: 3 were already taking opioids at the time of surgery; 3 had an opioid allergy; and 2 were lost to follow-up. Overall, 51 patients (30%) underwent ACLRs, 72 patients (43%) underwent knee arthroscopies, and 45 patients (27%) underwent rotator cuff repairs (Table 2). The mean reported opioid consumption among all procedures was  $13.5 \pm 13.0$  pills (range, 0-55), with a utilization rate of 46% of the entire prescription. The mean reported opioid consumption for ACLRs, knee arthroscopies, and rotator cuff repairs were  $19 \pm 15$  pills (range, 0-45),  $7 \pm 5$  pills (range, 0-20), and  $17 \pm 14$  pills (range, 0-55), respectively ( $P < .001$ ) (Figure 1). This represented a utilization rate for these procedures of 48%, 47%, and 41%, respectively. The pills were used over a mean time of 7.3, 4.1, and 6.3 days for ACLRs, knee

TABLE 2  
Most Common Surgical Procedures Performed<sup>a</sup>

Procedure	No. of Patients (%)
ACLR	51 (30)
Autograft	38 (75)
Allograft	13 (25)
Knee arthroscopy	72 (43)
Rotator cuff repair	45 (27)

<sup>a</sup>Percentage of autograft versus allograft for ACLR is relative to total number of ACLRs performed. ACLR, anterior cruciate ligament reconstruction.

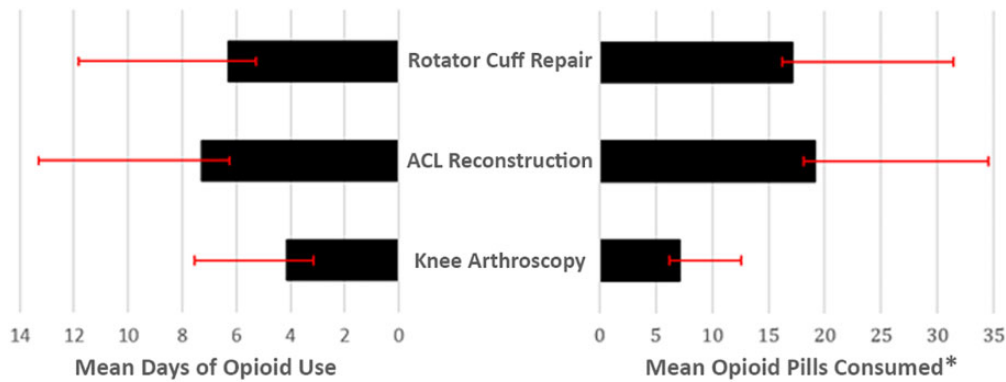
arthroscopies, and rotator cuff repairs, respectively (Table 1 and Figure 1).

### Overall Opioid Consumption

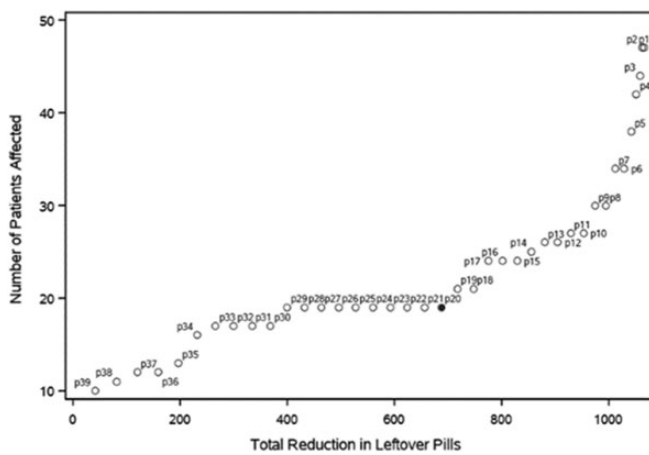
Of the 168 patients included, 143 (85%) discontinued the use of their prescription before finishing all the pills. A total of 24 patients (14%) either did not fill the prescription they were given or did not consume any pills. Of those who completed their prescription to its entirety, 10 (20%) underwent ACLRs, 10 (14%) underwent knee arthroscopies, and 5 (11%) underwent rotator cuff repairs ( $P = .48$ ). Five patients (3%) required additional opioids after exhaustion of the initial prescription. Overall, of the 4965 total pills prescribed from the entire study cohort, 2701 (54%) were not consumed. By prescribing 20, 10, and 20 pills postoperatively for ACLRs, knee arthroscopies, and arthroscopic rotator cuff repairs, respectively, the amount of unused medications would decrease by 60%, 47%, and 64%, respectively (Figures 2-4).

