www.medscape.com

Educating Patients Regarding Pain Management and Safe Opioid Use After Surgery

A Narrative Review

Bradley H. Lee, MD; Christopher L. Wu, MD

Anesth Analg. 2020;130(3):574-581.

Abstract and Introduction

Abstract

In recent years, there have been escalating concerns related to the opioid epidemic. With a steadily increasing opioid supply, it is critical to provide proper education to patients who are prescribed these medications. Education should be emphasized as a means of ensuring safe use and potentially as a strategy for curbing the opioid supply. Patients who undergo surgery are frequently prescribed opioids for postoperative pain; however, the content and delivery of information related to usage is inconsistent and often inadequate. Lack of education on postoperative pain management and opioid use places patients at risk for poor compliance and worse pain control. Furthermore, patients are often not properly educated on opioid-related side effects and risks or about safe behaviors when taking medications. The majority of patients are also not informed about how to store and dispose of leftover medications. Patients who are prescribed opioids require education preoperatively to cover the topics of pain management, opioid-related side effects, and risks, storage, and disposal. Evidence from various studies demonstrates that educational interventions improve knowledge and potentially lead to safer behaviors and reduced opioid use. Education can be provided in various formats with each having unique advantages and limitations.

Introduction

Opioids are frequently prescribed to treat pain after surgery, and while these medications may be effective analgesics, they are also susceptible to misuse and addiction. There are growing concerns that prescription opioids contribute to the existing opioid supply and become potential sources for abuse.[1,2] In fact, opioids are often abused by those using medications not prescribed to them but obtained from friends or relatives.[3,4]

Unfortunately, many patients who undergo surgery may not be given adequate information about opioids and strategies for postoperative pain management.[5–7] In addressing the opioid epidemic, there needs to be a greater emphasis on educating patients so that they may learn to use opioids appropriately. Patients should be educated specifically on how to use opioids to treat postoperative pain and also informed regarding opioid-related side effects, risks, and proper disposal. The goal should be to reduce reliance on opioids, lower risks of addiction, and ultimately limit the supply of opioids that are liable to be misused.

We explore the existing literature to investigate the effects of patient education and current gaps that are present. We then present information that may help guide patients and lead to safer opioid handling and consider approaches to education and areas of research moving forward.

Influence of Education on Postoperative Pain and Opioid use

There is evidence that preoperative counseling and education can shape patients' expectations, attitudes, and behaviors related to opioid use. In a study by Sugai et al,[8] patients undergoing ambulatory surgery were randomly assigned to education sessions 2 weeks before their procedure. They were given both oral and written information focusing on the negative side effects of opioids, role of exogenous opioid in the processing of pain, and importance of nonopioid analgesics. Patients who received this education were less likely to request opioids postoperatively while actually reporting lower average pain scores and shorter duration of pain.[8]

Informing patients about opioid use and managing postoperative pain may reduce opioid consumption after surgery. Holman et al[9] investigated this in orthopedic trauma patients who were given preoperative counseling that included the following points: (1) acknowledging that discomfort is associated with injury, (2) reduction of discomfort is a priority for caregivers, (3) pain may be reduced but not eliminated, and (4) oral opioids are part of treatment but come with risks including side effects, physical dependence, and withdrawal symptoms. Patients who received counseling were more likely to stop opioid use by

the 6-week mark compared with those who had not received any counseling.[9] In another study, a preoperative educational program consisting of a video and handout detailing opioid side effects, dependence, and addiction led to earlier opioid cessation and less overall use in patients who underwent rotator cuff repair.[10] Last, in a study by Yajnik et al,[11] a reference card describing the patient's multimodal analgesic regimen was reviewed both preoperatively and postoperatively in patients undergoing total knee replacement. The use of the reference card resulted in significantly less opioid consumption which may reflect the influence of education and multimodal analgesia.[11]

Educating patients about safe practices when taking opioids may reduce risky behaviors associated with opioid use. In evaluating emergency department patients who received both written and verbal instructions after being prescribed Norco (hydrocodone and acetaminophen), McCarthy et al[12] found that instructions led to improved knowledge of medication side effects. Patients were also more likely to remember precautions about taking additional acetaminophen while taking Norco (hydrocodone and acetaminophen).[12] Furthermore, patients who received the intervention were less likely to report having driven a vehicle within 6 hours after taking the opioid.[12] Increasing knowledge about dangers of addiction and abuse may lead to safer patient practices with opioid management. In patients using opioids for longer durations, there is evidence that those who are informed regarding the risks of addiction reported lower rates of pill saving.[7]

