Patient Satisfaction and Pain Control Using an Opioid-Sparing Postoperative Pathway

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BACKGROUND: Opioids are overprescribed after surgical procedures, leading to dependence and diversion into the community. This can be mitigated by evidence-based prescribing practices. We investigated the feasibility of an opioid-sparing pain management strategy after surgical procedures.

STUDY DESIGN: Patients undergoing 6 procedures were offered the opportunity to participate in an opioid-sparing pain management pathway. Patients were advised to use acetaminophen and ibuprofen, and were provided with a small "rescue" opioid prescription for breakthrough pain. They were then surveyed postoperatively about opioid use and patient-reported outcomes measures. Overall cohort characteristics and differences between opioid users and non-users were analyzed.

RESULTS: A total of 190 patients were analyzed. Median prescription size was 5 (interquartile range [IQR] 4 to 6) pills and opioid use was 0 (IQR 0 to 4) pills. Fifty-two percent of patients used no opioids after procedures. Median number of leftover pills was 2 (IQR 0 to 5). Median pain score was 1 (IQR 1 to 2) and satisfaction score was 10 (IQR 8 to 10). Almost all (91%) patients agreed that their pain was manageable. Patients who used opioids were younger (52 ± 14 vs 59 ± 13 years; $p = 0.001$), reported higher pain scores (2 [IQR 1 to 2] vs 1 [1 to 2]; $p = 0.014$), received larger rescue prescriptions (6 ± 3 vs 4 ± 4 pills; $p = 0.003$), and were less likely to agree that their pain was manageable (82% vs 98%; $p = 0.001$). There were no other significant differences between opioid users and non-users.

CONCLUSIONS: Patients reported minimal or no opioid use after implementation of an opioid-sparing pathway, and still reported high satisfaction and pain control. These results demonstrate the effectiveness and acceptability of major reduction and even elimination of opioids after discharge from minor surgical procedures. (J Am Coll Surg 2019;229:316–322. © 2019 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)

Opioids are commonly overprescribed after surgical procedures.[1] This has been shown to affect many general surgical procedures, as well as a number of surgical subspecialties.[2] Excessive prescribing increases the risk of prolonged postoperative use and contributes to pills that get diverted and abused in the community.[3-5] Some

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have attributed this phenomenon to the campaign to recognize pain as the "fifth vital sign," which was prevalent in the late 1990s in the US.[6] Given the growing public health crisis related to opioids, there has been a national call to curtail the overuse of opioids in all areas of healthcare. Although prescribing by primary care physicians has been decreasing for several years, the relative contribution of new opioid prescriptions by surgeons increased by 18% between 2010 and 2016.[7]

In response to this, considerable effort has been dedicated to reducing excessive opioid prescribing after surgical procedures. Some of the most widely reported strategies have involved the use of procedure-specific prescribing guidelines based on patient-reported opioid use after surgical procedures, analysis of refill patterns, and expert consensus.[8-11] Although these studies have demonstrated substantial reductions in opioid prescription sizes, they still fundamentally involve opioid analgesia as a central component of postoperative pain control. As prescription sizes continue to shrink in response to the opioid epidemic, the question arises as to the feasibility and acceptability of opioid-sparing postoperative pain control.

Within this context, the following study describes our experience implementing an opioid-sparing pain management strategy for common surgical procedures. This is a significant departure from the development of prescribing guidelines in that it focuses on pain management without opioids. Using patient-reported outcomes measures, we evaluated the impact of opioid-sparing pain control on patient satisfaction and pain level.