### Opioid Consumption by Age

There were no statistically significant differences in opioid consumption among different age groups ( $P = .44$ ). Patients aged 14 to 17 years had the lowest percentage of prescription used at 28%, compared with 46% in the other age



**Figure 1.** Differences in mean number of days opioids consumed and mean opioid pill consumption based on procedure type. \*Significant difference for mean opioid pills consumed based on procedure type ( $P < .001$ ). ACL, anterior cruciate ligament.

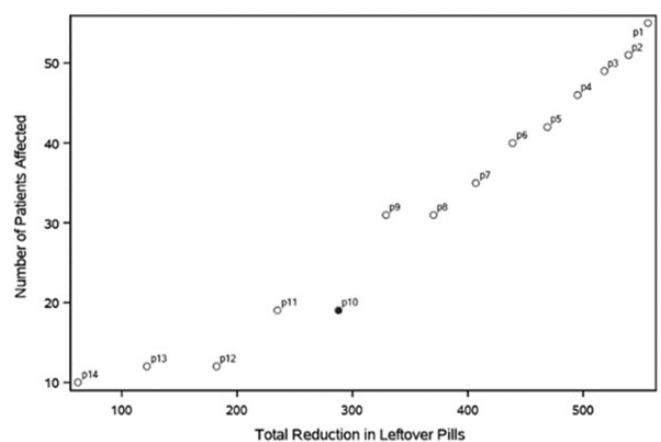


**Figure 2.** The reduction of unused opioid pills versus the number of patients affected based on the initial number of opioid pills prescribed for anterior cruciate ligament reconstructions. Specific values were found by analyzing the relationships between the total reduction of opioid pills by reducing a prescription to a certain value versus the number of patients negatively affected by the change. A prescription of 20 opioid pills optimizes the reduction of leftover opioids while minimizing the number of patients affected.

groups, though there were only 10 patients in the 14 to 17-year age group (Table 1 and Figure 5).

### Opioid Consumption by Sex

Female patients underwent more knee arthroscopies than male patients (39 vs 33), fewer ACLRs (15 vs 36), and fewer rotator cuff repairs (17 vs 28). Overall, there was a significant difference in percentage of the prescription used, with female patients taking 56% of their pills and male patients taking 38% ( $P < .001$ ) (Table 1). There was a significant difference between female and male patients regarding ACLRs, with a mean opioid consumption of 32.9 pills for female patients and 13.4 pills for male patients ( $P < .001$ ) (Figure 6). There were no significant differences between



**Figure 3.** The reduction of unused opioid pills versus the number of patients affected based on the initial number of opioid pills prescribed for knee arthroscopy procedures. Specific values were found by analyzing the relationships between the total reduction of opioid pills by reducing a prescription to a certain value versus the number of patients negatively affected by the change. A prescription of 10 opioid pills optimizes the reduction of leftover opioids while minimizing the number of patients affected.

female and male prescription utilization after knee arthroscopies and rotator cuff repairs (Figure 6).