Emphasizing safe storage and disposal of opioids can improve proper handling. de la Cruz et al[13] demonstrated this using a combined written and in-person educational intervention. Patients received educational material consisting of a 2-page handout written for comprehension at an eighth-grade level of education. In addition, clinic staff including nurses, pharmacists, and physicians were given in-service training about safe practices, and each patient was provided information by staff members who reviewed general points in the educational material and answered questions.[13] Educational material provided to patients regarding safe use, storage, and disposal of opioids led to greater awareness of proper disposal methods, and those who received education were less likely to report having unused medications at home.[13] Other studies have also demonstrated improved rates of proper opioid disposal with educational interventions.[14,15]

Preoperative education has not consistently demonstrated effects on anxiety, pain perception, or length of stay after surgery.[16–20] Some studies show a positive effect of education on postoperative pain control,[21,22] while others do not.[19] The emphasis and priority with patient education are primarily to improve knowledge using concepts of early education, repetition, and reinforcement.[16,23] The subjective experience and perception of pain may not necessarily change with education; however, providing patients with practical information about using opioids to manage pain will improve their knowledge. The objective is for this knowledge to shape patients' attitudes and behaviors related to opioid use resulting in safer practices.

Current Gaps and Deficiencies of Patient Education: Defining the Problem

In response to the opioid epidemic, increasing efforts have been made to develop strategies and policies to address this problem. Educating patients to promote safe opioid use has consistently been acknowledged as an important issue,[24,25] yet little progress has been made in this area because patients are often inadequately informed regarding postoperative pain management. Research to determine efficacious strategies for improving safety and minimizing perioperative opioid use is also lacking which is a concern acknowledged by the Centers for Disease Control and Prevention.[26]

Inadequate education regarding postoperative pain management is liable to result in poor understanding, compliance, and worse pain control. Lemay et al[5] noted that 44% of patients who underwent total joint arthroplasty reported that they had not received information about postoperative pain management, and worse function at 6 months was associated with those who had not received any education. Another study revealed that, among patients who underwent surgery for orthopedic trauma, up to 70% could not recall their postoperative pain medication regimen, and many of these patients modified their regimen with nonprescribed pain medications reflecting the poor compliance associated with deficient education.[6]

Patients who are prescribed opioids are also not consistently educated or given resources related to medication side effects and risks. In 1 population-based study, as few as 36% of patients who were prescribed opioids reported having a discussion about the potential risks of addiction.[7] In a review of online sources of information related to postoperative pain management available to patients, approximately 75% of websites were found to present information about opioids.[27] Among these, only half discussed dependence related to opioids and <15% provided guidance on weaning opioids.[27] The extent of patients' knowledge regarding opioid-related side effects is unclear based on the literature, and there are likely varying degrees of awareness based on an individual's prior experiences and background.

Gaps in knowledge about proper opioid use, storage, and disposal put patients at risk for improper handling of medications. Studies demonstrate that most patients are unaware of how to properly store and dispose of prescription opioids.[1,28] Without education, opioid misuse is fairly common, including behaviors such as saving unused pills, sharing medication, and taking larger doses than prescribed.[28] Eventually, opioids are no longer needed after surgery and patients discontinue their use; yet, patients are rarely given information about the appropriate disposal of unused opioids.[1] This is especially

problematic because opioids are typically prescribed in excess, resulting in a significant portion of unused pills.[29–32] Surveys have identified that as little as 5% to 6% of physicians discuss with patients how to properly dispose of excess opioids.[30,33] Possibly related to this, only 4% to 30% of patients report that they actually disposed of unused medications.[1]

In terms of educational resources, the content and delivery to patients do not reliably ensure comprehension. Low literacy rates are associated with worse health-related outcomes,[34,35] and the American Medical Association (AMA) specifically recommends that patient education materials (PEMs) used to provide patient information, instructions, consents, and other materials be written at the sixth-grade reading level or lower to promote improved comprehension.[36,37] However, in evaluating the readability of web-based PEMs related to postoperative opioid management, Kumar et al[38,39] found that many were beyond the sixth-grade reading level and often did not address important issues such as opioid tapering, cessation, disposal, dependence, and withdrawal.

