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Defining Optimal Length of Opioid Pain Medication Prescription After Common Surgical Procedures

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IMPORTANCE The overprescription of pain medications has been implicated as a driver of the burgeoning opioid epidemic; however, few guidelines exist regarding the appropriateness of opioid pain medication prescriptions after surgery.

OBJECTIVES To describe patterns of opioid pain medication prescriptions after common surgical procedures and determine the appropriateness of the prescription as indicated by the rate of refills.

DESIGN, SETTING, AND PARTICIPANTS The Department of Defense Military Health System Data Repository was used to identify opioid-naive individuals 18 to 64 years of age who had undergone 1 of 8 common surgical procedures between January 1, 2005, and September 30, 2014. The adjusted risk of refilling an opioid prescription based on the number of days of initial prescription was modeled using a generalized additive model with spline smoothing.

EXPOSURES Length of initial prescription for opioid pain medication.

MAIN OUTCOMES AND MEASURES Need for an additional subsequent prescription for opioid pain medication, or a refill.

RESULTS Of the 215 140 individuals (107 588 women and 107 552 men; mean [SD] age, 40.1 [12.8] years) who underwent a procedure within the study time frame and received and filled at least 1 prescription for opioid pain medication within 14 days of their index procedure, 41 107 (19.1%) received at least 1 refill prescription. The median prescription lengths were 4 days (interquartile range [IQR], 3-5 days) for appendectomy and cholecystectomy, 5 days (IQR, 3-6 days) for inguinal hernia repair, 4 days (IQR, 3-5 days) for hysterectomy, 5 days (IQR, 3-6 days) for mastectomy, 5 days (IQR, 4-8 days) for anterior cruciate ligament repair and rotator cuff repair, and 7 days (IQR, 5-10 days) for discectomy. The early nadir in the probability of refill was at an initial prescription of 9 days for general surgery procedures (probability of refill, 10.7%), 13 days for women's health procedures (probability of refill, 16.8%), and 15 days for musculoskeletal procedures (probability of refill, 32.5%).

CONCLUSIONS AND RELEVANCE Ideally, opioid prescriptions after surgery should balance adequate pain management against the duration of treatment. In practice, the optimal length of opioid prescriptions lies between the observed median prescription length and the early nadir, or 4 to 9 days for general surgery procedures, 4 to 13 days for women's health procedures, and 6 to 15 days for musculoskeletal procedures.

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Invited Commentary page 43

Supplemental content

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As rates of opioid prescribing have increased dramatically in recent years, the overprescription of pain medications has been implicated as a driver of the burgeoning opioid epidemic and the associated increases in overdose deaths in the United States.[1,2] It is estimated that as many as 259 million opioid prescriptions were issued in 2012, four times the number prescribed in 1999.[3,4] This increase in opioid prescriptions has come at a cost, however, including increased rates of overdose deaths,[1] as well as expenditures associated with the treatment of prescription opioid abuse and dependence.[5]

To address these issues, governmental efforts limiting the length of initial prescriptions of opioid pain medication, typically to fewer than 7 days, have recently been passed in several states, including New York and Massachusetts.[6,7] Prescription drug monitoring programs have also become increasingly common despite a lack of evidence regarding appropriate duration of prescriptions of opioid pain medication or the efficacy of such legislation.[8-10]

As a result, uncertainty remains regarding optimal prescribing practices for opioid pain medications, particularly in the setting of postoperative, outpatient pain management, where few guidelines exist.[11,12] In this context, we investigated prescription patterns of opioid pain medications after common surgical procedures. We also endeavored to determine the appropriateness of the prescription as indicated by the rate of refills and to develop recommendations regarding optimal prescription length after common surgical procedures.

Key Points

Question What are the optimal ranges of initial durations of opioid prescriptions in a cohort of opioid-naive patients who have undergone common surgical procedures?

Findings In this cohort study of 215 140 individuals, the median observed prescription lengths were 4 days for general surgery procedures, 4 days for women's health procedures, and 6 days for musculoskeletal procedures. The prescription lengths associated with lowest requirement for refill were 9 days for general surgery, 13 days for women's health, and 15 days for musculoskeletal procedures.

Meaning The ideal initial prescription duration likely falls between the observed median and the modeled nadir in refill rate.