### Opioid Consumption by ACL Autograft Versus Allograft

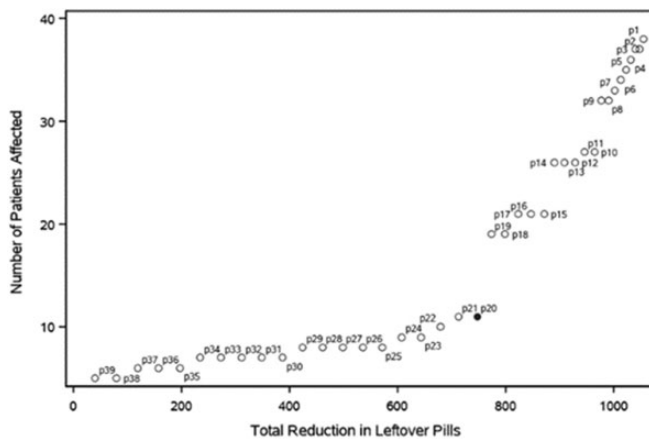
Patients who underwent ACL autograft procedures consumed a mean of  $21.2 \pm 17.6$  pills over the span of 9.5 days, followed by ACL allograft procedures at  $18.4 \pm 14.8$  pills for 6.5 days ( $P = .6$ ) (Figure 7).

### DISCUSSION

The purpose of this study was to demonstrate patient-reported consumption data of opioid medications after

ACLs, knee arthroscopies, and arthroscopic rotator cuff repairs to provide data-driven guidelines for prescribing medications after these common procedures. In this study, a low utilization rate and low refill rate was demonstrated with our current standardized prescription regimen of 40, 15, and 40 hydrocodone/acetaminophen (5/325 mg) pills for ACLs, knee arthroscopies, and arthroscopic rotator cuff repairs, respectively, indicating that fewer postoperative narcotics are required for optimal opioid stewardship associated with these procedures.

The majority of patients (85%) in this study had unused opioid pills after surgery and recovery. The absolute number and percentage of remaining pills varied by procedure, suggesting that a standard number of opioids cannot be

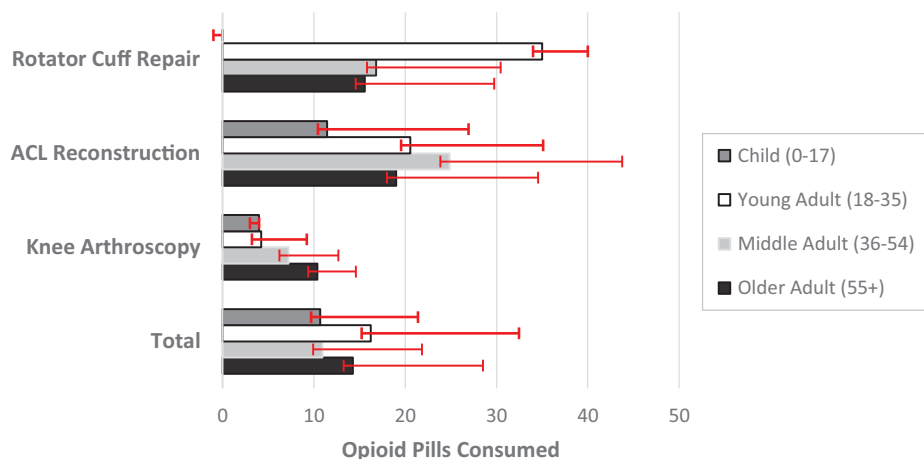


**Figure 4.** The reduction of unused opioid pills versus the number of patients affected based on the initial number of opioid pills prescribed for rotator cuff repairs. Specific values were found by analyzing the relationships between the total reduction of opioid pills by reducing a prescription to a certain value versus the number of patients negatively affected by the change. A prescription of 20 opioid pills optimizes the reduction of leftover opioids while minimizing the number of patients affected.

normalized for all procedures and that a systematic approach must be taken for each specific surgery. ACLs, knee arthroscopies, and arthroscopic rotator cuff repairs resulted in a mean of 53%, 53%, and 59% of the initial prescription not being consumed after surgery, respectively. The high values of standard deviation found in the study suggested a tendency for patients to gravitate toward the extremes of opioid consumption, with 26% of the cohort consuming <15% of their prescribed opioids and 20.2% of the cohort consuming >85% of their prescribed opioids. By prescribing 20, 10, and 20 pills postoperatively for ACLs, knee arthroscopies, and arthroscopic rotator cuff repairs, respectively, the quantity of unused medications would decrease by 60%, 47%, and 64%, respectively (Figures 2–4). Specific values were found by analyzing the relationships between the total reduction of pills with certain prescription values versus the number of patients negatively affected by the change.