Finally, lack of quality research regarding educational interventions has hindered the development of guidelines for preoperative education. In 2016, a systematic review was conducted by an interdisciplinary panel of members of the American Pain Society to determine research gaps in managing acute postoperative pain.[24] Only 4 trials were rated as higher quality, which was too few to provide comparisons of types of education methods or direction regarding the timing and most effective strategies for preoperative education.[24] Greater comparative effectiveness research is needed to determine the most appropriate methods for educational interventions.

Providing Information on Pain Management and Opioids: Developing the Solution

Patients undergoing surgery who are prescribed opioids need specific details about medications and their role in managing postoperative pain to guide them on safe and appropriate use (summarized in).

Table 1. Information About Opioids and Pain Management After Surgery to Guide Patients in Safe and Appropriate Use

Reviewing opioids and strategies for analgesia
Defining opioids (prescription pain medications that are controlled substances due to potential for abuse and addiction, generic and brand names—morphine, oxycodone, Percocet, hydrocodone, Norco, Vicodin)
Goals for postoperative pain management and utilizing opioids to treat pain (experiencing some degree of pain after surgery is normal, pain control should facilitate movement and recovery, opioids are to be used sparingly to treat pain that interferes with activity, taper and discontinue opioid use as early as possible)
Alternative modes of treating pain (multimodal analgesia can improve pain control and reduce opioid use, nonopioid forms of multimodal analgesia: acetaminophen, NSAIDs, gabapentinoids, cold/heat, meditation)
Regional anesthesia/analgesia (define regional anesthesia and role in postoperative pain if applicable, regional anesthesia potentially improves analgesia and reduces opioid needs)
Side effects and risks of opioids
Common side effects (nausea, vomiting, pruritus, sedation, respiratory depression, constipation)
Risks of addiction, tolerance, dependence, opioid-induced hyperalgesia
Proper use and handling of opioids
Safe practices when taking opioids (take medications only as prescribed, avoid concurrent use of sedating substances/medications including alcohol, do not share medications, OSA patients need to adhere to CPAP use while taking opioids)
Weaning opioids (risk of addiction increases with longer duration of use, take medication for as short duration as needed, discontinue use as soon as possible)
Safe storage and disposal of opioids (store away from children and pets in hidden locked area, do not store unused medications, dispose of medication as soon as discontinued, review options for proper disposal: take-back program, official drop site)

Abbreviations: CPAP, continuous positive airway pressure; NSAID, nonsteroidal anti-inflammatory drug; OSA, obstructive sleep apnea.

It may be helpful to clarify the term "opioid" and explain how it refers to a class of prescription pain medications and

distinguish this from the term "narcotic" which describes more broadly anything that causes sedation or narcosis including illicit substances.[40] Patients may also recognize generic or brand names of opioids (eg, morphine, oxycodone, Oxycontin [Purdue Pharma LP, Stamford, CT], Percocet [Endo Pharmaceuticals Inc, Malvern, PA], hydrocodone, and Vicodin [Mikart Inc, Atlanta, GA]).

After identifying these medications, it is helpful to explain how they fit into the overall pain management strategy by reviewing the goals of pain control and how opioids are used. This is important because many patients do not have adequate knowledge about pain relief to effectively manage their own pain and may therefore have difficulty with postoperative analgesia.[41,42] Patients need to understand that experiencing pain after surgery is normal; however, the role of pain control is to allow movement and facilitate recovery.[43] Opioids may be used but are limited to pain intensity that interferes with activities and is not covered by nonopioid strategies, and these medications are used for the shortest duration possible. Pain is typically most significant in the initial few days after surgery; however, pain improves over time and fewer opioids are needed.[44,45] Therefore, the goal is to taper and discontinue these medications as early as possible.

Multimodal analgesia is an important concept for managing postoperative pain, and there is increasing evidence that it results in improved pain control after surgery and reduced opioid consumption.[46–50] In fact, recent guidelines on postoperative pain management recommend multimodal analgesia when possible, which is supported by high-quality evidence.[51] Educating patients on utilizing various forms of analgesia apart from opioids will ideally help them to understand the importance of multimodal analgesia and appreciate how addressing different forms of pain processing will improve postoperative analgesia. The various forms of multimodal analgesia may be reviewed including nonopioid analgesics, namely acetaminophen, nonsteroidal anti-inflammatory drugs (NSAIDs), gabapentinoids, as well as other interventions including meditation, heat, and cold.[47]

A wide range of procedures have become amenable to various forms of regional anesthesia. Regional anesthesia techniques can be utilized for upper extremity, lower extremity, abdominal, thoracic, and breast operations.[52–60] There is mounting evidence that regional anesthesia is effective for improving analgesia and minimizing opioid use postoperatively.[61–65] When regional anesthesia is involved, patients may benefit by receiving information about its use and, in particular, how it improves postoperative analgesia. This will hopefully help them understand that by utilizing regional techniques, fewer opioids may be needed after surgery.