METHODS

Beginning January 1, 2018, patients undergoing 6 selected surgical procedures were offered the opportunity to participate in an opioid-sparing pain management pathway after their procedure. These procedures were laparoscopic cholecystectomy, laparoscopic inguinal hernia repair, thyroidectomy/parathyroidectomy, robotic prostatectomy, endoscopic sinus operation, and laparoscopic sleeve gastrectomy. Patients were eligible if they were not currently using opioids and did not have any allergies or medical conditions that would preclude them from using acetaminophen or non-steroidal anti-inflammatory drugs after the surgical procedure. There were no eligibility differences between procedures and, as a pilot project, providers were at their own discretion to enroll patients. Based on provider discretion, eligible patients were selected for participation in this pathway and given specific instructions about pain control after their procedure. There was no compensation or incentive to participate. If patients agreed to participate, they were counseled to manage their pain without the use of opioids. This was done at their preoperative visit and involved telling patients that they should take both acetaminophen 650 mg and ibuprofen 600 mg every 6 hours around the clock. Patients were instructed to "stagger" these medications by 3 hours, which would result in them taking a dose of either acetaminophen or ibuprofen every 3 hours for maximal continuous pain control. This counseling was performed by physician assistants who staff the preoperative clinic, using a document that contained a standardized set of instructions read to each patient.[12]

During the surgical procedure, no changes were made to routine analgesic protocols, which were at the discretion of the anesthesiologist and surgeon as they would be usually. After the procedure, patients were provided with a prescription for acetaminophen and ibuprofen, as well as a small "rescue" prescription of opioids for uncontrolled breakthrough pain. Patients were instructed both in their preoperative visit and after the operation that they did not have to use this prescription if it was not needed. Providers were advised to prescribe oxycodone as the preferred opioid, but substitutions were allowed based on surgeon preference or patient factors. The respective rescue prescription sizes in tablets of oxycodone 5 mg were: 4 pills for laparoscopic cholecystectomy, 10 pills for laparoscopic inguinal hernia repair, 5 pills for thyroidectomy/parathyroidectomy, 6 pills for robotic prostatectomy, 8 pills for sinus operation, and 10 pills for laparoscopic sleeve gastrectomy. These prescription sizes were based on previous work describing opioid use after surgical procedures.[9,13]

Information about this pilot project was communicated to surgical faculty, residents, and advanced practice providers through in-person presentations at weekly educational conferences and through email. Patients were identified as participating in this pathway via a notification in their electronic medical record that prompted the surgeon to provide the appropriate rescue prescription for a given procedure. All prescriptions were written at the time of discharge.

Patients were then surveyed between postoperative days 30 and 90 using a telephone survey. If patients could not be contacted after 3 attempts, no additional attempts were made to administer the survey. In the survey, patients were asked to report opioid use in the number of pills they used after the operation. The number of leftover pills was calculated by subtracting the number of pills used from the number of opioids prescribed. Patients were not asked how they disposed of leftover medication.

Patients were also asked to rate their average pain in the first week after the procedure (0 = no pain, 1 = minimal pain, 2 = moderate pain, 3 = severe pain), their surgical site pain at the time of the survey (0 = no pain, 10 = worst pain imaginable), their satisfaction with

undergoing the surgical procedure on a scale of 1 to 10 (1 = extremely dissatisfied, 10 = extremely satisfied), their quality of life after the procedure (1 = worst possible quality of life, 5 = best possible quality of life), their regret for undergoing the surgical procedure (1 = strongly regret, 5 = absolutely no regret), and the percent recovered they felt at the time of the survey (0 to 100%). They were also asked whether they used acetaminophen and/or ibuprofen (yes/no) and whether they agreed (yes/no) that their pain was manageable with this pain-control regimen.

Primary outcomes were the prevalence and amount of opioid use among the cohort, as well as patient-reported outcomes for pain, satisfaction, and the acceptability of this pain-control regimen. Secondary analysis was performed to retrospectively compare patients who used opioids after surgical procedures with patients who did not use opioid after surgical procedures.

Descriptive statistics included means with SD and medians with interquartile range (IQR) for outcomes that were not normally distributed. Comparison of groups was performed using Student's *t*-test, chi-square analysis, Mann-Whitney U test, and Kruskal-Wallis H test, as appropriate. All hypotheses were 2-sided and significance was set at $\alpha = 0.05$. All analyses were conducted using Stata, version 15 (StataCorp).