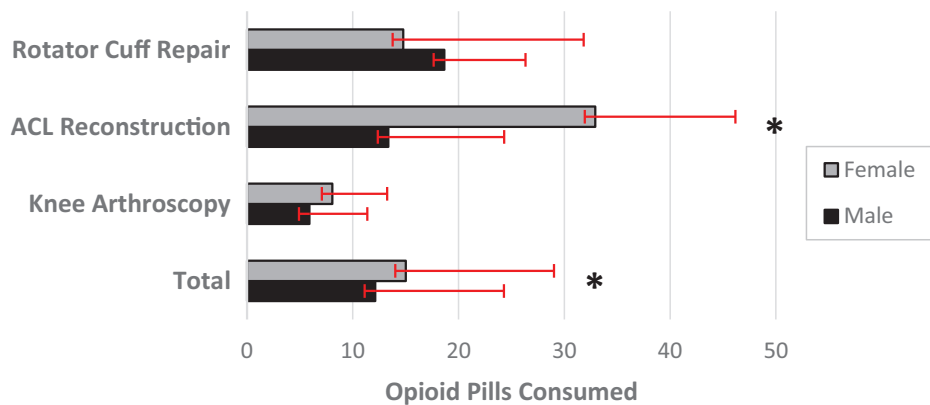
A similar study conducted by Rodgers et al,<sup>14</sup> focusing on upper extremity outpatient surgeries, suggested comparable results. Of the patients examined, patients most frequently received 30 opioid pills, which consisted of oxycodone, hydrocodone, or propoxyphene in >95% of the cases. Patients undergoing bone procedures reported the highest medication use (14 pills), whereas patients undergoing soft tissue procedures reported the lowest use (9 pills). Over half of the participants reported taking the opioid medication for 2 days or fewer. The study concluded that a prescription of 30 opioid pills for outpatient surgery appeared to be excessive and unnecessary and thus recommended a prescription of 15 pills with 1 refill if needed. Almost half of the study’s prescribed narcotic pills were unused. Similarly, Bates et al<sup>1</sup> found that two-thirds of their cohort of urology patients had narcotics remaining from their acute pain prescriptions.

Rising death rates due to narcotic overdose have prompted the Centers for Disease Control and Prevention to label the event as an opioid epidemic.<sup>3,13</sup> In 2013, *The Journal of the American Medical Association* reported that there had been 38,329 drug overdose deaths in the United

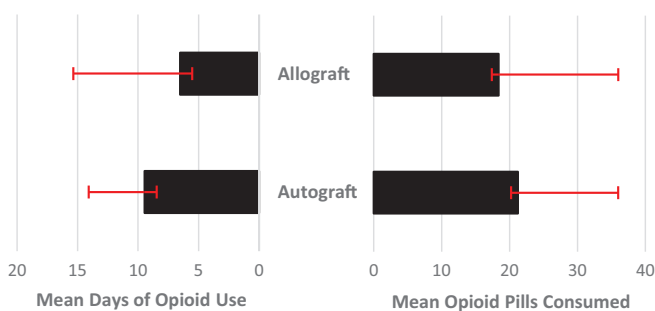


**Figure 5.** Differences in mean opioid pill consumption based on procedure type and patient age. ACL, anterior cruciate ligament.





**Figure 6.** Differences in mean opioid pill consumption based on procedure type and patient sex. \*Statistically significant difference. ACL, anterior cruciate ligament.



**Figure 7.** Differences in mean number of days opioids consumed and mean opioid pill consumption based on anterior cruciate ligament reconstruction utilizing autograft versus allograft.