Patients who are prescribed opioids need information on their associated side effects and risks as improved education about these details appears to limit high-risk behaviors and opioid misuse[7,12] (). It is helpful to review common side effects such as nausea, vomiting, pruritus, sedation, respiratory depression, and constipation[66,67] and for patients to appreciate that side effects may be dose dependent. It is also important for patients to be educated regarding important concepts of addiction, dependence, and tolerance as well as risks associated with these disorders. Concerns for addiction can occur even after only 5 days of use, and the risk increases with longer durations of use.[68] Tolerance resulting in higher doses of medication to achieve the same effect not only makes controlling pain more difficult but also increases the risk of accidental overdose.[67] Finally, in patients using opioids long term, opioid-induced hyperalgesia can increase pain sensitivity and result in abnormal pain perception and increasingly difficult-to-manage pain.[67,69,70]

Table 1. Information About Opioids and Pain Management After Surgery to Guide Patients in Safe and Appropriate Use

Reviewing opioids and strategies for analgesia
Defining opioids (prescription pain medications that are controlled substances due to potential for abuse and addiction, generic and brand names—morphine, oxycodone, Percocet, hydrocodone, Norco, Vicodin)
Goals for postoperative pain management and utilizing opioids to treat pain (experiencing some degree of pain after surgery is normal, pain control should facilitate movement and recovery, opioids are to be used sparingly to treat pain that interferes with activity, taper and discontinue opioid use as early as possible)
Alternative modes of treating pain (multimodal analgesia can improve pain control and reduce opioid use, nonopioid forms of multimodal analgesia: acetaminophen, NSAIDs, gabapentinoids, cold/heat, meditation)
Regional anesthesia/analgesia (define regional anesthesia and role in postoperative pain if applicable, regional anesthesia potentially improves analgesia and reduces opioid needs)
Side effects and risks of opioids
Common side effects (nausea, vomiting, pruritus, sedation, respiratory depression, constipation)
Risks of addiction, tolerance, dependence, opioid-induced hyperalgesia
Proper use and handling of opioids

Safe practices when taking opioids (take medications only as prescribed, avoid concurrent use of sedating substances/medications including alcohol, do not share medications, OSA patients need to adhere to CPAP use while taking opioids)
Weaning opioids (risk of addiction increases with longer duration of use, take medication for as short duration as needed, discontinue use as soon as possible)
Safe storage and disposal of opioids (store away from children and pets in hidden locked area, do not store unused medications, dispose of medication as soon as discontinued, review options for proper disposal: take-back program, official drop site)

Abbreviations: CPAP, continuous positive airway pressure; NSAID, nonsteroidal anti-inflammatory drug; OSA, obstructive sleep apnea.

It is important for patients receiving prescription opioids to receive guidance on safe practices because improved knowledge may reduce potentially risky behaviors associated with opioid use[7,12] (). Patients need to understand that opioids are taken only as prescribed to avoid misuse and risks associated with misuse. Common examples of opioid misuse include taking opioids as sleep aids, crushing pills for faster onset, and combining medications with alcohol or other sedating medications. Patients with sleep apnea are also at increased risk of opioid-induced respiratory depression[71,72] and therefore need to adhere strictly to Continuous Positive Airway Pressure (CPAP) use while taking opioids. These patients, in particular, may benefit from multimodal analgesia to reduce opioid use and associated postoperative complications.[73]

Table 1. Information About Opioids and Pain Management After Surgery to Guide Patients in Safe and Appropriate Use