Methods

Patient Data and Cohort Selection

This project used data from the Military Health System Data Repository and the TRICARE insurance program, the specifics of which have been described previously.[13-16] The TRICARE insurance program covers more than 9 million beneficiaries, including members of the Department of Defense, dependents, retirees, and those with medical disabilities. Only 20% of covered individuals are active members of the US military.[13-16] The TRICARE insurance program is not involved in the delivery of health care in combat zones, and beneficiaries are not obligated to receive care in the Veterans Affairs system.[17] This study was approved as an exempt protocol and written informed consent was waived by the Partners Healthcare Institutional Review Board.

The Military Health System Data Repository was queried by *International Classification of Diseases, Ninth Revision* (*ICD-9*) and Current Procedural Terminology procedure codes to identify all patients 18 to 64 years of age who underwent 1 of 8 common surgical procedures (cholecystectomy, appendectomy, inguinal hernia repair, anterior cruciate ligament reconstruction, rotator cuff tear repair, discectomy, mastectomy, and hysterectomy; see eAppendix in the Supplement for *ICD-9* and Current Procedural Terminology codes) between January 1, 2005, and September 30, 2014. Enrollees who underwent more than 1 procedure within 6 months of their index operation were excluded, given the potential for reoperation to confound requirements for opioid pain medications, as were those who could not be evaluated for at least 1 year before and after their operation. Individuals with an opioid prescription within the 6 months preceding the index procedure were similarly excluded. Individuals with initial prescription durations longer than 90 days were also excluded.

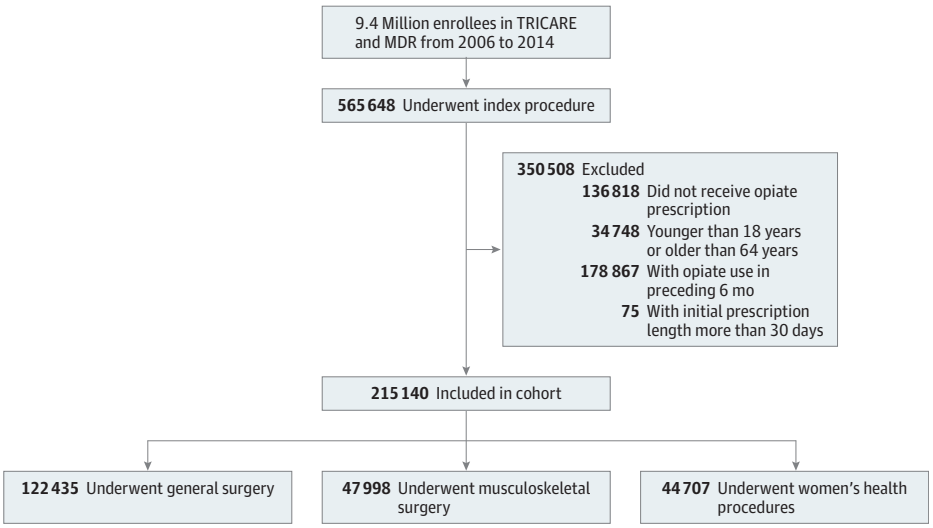
Demographic information including age, biological sex, race/ethnicity, marital status, sponsor rank (categorized as Junior enlisted [lowest 4 ranks in any branch], Senior enlisted [noncommissioned officers], Officers, and Other [cadets and warrant officers]), and beneficiary category were abstracted for all individuals in the study. The modified Charlson Comorbidity Index was used to account for medical comorbidities.[18] Postoperative complications were also recorded using a previously published algorithm using *ICD-9* coding.[14]

Information on prescription claims billed to TRICARE is available through the Military Health System Data Repository. This information was queried for the medications defined by the Drug Enforcement Administration as opioid combinations, opioid partial agonists, or opioid agonists in categories II (high abuse potential) or III (moderate risk of dependence). For the purposes of this investigation, refill was defined as repeat prescription within 14 days of the end date of the initial prescription.

Adjusted Model

The adjusted risk of opioid prescription refill based on the number of days in the initial prescription was modeled using a generalized additive model[19] with spline smoothing. In contrast with generalized linear models that assume a linear association between the dependent and independent variables, generalized additive models replace the linear assumptions with smooth functions, creating a nonparametric function that can estimate a greater variety of associations. Covariates in the model included age, biological sex, race/ethnicity, sponsor rank as a proxy for socioeconomic status,[14,15] preoperative history of substance abuse, depression, fibromyalgia, and postoperative complications. The modified Charlson Comorbidity Index was used to adjust for comorbidities. By plotting risk of refill as a function of duration of the initial prescription, we were able to identify the adjusted risk of prescription refill associated with the length of initial opioid prescription as well

Figure 1. Study Cohort



MDR indicates Military Health System Data Repository.

as the initial prescription duration associated with the lowest modeled risk of refill, or the nadir of the adjusted curve. $P < .05$ and 95% CIs exclusive of 0.0 were used as the criteria for statistical significance. A stratified analysis was also performed comparing active duty TRICARE enrollees with nonactive-duty individuals. Data manipulation and statistical analysis were performed using SAS, version 9.4 (SAS Institute Inc).