States in 2010, and 75.2% of these deaths involved prescription opioids.<sup>6</sup> Narcotic overdoses have surpassed motor vehicle and firearm-related fatalities in annual preventable deaths.<sup>5,15</sup> A 2012 report showed that a person dies from a prescription drug overdose every 19 minutes.<sup>3</sup> State and federal government action has been taken regarding this rapid influx in deaths, with government officials issuing states of emergency.<sup>16</sup> Manchikanti et al<sup>8</sup> demonstrated that >70% of people abusing or diverting narcotics obtained their pills from a friend or relative who had obtained their pills from legitimate, medical prescription. Given that orthopaedic surgeons are the third highest prescribers of opioid prescriptions among physicians in the United States, prescribing habits in the field of orthopaedic surgery have a significant impact on this crisis.<sup>11</sup>

While this is the case, the goal of this study is not to deprive patients of adequate pain management. Patients with persistent pain result in prolonged rehabilitation times, extended time away from work, and the development of chronic issues. Patients trust that their physicians will help manage their pain, and it is important for physicians to reassure patients that they intend to control their pain but emphasize the importance of doing so in a responsible manner. By simply enrolling patients in this study, there

was an educational component to the management of their pain that likely affected their postoperative narcotic usage. In a study by Yajnik et al,<sup>19</sup> preoperative counseling and education in postoperative pain management resulted in a reduction of postoperative opioid use after knee replacement surgery.<sup>19</sup> Employing a routine preoperative education process before arthroscopic procedures also likely benefits postoperative pain management and reduces opioid usage.

The ongoing opioid epidemic requires increasing attention by physicians to manage pain in a way that minimizes the use of opioids to prevent potential problems for patients.<sup>11</sup> Physicians should seek to alleviate pain as much as possible but do so in a data-driven manner. Our finding of a mean consumption of 7 pills after knee arthroscopy procedures is remarkably similar to the results of Wojahn et al,<sup>18</sup> whose study found that patients used a median of 7 hydrocodone 5-mg pills and 59% used <10 pills after knee arthroscopy procedures at a single ambulatory surgery center.

Based on the results of the present study and the existing literature, we recommend prescribing no more than 10 hydrocodone/acetaminophen (5/325 mg) pills for knee arthroscopies and 20 hydrocodone/acetaminophen (5/325 mg) pills for arthroscopic rotator cuff repairs and ACLRs. These recommendations would likely result in a total reduction of >60% of unused opioid prescription pills in our community and a new utilization rate of 83%. A recent study completed by an expert panel of health care providers at Johns Hopkins provides a compilation of opioid prescribing guidelines for several common surgical procedures, showing results that parallel those found in this study for the 3 surgeries of focus.<sup>13</sup>

Noteworthy is that with these recommendations, 30% of patients would require a medication refill after 1 week of opioid use. Thus, potential issues are recognized with these changes. Insurance companies might try to argue the necessity of a refill and refuse coverage. Also, physicians cannot call in refills for opioids over the phone, which could result in additional physician visits; however, if pain is serious enough to warrant management after the suggested time frame, a follow-up examination is necessary.

The limitations of the present study include its retrospective design and all the typical limitations associated with retrospective medical record reviews. Additionally, this study consisted of a single surgeon's patient population and may therefore not be generalizable to other institutions or geographic locations. Also, given its retrospective nature, we were unable to implement additional factors into the study, such as a patient's reason for discontinuing one's prescriptions, perceived pain scales, insurance type, and concurrent use of nonsteroidal anti-inflammatory drugs. Furthermore, an a priori power analysis was not conducted for this study, and as a result, it is likely underpowered to detect differences in subgroup analyses. Last, determination of the number of unused narcotics through patient reporting rather than direct collection of unused pills renders itself liable to recall bias. Although this is the case, the prescribing physician involved in the study had previously instituted a standard practice of asking patients as a routine part of their postoperative visit how many pills they used and for how many days, in order to gauge the need for refills and assess whether the initial prescription was adequate. While asking patients to recall how many pills they used and for how many days potentially leads to bias, this practice eliminated the need for phone interviews and prospective study enrollment, which also could have influenced patient reporting. Although this study was limited in its magnitude, and further research could provide data with greater statistical significance and robustness, it provides important information regarding opioid utilization after common arthroscopic procedures. Additional research can examine other surgical procedures and concurrent non-narcotic pain control modalities as well.