RESULTS

Between January 1 and December 31, 2018, 281 patients were enrolled in this opioid-sparing pathway, underwent operations, and were eligible to receive the survey (Table 1). Of the 200 (71%) patients who responded to a postoperative survey, 10 were excluded for chronic opioid use, leaving a cohort of 190 patients for analysis. Mean time to follow-up was 39 (SD 35) days. Mean age of this cohort was 56 (SD 14) years old and 66 (35%) patients were female. Within this cohort, 31 patients underwent laparoscopic cholecystectomy, 12 patients underwent laparoscopic inguinal hernia repair,

Table 1. Cohort Characteristics, Opioid Prescriptions, and Patient-Reported Outcomes

Variable	Laparoscopic cholecystectomy (n = 31)	Laparoscopic inguinal hernia repair (n = 12)	Thyroidectomy/ parathyroidectomy (n = 31)	Robotic prostatectomy (n = 87)	Endoscopic sinus operation (n = 19)	Laparoscopic sleeve gastrectomy (n = 10)	p Value
Age, y, mean (SD)	46 (16)	53 (19)	57 (14)	62 (7)	52 (15)	44 (15)	<0.001
Female sex, n (%)	22 (71)	0 (0)	26 (84)	0 (0)	9 (47)	9 (90)	<0.001
Opioid prescription, n (%)	26 (84)	2 (17)	23 (74)	77 (89)	14 (74)	4 (40)	<0.001
Prescription size, pills, median (IQR)	4 (4−5)	6 (5−6)	0 (0−5)	6 (5−6)	8 (8−10)	10 (10−10)	<0.001
Opioid used, pills, median (IQR)	0 (0−4)	1 (0−6)	0 (0−2)	1 (0−4)	0 (0−8)	1 (0−10)	0.245
Used no opioid, n (%)	16 (52)	5 (42)	22 (71)	41 (47)	10 (53)	5 (50)	0.323
Request for refill, n (%)	1 (3)	0 (0)	0 (0)	2 (2)	0 (0)	0 (0)	0.858
Use of nonopioid, n (%)	29 (94)	12 (100)	28 (90)	72 (83)	18 (95)	8 (80)	0.275
Pain manageable, n (%)	24 (77)	12 (100)	28 (90)	83 (95)	15 (79)	10 (100)	0.016
Pain score, 0−3, median (IQR)	2 (1−2)	2 (1−2)	1 (0−2)	1 (1−2)	1 (1−2)	2 (1−2)	0.035
Satisfaction score, 1−10, median (IQR)	9 (8−10)	10 (9−10)	9 (8−10)	10 (9−10)	10 (10−10)	9 (8−10)	0.031
Quality of life score, 1−5, median (IQR)	5 (4−5)	4 (4−5)	4 (3−4)	4 (3−4)	5 (4−5)	5 (4−5)	<0.001
Regret score, 1−5, median (IQR)	5 (5−5)	5 (5−5)	5 (5−5)	5 (5−5)	5 (5−5)	5 (4−5)	0.334
Percent recovered, 1−100, median (IQR)	100 (95−100)	83 (80−90)	75 (70−90)	75 (65−90)	95 (80−100)	90 (85−100)	<0.001
Surgical site pain, 1−10, median (IQR)	0 (0−2)	2 (0−3)	0 (0−1)	0 (0−2)	0 (0−1)	0 (0−1)	0.270
Leftover pills, median (IQR)	2 (0−4)	0 (0−0)	3 (0−5)	5 (0−6)	1 (0−3)	0 (0−2)	0.006

IQR, interquartile range.

31 patients underwent thyroidectomy/parathyroidectomy, 87 patients underwent robotic prostatectomy, 19 patients underwent sinus operation, and 10 patients underwent laparoscopic sleeve gastrectomy. Regarding surgeon participation, laparoscopic cholecystectomy was performed by 6 different surgeons, laparoscopic inguinal hernia repair was performed by 2 different surgeons, thyroidectomy/parathyroidectomy was performed by 4 different surgeons, robotic prostatectomy was performed by 9 different surgeons, sinus operation was performed by 4 different surgeons, and laparoscopic sleeve gastrectomy was performed by 4 different surgeons.