Results

In the period under study, 565 648 individuals underwent 1 of the 8 procedures of interest and 428 830 (75.8%) filled at least 1 opioid pain medication prescription in the 14 days after the procedure (**Figure 1**). Among these individuals, 34 748 (8.1%) were excluded owing to age restrictions and an additional 178 867 were excluded because they had filled an opioid pain medication prescription in the 6 months prior to their index procedure. An additional 75 individuals had an initial prescription length of longer than 30 days and were also excluded. This left a final 215 140 individuals within the study cohort. The mean (SD) age of the final study population was 40.1 (12.8) years. A total of 107 552 individuals (50.0%) were male, and 129 357 participants (60.1%) were white (**Table 1**). Most of the study population had a modified Charlson Comorbidity Index score of 0 (201 995 [93.9%]). General surgery procedures were performed in 122 435 individuals, while 47 998 underwent musculoskeletal procedures and 44 707 received a mastectomy or hysterectomy.

Initial Duration of Opioid Prescription

Among patients undergoing general surgery procedures, the median duration of initial opioid pain medication prescription was 4 days (interquartile range [IQR], 3-5 days) for appendectomy and cholecystectomy and 5 days (IQR, 3-6 days) for inguinal hernia repair (**Table 2**). Among musculoskeletal procedures, the median duration of initial prescription was 5 days (IQR, 4-8 days) for anterior cruciate ligament repair and rotator cuff repair and 7 days (IQR, 5-10 days) for discectomy. The median duration of initial opioid pain medication prescription was 5 days (IQR, 3-6 days) for mastectomy and 4 days (IQR, 3-5 days) for hysterectomy.

Opioid Prescription Refill Rates

Observed prescription refill rates ranged from 11.3% (5513 of 48 622) for cholecystectomy to 39.3% (6485 of 16 511) after anterior cruciate ligament repair (**Table 3**). The median time to refill was 6 days (appendectomy, cholecystectomy, and inguinal hernia repair) to 10 days (discectomy) from the date of the initial prescription. The median duration of a refill prescription ranged from 4 days (appendectomy, cholecystectomy, hernia repair, and hysterectomy) to 8 days (discectomy).

Adjusted Results

In the adjusted model, the modeled proportion of individuals requiring a refill prescription varied based on procedure type and the duration of initial prescription, ranging from 10.7% for those undergoing general surgery procedures who received an initial prescription of 9 days' duration to 43.9% for those undergoing musculoskeletal procedures who received an initial prescription of 1 day's duration (**Figure 2**). The early nadir in the proportion of patients requiring refill after musculoskeletal procedures was 32.5% at an initial prescription duration of 15 days (Figure 2). Among general surgery procedures, the early nadir in the proportion of patients requiring a refill was 10.7% at 9 days. For mastectomy and hysterectomy, the early nadir was 16.8% at 13 days. When stratified by beneficiary category, the overall early nadir in refill rate was similar between active duty individuals and all others, with the early nadir at 16.5% associated with an initial prescription duration of 16 days for those on activity duty and 12.8% at 15 days for all others. By procedure category, when active duty individuals were excluded from the analysis, for all other individuals, the nadir in the proportion of individuals requiring a refill was

Table 1. Demographics

Characteristic	No. (%) (N = 215 140)
Age, y	
18-24	32 786 (15.2)
25-34	44 602 (20.7)
35-44	53 134 (24.7)
45-64	84 618 (39.3)
Male	107 552 (50)
Married	169 414 (78.8)
White race/ethnicity	129 357 (60.1)
Sponsor rank	
Officer	37 796 (17.6)
Enlisted junior	33 938 (15.8)
Enlisted senior	135 943 (63.2)
Others	6629 (3.1)
Beneficiary category	
Active duty	78 455 (36.5)
Retired	36 453 (16.9)
Dependent	95 477 (44.4)
Others	4755 (2.2)
Hospital region	
South	125 150 (58.2)
West	55 033 (25.6)
Midwest	23 033 (10.7)
Northeast	9817 (4.6)
Charlson comorbidity index score	
0	201 995 (93.9)
1	7452 (3.5)
≥2	5693 (2.6)

10.0% for general surgery procedures and was associated with an initial prescription length of 8 days, 16.2% for women's health procedures at 13 days, and 30.2% for musculoskeletal procedures at 15 days.