## CONCLUSION

We recommend prescribing no more than 20, 10, and 20 hydrocodone/acetaminophen (5/325 mg) pills for ACLRs, knee arthroscopies, and arthroscopic rotator cuff repairs, respectively. Based on our results, this would result in a potential 70% total reduction of unused opioid prescription pills in the community and a new utilization rate of 83%. The distribution of further pills can be eliminated through a joint effort by physicians to inform their patients of proper disposal practices for their unused medications.

## ACKNOWLEDGMENT

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## REFERENCES

- Bates C, Laciak R, Southwick A, Bishoff J. Overprescription of postoperative narcotics: a look at postoperative pain medication delivery, consumption and disposal in urological practice. *Urol*. 2011;185(2):551-555.
- Bohnert AS, Valenstein M, Bair MJ, et al. Association between opioid prescribing patterns and opioid overdose-related deaths. *JAMA*. 2011;305(13):1315-1321.
- Centers for Disease Control and Prevention. CDC Grand Rounds: prescription drug overdoses—a U.S. epidemic. *MMWR Morb Mortal Wkly Rep*. 2012;61(1):10-13.
- Cicero TJ, Ellis MS, Harney J. Shifting patterns of prescription opioid and heroin abuse in the United States. *N Engl J Med*. 2015;373(18):1789-1790.
- Drug Enforcement Administration. 2015 National drug threat assessment summary. October 2015. Accessed April 19, 2018. <https://www.dea.gov/docs/2015%20NDA%20Report.pdf>
- Jones CM, Mack Ka, Paulozzi LJ. Pharmaceutical overdose deaths, United States, 2010. *JAMA*. 2013;309(7):657-659.
- Kolodny A, Courtwright DT, Hwang CS, et al. The prescription opioid and heroin crisis: a public health approach to an epidemic of addiction. *Annu Rev Public Health*. 2015;36:559-574.
- Manchikanti L, Helm S II, Fellows B, et al. Opioid epidemic in the United States. *Pain Physician*. 2012;15(3)(suppl):eS9-e38.
- Manchikanti L, Singh A. Therapeutic opioids: a ten-year perspective on the complexities and complications of the escalating use, abuse, and nonmedical use of opioids. *Pain Physician*. 2008;11(2)(suppl):S63-S88.
- Merrill HM, Dean DM, Mottla JL, Neufeld SK, Cuttica DJ, Buchanan MM. Opioid consumption following foot and ankle surgery. *Foot Ankle Int*. 2018;39(6):649-656.
- Morris BJ, Mir HR. The opioid epidemic: impact on orthopaedic surgery. *J Am Acad Orthop Surg*. 2015;23(5):267-271.
- Oakie S. A flood of opioids, a rising tide of deaths. *N Engl J Med*. 2010;363(21):1981-1985.
- Overton HN, Hanna MN, Bruhn WE, et al. Opioid-prescribing guidelines for common surgical procedures: an expert panel consensus. *J Am Coll Surg*. 2018;227(4):411-418.
- Rodgers J, Cunningham K, Fitzgerald K, Finnerty E. Opioid consumption following outpatient upper extremity surgery. *J Hand Surg Am*. 2012;37(4):645-650.
- Siegler A, Tuazon E, Bradley O'Brien D, Paone D. Unintentional opioid overdose deaths in New York City, 2005-2010: a place-based approach to reduce risk. *Int J Drug Policy*. 2014;25(3):182-184.
- Surratt HL, O'Grady C, Kurtz SP, et al. Reductions in prescription opioid diversion following recent legislative interventions in Florida. *Pharmacoepidemiol Drug Saf*. 2014;23(3):314-320.
- Tepolt FA, Bido J, Burgess S, Micheli LJ, Kocher MS. Opioid overprescription after knee arthroscopy and related surgery in adolescents and young adults. *Arthroscopy*. 2018;34(12):3236-3243.
- Wojahn RD, Bogunovic L, Borphy RH, et al. Opioid consumption after knee arthroscopy. *J Bone Joint Surg Am*. 2018;100(19):1629-1636.
- Yajnik M, Hill JN, Hunter OO, et al. Patient education and engagement in postoperative pain management decreases opioid use following knee replacement surgery. *Patient Educ Couns*. 2019;102:383-387.