Median rescue prescription size was 5 (IQR 4 to 6) pills and prescriptions were provided for 152 (82%) patients. Rescue prescription medications included oxycodone 5 mg (68%), tramadol 50 mg (27%), and hydrocodone/acetaminophen 5/325 mg (5%). All patients were prescribed acetaminophen and ibuprofen.

Median opioid use for the entire cohort was 0 (IQR 0 to 4) pills. Fifty-two percent of patients used no opioids after the procedure, and 98% of patients used 10 pills or fewer (Fig. 1). Among patients who did use opioids (48%), median use was 4 (IQR 2 to 6) pills. Median number of leftover pills was 2 (IQR 0 to 5). Three (1.6%) patients requested a refill. Sixty-two (33%) patients reported using both acetaminophen and ibuprofen after the procedure, 167 (88%) patients reported using either medication, and 23 (12%) patients reported using neither medication.

Median pain score was 1 (IQR 1 to 2) or minimal (minimal to moderate) pain. Median patient satisfaction score was 10 (IQR 8 to 10), or extremely satisfied. Median quality of life since the operation was 4 (IQR 4 to 5). Median level of regret for undergoing the operation was 5 (IQR 5 to 5), or "absolutely no regret." Median percent recovered after operation was 85% (IQR 70% to 95%), with 72% of patients at least 75% recovered from the operation at the time of survey. Median surgical site pain at the time of survey was 0 (IQR 0 to 2). Almost all (91%) patients said that their pain was manageable with this regimen. Results by procedure are presented in Table 1.

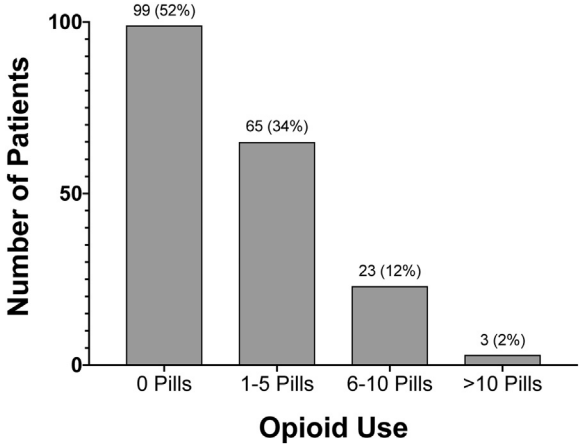

Figure 1. Distribution of opioid use after operation. Patients who participated in an opioid-sparing postoperative pathway used very little opioid medication after common surgical procedures. More than half (52%) of patients used no opioids and 98% of patients used 10 pills or fewer.

Comparing opioid users with non-users, patient who used opioids after operation in this cohort were younger (52 ± 14 vs 59 ± 13 years; p = 0.001), reported higher pain scores (2 [IQR 1 to 2] vs 1 [1 to 2]; p = 0.014), received larger rescue prescriptions based on procedure-specific recommendations (6 ± 3 vs 4 ± 4 pills; p = 0.003), and were less likely to agree that their pain was manageable with this regimen (82% vs 98%; p = 0.001) (Table 2). There were no significant differences in sex, satisfaction, quality of life, regret, percent recovered, surgical site pain, acetaminophen/ibuprofen use, prescription type, or number of leftover pills between opioid users and non-users. There were also no significant differences in procedure distribution between opioid users and non-users, although thyroidectomy/parathyroidectomy had the highest prevalence of opioid non-users (71%) and robotic prostatectomy had the lowest prevalence of opioid non-users (47%).

There was no difference in opioid use between patients who reported using both, either, or neither acetaminophen or ibuprofen (2.0 vs 2.3 vs 2.0 pills; p = 0.847).