Discussion

In this study including more than 215 000 opioid-naive patients undergoing a variety of general surgical, orthopedic, and women's health procedures, the median initial opioid prescription duration ranged from 4 to 7 days, and 11.3% to 39.3% of patients required at least 1 refill, depending on procedure undergone. The modeled early nadir in rate of prescription refill was 9 days after general surgery procedures, 13 days after breast and gynecologic procedures, and 15 days after orthopedic and neurosurgical procedures.

These results expand on previously published work examining prescribing patterns of pain medications after surgical interventions in opioid-naive patients, which has thus far been limited largely to single-institution trials.[2,20] A strength of this study is its inclusion of a large population considered to be nationally representative in many respects.[14,15] We were also able to include a variety of procedures across general, orthopedic, neurosurgical, and gynecologic care. In terms of generalizability, only procedures for which patients are commonly discharged to home were included, given the fact that discharge to a rehabilitation or skilled nursing facility would likely confound prescription practices. Patients with preoperative pain medication use were also excluded from the study given its effect on postprocedure pain requirements as well as recovery

Table 2. Opioid Pain Medication Prescription Duration Information by Procedure Type After Common Surgical Procedures

Characteristic	Appendectomy (n = 34 516)	Cholecystectomy (n = 48 622)	Inguinal Hernia Repair (n = 39 297)	ACL Repair (n = 16 511)	Rotator Cuff Repair (n = 14 840)	Discectomy (n = 16 647)	Mastectomy (n = 5233)	Hysterectomy (n = 39 474)
Initial opioid prescription duration, d								
Mean (SD)	5.79 (6.14)	5.72 (5.79)	6.26 (6.46)	7.37 (5.67)	6.90 (5.21)	9.32 (6.43)	6.23 (5.89)	5.73 (5.74)
Median (IQR) [range]	4 (3-5) [1-30]	4 (3-5) [1-30]	5 (3-6) [1-30]	5 (4-8) [1-30]	5 (4-8) [1-30]	7 (5-10) [1-30]	5 (3-6) [1-30]	4 (3-5) [1-30]

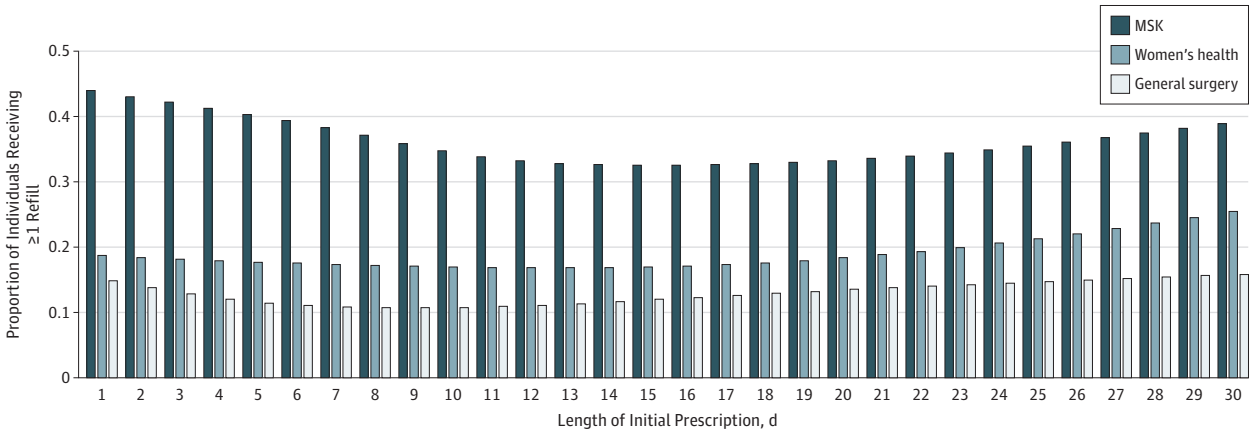
Abbreviations: ACL, anterior cruciate ligament; IQR, interquartile range.