Reviewing opioids and strategies for analgesia
Defining opioids (prescription pain medications that are controlled substances due to potential for abuse and addiction, generic and brand names—morphine, oxycodone, Percocet, hydrocodone, Norco, Vicodin)
Goals for postoperative pain management and utilizing opioids to treat pain (experiencing some degree of pain after surgery is normal, pain control should facilitate movement and recovery, opioids are to be used sparingly to treat pain that interferes with activity, taper and discontinue opioid use as early as possible)
Alternative modes of treating pain (multimodal analgesia can improve pain control and reduce opioid use, nonopioid forms of multimodal analgesia: acetaminophen, NSAIDs, gabapentinoids, cold/heat, meditation)
Regional anesthesia/analgesia (define regional anesthesia and role in postoperative pain if applicable, regional anesthesia potentially improves analgesia and reduces opioid needs)
Side effects and risks of opioids
Common side effects (nausea, vomiting, pruritus, sedation, respiratory depression, constipation)
Risks of addiction, tolerance, dependence, opioid-induced hyperalgesia
Proper use and handling of opioids
Safe practices when taking opioids (take medications only as prescribed, avoid concurrent use of sedating substances/medications including alcohol, do not share medications, OSA patients need to adhere to CPAP use while taking opioids)
Weaning opioids (risk of addiction increases with longer duration of use, take medication for as short duration as needed, discontinue use as soon as possible)
Safe storage and disposal of opioids (store away from children and pets in hidden locked area, do not store unused medications, dispose of medication as soon as discontinued, review options for proper disposal: take-back program, official drop site)

Abbreviations: CPAP, continuous positive airway pressure; NSAID, nonsteroidal anti-inflammatory drug; OSA, obstructive sleep apnea.

Finally, all patients require education regarding proper storage and disposal of opioids to limit the risk of opioid misuse, theft, or overdose. Safe handling involves keeping medications out of reach of children, storing medications in the original container locked or hidden away from others, and never sharing medications. Medications are disposed of as soon as they are no longer needed, and options for disposal include drug take-back programs or safe drop sites which can be found

online.

If patients are not able to use these options, then they should mix unused medications with an unpalatable substance and disposed in the trash. The Food and Drug Administration (FDA) has also listed certain medications that may be safely flushed down the toilet without posing environmental consequences when take-back programs are not available.[74]

Approaches to Educational Interventions

In terms of educational interventions, a wide range of methods have been evaluated and found to be effective with distinct advantages and limitations of each method (see).

Table 2. Modes of Educational Interventions

Written (eg, booklet, pamphlet, brochures)
Advantages: can be distributed before surgery, serves as reference, lack of time constraints
Limitations: unable to answer questions not covered by written content, variable patient reading comprehension (written material should be at sixth-grade reading level)
In-person
Advantages: ability to confirm comprehension, opportunity to answer questions, does not require literacy
Limitations: cannot reference information later, provider accessibility, time constraints
Web-based
Advantages: readily accessible, can be referenced, interactive capability, ability to update information
Limitations: requires computer literacy, not universally accessible
Video
Advantages: does not require literacy, no provider constraints
Limitations: unable to ensure comprehension or answer questions, unable to reference as needed

Information provided in written formats has traditionally been used to educate patients. Pamphlets and booklets, for example, have demonstrated efficacy for educating patients.[18,75] This form of information can be easily distributed and may be referenced as needed. Though written information is commonly used, unfortunately it does not allow confirmation of understanding or addresses potential questions that patients might have. Patients also have varying degrees of reading comprehension which can be problematic, and written formats may not be the preferred mode for certain patients due to some of these factors.[76]

Videos do not rely on reading comprehension and are effective for providing information. For example, patients who viewed an informational video before elective surgery under regional anesthesia experienced less anxiety, and this effect was extended into the postoperative period, as well.[77] Video information provided to patients preoperatively also resulted in lower levels of anxiety in those undergoing procedures such as colonoscopy and hip and knee arthroplasty.[78,79] To prevent opioid overdose deaths, the Veterans Health Administration (VHA) developed a program for educating providers and patients that included videos as part of the training.[80] A significant number of successful overdose reversals were reported after the implementation of this educational program.[80] Chakravarthy et al[81] found that acquisition of information regarding opioid risks and safe usage was improved in those who viewed an animated video. Similar to written formats, however, video does not provide opportunity to address questions that patients might have.