DISCUSSION

After a variety of elective surgical procedures, opioid-naïve patients who were instructed to use nonopioid analgesics as their primary method of pain control after operation used minimal opioids and reported high satisfaction and acceptable pain control. More than half of these patients used no opioids after procedures that have historically received prescriptions of 20 to 40 tablets of oxycodone 5 mg.[13] Patients who did use opioids tended to be younger, reported higher pain scores, received larger rescue prescriptions, and were less likely to agree that this was a manageable postoperative pain regimen. Despite these differences, these patients still used minimal opioids, reported high satisfaction with their care, and reported good recovery after operation.

This study provides important insight into the feasibility and acceptability to patients of an opioid-sparing postoperative pain management pathway across a variety of surgical procedures. This approach to postoperative

Table 2. Comparison of Characteristics between Opioid Users and Non-Users

Characteristic	Opioid user (n = 91)	Opioid non-user (n = 99)	p Value
Age, y, mean (SD)	52 (14)	59 (13)	0.001
Female sex, %	31	38	0.217
Pain score, 0−3, median (IQR)	2 (1−2)	1 (1−2)	0.014
Satisfaction score, 0−10, median (IQR)	10 (9−10)	10 (8−10)	0.687
Quality of life score, 1−5, median (IQR)	4 (4−5)	4 (3−5)	0.771
Regret score, 1−5, median (IQR)	5 (5−5)	5 (5−5)	0.900
Percent recovered, 1−100, median (IQR)	88 (70−97)	80 (71−95)	0.633
Surgical site pain, 1−10, median (IQR)	0 (0−2)	0 (0−2)	0.285
Agree pain manageable, %	82	98	0.001
Acetaminophen/ibuprofen use, %	91	85	0.179
Prescription size, pills, median (IQR)	6 (3)	4 (4)	0.003
Leftover pills, median (IQR)	2 (0−5)	3 (0−5)	0.395
Prescription type, %			0.378
Oxycodone 5 mg	71	63	
Tramadol 50 mg	23	32	
Hydrocodone/Acetaminophen 5/325 mg	6	4	
Procedure, %			0.323
Laparoscopic cholecystectomy	17	16	
Laparoscopic inguinal hernia repair	8	5	
Thyroidectomy/parathyroidectomy	10	22	
Robotic prostatectomy	51	41	
Endoscopic sinus operation	10	10	
Laparoscopic sleeve gastrectomy	6	5	

IQR, interquartile range.

pain management can have several advantages over traditional postoperative pain control. Up to 10% of opioid-naïve patients who receive an opioid after operation go on to develop long-term opioid dependence.[3] The risk of overdose and dependence has also been shown to be associated with the size of the initial prescription.[14-16] This introduces significant risk of morbidity and mortality related to long-term opioid use.[17] Additionally, patients who receive larger prescription are more likely to use more opioids in the immediate postoperative period, which further increases their risk of adverse events.[13] In an effort to increase patient safety, the CDC recommends prescribing the "lowest effective dosage" when prescribing opioids.[17] These results suggest that the lowest effective dose for postoperative pain might be much less than has been demonstrated previously.

This pathway also reduced the amount of excess medication introduced into the community that becomes available for diversion and abuse. Leftover prescription opioids are a major source of nonmedical opioid use, especially for adolescents.[18,19] A study evaluating general and obstetric surgical procedures across 2,392 patients demonstrated a median of 19 leftover pills per patient.[13] Patients in the current study had a median of 2 leftover pills after their operations, or 90% less than the amount of leftover medication observed in routine practice. As such, this pathway might represent an effective way to prevent excess opioids from entering the community without compromising patient recovery. Along these lines, it might even be reasonable to further reduce the amount of opioids prescribed for these procedures because patients still reported having leftover pills. This is particularly true for thyroidectomy/parathyroidectomy and robotic prostatectomy, where patients reported having the greatest number of leftover pills.