Table 3. Opioid Pain Medication Refill Rate and Duration by Procedure Type for Opioid-Naive Patients After Common Surgical Procedures

Characteristic	Appendectomy (n = 34 516)	Cholecystectomy (n = 48 622)	Inguinal Hernia Repair (n = 39 297)	ACL Repair (n = 16 511)	Rotator Cuff Repair (n = 14 840)	Discectomy (n = 16 647)	Mastectomy (n = 5233)	Hysterectomy (n = 39 474)
Enrollees receiving ≥1 refill, No. (%)	4676 (13.6)	5513 (11.3)	5611 (14.3)	6485 (39.3)	5337 (36.0)	5017 (30.1)	1650 (31.5)	6818 (17.3)
Time to refill, d								
Mean (SD)	7.10 (5.65)	7.30 (5.73)	7.20 (5.52)	7.79 (4.73)	8.50 (5.48)	11.29 (6.71)	8.48 (5.53)	8.03 (5.31)
Median (IQR) [range]	6 (3-10) [1-45]	6 (3-10) [1-45]	6 (3-10) [1-45]	7 (5-11) [1-44]	8 (4-12) [1-45]	10 (7-15) [1-45]	7 (5-12) [1-44]	7 (4-11) [1-45]
Duration of first refill, d								
Mean (SD)	6.22 (7.19)	6.44 (7.47)	6.49 (7.43)	7.67 (8.09)	7.40 (7.50)	10.51 (7.85)	6.42 (6.43)	6.02 (6.44)
Median (IQR) [range]	4 (3-5) [1-60]	4 (3-6) [1-90]	4 (3-5) [1-42]	5 (4-8) [1-300]	5 (4-8) [1-300]	8 (5-13) [1-84]	5 (3-7) [1-60]	4 (3-5) [1-41]

Abbreviations: ACL, anterior cruciate ligament; IQR, interquartile range.

Figure 2. Modeled Proportion of Individuals Requiring Opioid Pain Medication Refill by Length of Initial Prescription by Procedure Group



Adjusted proportion of individuals requiring repeated opioid prescription after procedure by duration of initial prescription. Risk was adjusted for age, sex, race/ethnicity, socioeconomic status, and postoperative complications. The modified Charlson Comorbidity Index was used to adjust for comorbidities. MSK indicates musculoskeletal.

times.[21] More than 40% of the cohort who filled an opioid pain medication prescription after their index procedure had received at least 1 opioid prescription in the 6 months preceding surgery, which is notable given results that suggest that individuals taking preoperative narcotics have poorer outcomes.[21-24]

Orthopedic procedures appeared to be associated with the highest refill rates and the highest median length of initial prescriptions, which is in line with previous work that showed that chronic use of postoperative opioid medications was higher after orthopedic and neurosurgical procedures.[20,25] For noncancer pain, orthopedic surgeons prescribe opioids more frequently than any other provider type and, among Medicare beneficiaries, have the highest frequency of opioid pain medication claims of any surgical specialty.[26,27]

In terms of guidelines for pain management, there are relatively few efforts that help inform evidence-based prescribing guidelines in the postoperative, outpatient setting.[3] The American College of Occupational and Environmental Medicine guidelines on opioid treatment include postoperative pain, but the recommendations are limited to screening patients who continue opioid pain medications beyond the second postoperative week, prescribing a maximum daily dose of 50 mg morphine equivalent in opioid-naive patients, and discontinuing opioids for patients who have reached meaningful functional recovery.[12] The American Pain Society recommends instructing patients on opioid use at the transition to outpatient care but otherwise has no recommendations on type or duration of analgesia.[11] The Institute for Clinical Systems Improvement recommends limiting initial prescriptions to 3 days or 20 tablets with appropriate adjuncts, education, and follow-up, without specification regarding the type of procedure performed.[28]

The optimal length of opioid prescription after common surgical procedures likely lies between the observed median prescription length and the early nadir in the modeled probability of refill: 4 to 9 days for general surgery procedures, 4 to 13 days for women's health procedures, and 6 to 15 days for musculoskeletal procedures. Although a 7-day limit on initial opioid prescription appears to be adequate for many common general surgery and gynecologic procedures, for patients undergoing orthopedic and neurosurgical interventions, a 7-day limit may be inappropriately restrictive and place an undue burden on patients and clinicians.

Limitations

This study is not without limitations. It addresses only prescription opioid use within this population and cannot address opioid medications obtained through other means. It also does not capture rates of unused prescriptions, which have been shown to be as high as 70% in some groups.[2] Similarly, information on use of nonopioid adjuncts, including acetaminophen and nonsteroidal anti-inflammatory drugs, is also not available within the current data set; however, these medications likely affect postoperative opioid use. Specific procedural approaches and techniques as well as intraoperative anesthesia adjuncts may also affect postoperative pain control. However, we were unable to make determinations regarding these details in light of the claims-based nature of the information presently available through the Military Health System Data Repository. Although the concern could be raised that this study represents only the experience of a military population, active duty members of the military represent a minority of this cohort and, in a sensitivity analysis, risk of prescription refill was similar between groups. Furthermore, prior work has found this population to be sociodemographically similar to individuals younger than 65 years of age among the US population as a whole.[13,14,29-31] Finally, data were available only for prescription days rather than the number of pills or tablets issued. However, given that opioid legislation thus far has focused primarily on limiting the number of prescription days rather than quantity, these data are directly comparable with currently available guidelines.

Despite these limitations, this work highlights the wide variation in prescribing patterns for postoperative pain management among surgeons as well as the variability in opioid requirements between procedures and patients. Furthermore, it offers empirical guidance to clinicians regarding opioid prescribing practices after surgery. Although 7 days appears to be more than

adequate for many patients undergoing common general surgery and gynecologic procedures, prescription lengths likely should be extended to 10 days, particularly after common neurosurgical and musculoskeletal procedures, recognizing that as many as 40% of patients may still require 1 refill at a 7-day limit.

Conclusions

An opioid prescription after surgery should balance adequate pain treatment with minimizing the duration of treatment and potential for medication complications including issues with dependence. Although 7-day limits on initial opioid pain medication prescriptions are likely adequate in many settings, and indeed also sufficient for many common general surgery and gynecologic procedures, in the postoperative setting, particularly after many orthopedic and neurosurgical procedures, a 7-day limit may be inappropriately restrictive. Critically, further work is needed to better identify the 10% to 30% of patients who will require more intensive pain management to better tailor postoperative pain regimens to these individuals.

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Invited Commentary

Addressing Variability in Opioid Prescribing

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Since the turn of the century, the United States has witnessed a dramatic increase in the misuse of opioid pain medications. According to the Centers for Disease Control and Prevention,[1] the amount of opioid pain relievers sold in the United States has quadrupled since 1999. The overprescription of pain medications has been implicated as a driving force behind the opioid epidemic and the associated increases in deaths from overdose.[2] Despite this recognition of opioid overprescription, few guidelines exist regarding the appropriateness of opioid prescriptions following surgery. In this issue of *JAMA Surgery*, Scully et al[3] describe prescription patterns and appropriateness of opioid pain medications based on the rate of prescription refills following common surgical procedures. Analyzing data from the Department of Defense Military Health System Data Repository, they identified opioid-naive individuals 18 to 64 years of age who had undergone 1 of 8 common surgical procedures between 2006 and 2014. Of 215 140 individuals who received and filled at least 1 prescription for opioid pain medication within 14 days of their index procedure, 41 107 (19.1%) received at least 1 refill. They found significant variability by procedure type, ranging from a nadir probability of refill of 9 days for general surgery procedures to 13 days for women's health procedures and 15 days for musculoskeletal procedures. They concluded that opioid prescriptions after surgery should balance adequate pain management with the duration of treatment.

Related article page 37

Any effort that reduces excessive prescription of opioid pain medications is welcome. In this population of more than 200 000 people, the authors found a marked variation in the timing and frequency of requests for narcotic prescriptions among postoperative patients who had undergone various operations. We hope the days of writing a prescription for 60 tablets of acetaminophen and oxycodone hydrochloride (Percocet) to discourage follow-up telephone calls for refills are gone. We are living in the midst of an ongoing crisis.

It is key to remember the importance of setting expectations in the interpretation of pain. Unfortunately, we have reached a point that 100% elimination of pain has become not only the goal but the expectation. If a surgeon allows a patient to expect a pain-free recovery, he or she will see refill requests increase. Alternatives to narcotics should be recommended and incorporated as the foundation of pain management. It does not take much time to explain the use of acetaminophen and ibuprofen and then follow up with a stronger option if the pain is not adequately relieved. It is also useful to prepare the patient to expect some discomfort, realize that complete relief of all pain is impossible, and that the cost of trying is not worth it. Beyond the itching, nausea, constipation, and nightmares associated with opiate medications are addiction and death. We should do our part to alleviate this burden on our patients.

ARTICLE INFORMATION

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