Central to this postoperative pathway is that prescription size and opioid use were significantly reduced without adversely affecting patient satisfaction. Recently, there has been a growing amount of data demonstrating that larger opioid prescriptions are not associated with increased patient satisfaction.[20] For example, Lee and colleagues[21] compared high and low opioid prescribing hospitals and found no difference in patient-reported pain scores between the highest and lowest quintiles of prescribing. It has also been found that smaller opioid prescription sizes after surgical procedures did not result in a higher number of medication refills among patients.[22] The results demonstrated in this postoperative pathway

are in line with previous evidence suggesting that patient satisfaction does not decline with smaller prescriptions. Importantly, the approach described here is inherently patient-centered and physician-driven, providing an effective alternative to legislative prescribing limits, which are not patient-centered, can lead to inadequate pain control, and are not always easily implemented.[23,24] Future work can even better tailor opioid prescriptions to the needs of each patient by using individual patient characteristics to predict analgesic needs, such as inpatient opioid use before discharge.[25]

This work also highlights the importance of multimodal analgesia for optimal pain control. Patients in this study reported using significantly more acetaminophen and ibuprofen than cohorts we have analyzed previously—88% compared with 61% to 69% in an earlier study.[9] Although the explicit prescription of these medications rather than simply recommending them is a unique feature of this postoperative pathway, this might not explain their increased use. We previously saw that doubling acetaminophen and ibuprofen prescriptions did not significantly increase patients' use of these medications.[9] Because the current cohort does use significantly more nonopioid analgesics than seen in an earlier work, it might be the focused preoperative instruction to take these medications around the clock that prompted their increased use. This emphasizes the central role of patient counseling on the postoperative recovery experience.

We acknowledge that this study is not without limitations. Namely, this study was a single-institution pilot project. It is possible that differences among patient populations outside of our institution might affect the success of implementing this pathway. An institution-specific prospective patient survey could be used at other institutions to gauge the analgesic requirements of their own patient populations, and a similar pathway could be used with adjustments to the actual medication amount. This pathway was also only offered for a finite number of procedures and might not be appropriate for more complex procedures. As we continue to implement this pathway for additional procedures at our institution, we hope to produce additional data on the feasibility of this approach across multiple surgical procedures and across a diverse patient population. Additionally, we did not collect data on patients who declined to participate in an opioid-sparing postoperative recovery pathway. Going forward, it will be important to understand the patient characteristics that favor the use of this pathway, as well as the proportion of overall total case volume this cohort of patients represents. Lastly, patient surveys can be subject to recall or observation bias. However, patient recall has been used in previous studies to determine opioid consumption, and the use of patient-reported outcomes, such as satisfaction, is critical to this pain management approach to ensure that changes in prescribing still provide appropriate pain care.

CONCLUSIONS

Patients reported minimal or no opioid use after the implementation of an opioid-sparing postoperative pain-control regimen and still reported high satisfaction and adequate pain control. The current study suggests that opioids can be greatly reduced or eliminated after many minor surgical procedures.

Author Contributions

Study conception and design: Hallway, Palazzolo, Howard
Acquisition of data: Waljee, Brummett, Englesbe
Analysis and interpretation of data: Hallway, Howard
Drafting of manuscript: Hallway, Vu, Lee, Palazzolo, Waljee, Brummett, Englesbe, Howard
Critical revision: Hallway, Waljee, Howard

REFERENCES

1. Hill MV, McMahon ML, Stucke RS, Barth RJ Jr. Wide variation and excessive dosage of opioid prescriptions for common general surgical procedures. Ann Surg 2017;265:709—714.
2. Bicket MC, Long JJ, Pronovost PJ, et al. Prescription opioid analgesics commonly unused after surgery: a systematic review. JAMA Surg 2017;152:1066—1071.
3. Brummett CM, Waljee JF, Goesling J, et al. New persistent opioid use after minor and major surgical procedures in US adults. JAMA Surg 2017;152:e170504.
4. Hughes AWM, Lipari RN, Bose J, et al. Prescription drug use and misuse in the United States: results from the 2015 National Survey on Drug Use and Health. NSDUH Data Review. Available at: 2016. http://www.samhsa.gov/data/sites/default/files/NSDUH-FFR2-2015/NSDUH-FFR2-2015.pdf. Accessed December 18, 2018.
5. Compton WM, Jones CM, Baldwin GT. Relationship between nonmedical prescription-opioid use and heroin use. N Engl J Med 2016;374:154—163.
6. Lucas CE, Vlahos AL, Ledgerwood AM. Kindness kills: the negative impact of pain as the fifth vital sign. J Am Coll Surg 2007;205:101—107.
7. Larach DB, Waljee JF, Hu HM, et al. Patterns of initial opioid prescribing to opioid-naive patients. Ann Surg 2018 [Epub ahead of print].
8. Hill MV, Stucke RS, McMahon ML, et al. An educational intervention decreases opioid prescribing after general surgical operations. Ann Surg 2018;267:468—472.
9. Howard R, Waljee J, Brummett C, et al. Reduction in opioid prescribing through evidence-based prescribing guidelines. JAMA Surg 2018;153:285—287.
10. Scully RE, Schoenfeld AJ, Jiang W, et al. Defining optimal length of opioid pain medication prescription after common surgical procedures. JAMA Surg 2018;153:37—43.

11. Overton HN, Hanna MN, Bruhn WE, et al. Opioid-prescribing guidelines for common surgical procedures: an expert panel consensus. J Am Coll Surg 2018;227:411−418.
12. Michigan Medicine. Managing your pain aftery surgery without opioids. Available at: 2019. http://www.med.umich.edu/1libr/Surgery/MPOPeducation-ManagingPainWithoutOpioids.pdf. Accessed April 14, 2019.
13. Howard R, Fry B, Gunaseelan V, et al. Association of opioid prescribing with opioid consumption after surgery in Michigan. JAMA Surg 2018;7:e184234.
14. Shah A, Hayes CJ, Martin BC. Characteristics of initial prescription episodes and likelihood of long-term opioid use—United States, 2006-2015. MMWR Morb Mortal Wkly Rep 2017;66:265−269.
15. Bohnert AS, Valenstein M, Bair MJ, et al. Association between opioid prescribing patterns and opioid overdose-related deaths. JAMA 2011;305:1315−1321.
16. Webster BS, Verma SK, Gatchel RJ. Relationship between early opioid prescribing for acute occupational low back pain and disability duration, medical costs, subsequent surgery and late opioid use. Spine (Phila Pa 1976) 2007;32:2127−2132.
17. Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain—United States, 2016. JAMA 2016;315:1624−1645.
18. McCabe SE, West BT, Boyd CJ. Leftover prescription opioids and nonmedical use among high school seniors: a multi-cohort national study. J Adolesc Health 2013;52:480−485.
19. Lipari RN, Hughes A. How people obtain the prescription pain relievers they misuse. The CBHSQ Report. Available at: 2017. https://www.samhsa.gov/data/sites/default/files/report_2686/ShortReport-2686.html. Accessed May 1, 2019.
20. North F, Crane SJ, Ebbert JO, Tulledge-Scheitel SM. Do primary care providers who prescribe more opioids have higher patient panel satisfaction scores? SAGE Open Med 2018;6.2050312118782547.
21. Lee JS, Hu HM, Brummett CM, et al. Postoperative opioid prescribing and the pain scores on Hospital Consumer Assessment of Healthcare Providers and Systems Survey. JAMA 2017;317:2013−2015.
22. Sekhri S, Arora NS, Cottrell H, et al. Probability of opioid prescription refilling after surgery: does initial prescription dose matter? Ann Surg 2018;268:271−276.
23. Chua KP, Brummett CM, Waljee JF. Opioid prescribing limits for acute pain: potential problems with design and implementation. JAMA 2019;321:643−644.
24. Lowenstein M, Grande D, Delgado MK. Opioid prescribing limits for acute pain—striking the right balance. N Engl J Med 2018;379:504−506.
25. Hill MV, Stucke RS, Billmeier SE, et al. Guideline for discharge opioid prescriptions after inpatient general surgical procedures. J Am Coll Surg 2018;226:996−1003.