Web-based strategies can combine audio, visual, and written information. Audio and visual aids might address low literacy barriers and interactive learning has demonstrated efficacy in acquiring and retaining knowledge.[82,83] Further benefits of web-based interventions include ability to update information, ease of dissemination, and ability to provide feedback and assess knowledge.[28] In a study by McCauley et al,[28] a web-based tool written at a sixth-grade reading level using multimedia format was used to teach patients about opioid misuse and how to safely use, store, and dispose of prescription opioids. Patients demonstrated improved knowledge including where to store pills and how to dispose of medications, and the intervention also resulted in lower reported rates of lending pills, borrowing pills, and saving unused medications.[28]

Some educators believe that live and in-person teaching is important because it provides a way to confirm understanding and answer questions. There is some evidence that verbal communication combined with written information may be more

effective than the written format alone.[84] Multidisciplinary information sessions involving providers and small groups of patients have demonstrated efficacy in reducing anxiety and pain associated with total hip arthroplasty.[85] By having a group session, it allows multiple patients to receive education simultaneously and is more efficient and cost-effective. Another advantage is the benefit of hearing answers to questions from other participants. The main barriers to in-person education, however, are the time constraints and limited availability of providers.

Regarding the timing of education, teaching patients before surgery and hospitalization may confer advantages in cost by improving recovery and requiring fewer postoperative services such as occupational and physiotherapy.[86] There is also evidence that education may be more effective in providing knowledge and potentially affecting outcomes when it is done preoperatively.[87] Unfortunately, information is often provided after surgery when patients are recovering from anesthesia and have received a number of sedating medications, and knowledge retention may be difficult in such stages of care.

The delivery of educational material is likely most effective as a collaborative effort among providers. Surgeons see patients before surgery and may therefore be in a position to provide informational brochures and pamphlets to patients. Information can be reiterated during presurgical visits, and there may be opportunity to address questions by both surgeons and anesthesiologists preoperatively. Anesthesiologists can clarify concepts of regional anesthesia and further explain strategies of multimodal analgesia and pain management. Nursing staff are also able to provide additional instruction after surgery and before discharge. The role of patient education is also well-suited for the emerging concept of the perioperative surgical home where patients are seen throughout the perioperative period.[88] Along these lines, the role of education is probably best handled as a combined effort among primary care physicians, surgeons, anesthesiologists, and other specialists.

It may also be useful to confirm or assess how well patients comprehend the information that they have received as delivering information is more effective when appropriately understood. There is no uniform method of evaluating patient knowledge, and this can be done in various ways. It may be as simple as having a patient verbalize key points to confirm their understanding. Patients can also be asked questions and evaluated based on their responses to see how well they comprehend and retain information. For practical purposes, this may involve reviewing only key concepts and providing resources as references for more straightforward details.

Finally, we have reviewed pain management and opioid use after surgery with the understanding that educational needs of each patient are highly variable and depend on the patient's background, history of substance abuse, type of procedure, and many other factors. Each patient has characteristics that lead to different experiences related to pain control and risks of opioid misuse and abuse, and ideally, the information and means of providing it are tailored as much as possible to each individual.

Cultural Perspectives and Future Research

The United States consumes 80% of the world's opioid supply which is a shockingly disproportionate amount relative to its population.[3,4] This is likely due at least in part to the cultural perspectives and expectations surrounding pain management and opioid use which is evident when comparing the United States to other countries. Compared to physicians in Japan, for example, US physicians are much more likely to believe that opioids are indicated for acute pain, and US physicians attribute this largely to standards of care for managing acute pain as well as legal expectations.[89] In the Netherlands, only 6% of patients were discharged with opioids after ankle fracture treatment compared with 82% in the United States, and Dutch patients relied instead on prescribed nonopioid analgesics such as acetaminophen and NSAIDs.[90]

Improving the education that patients receive related to postoperative pain management may promote a cultural shift and influence attitudes toward opioid use. In the future, areas of research addressing issues such as content, timing, and delivery of information should be explored to identify how to optimally equip patients with knowledge that will affect attitudes and behaviors related to postoperative opioid use. As education progresses, hopefully, there will be a change in perspectives related to opioids that will help reduce the prevalence of these medications.

References

1. Bicket MC, Long JJ, Pronovost PJ, Alexander GC, Wu CL. Prescription opioid analgesics commonly unused after surgery: a systematic review. *JAMA Surg*. 2017;152:1066–1071.

2. Raney EM, van Bosse HJP, Shea KG, Abzug JM, Schwend RM. Current state of the opioid epidemic as it pertains to pediatric orthopaedics from the advocacy committee of the pediatric orthopaedic society of North America. *J Pediatr Orthop*. 2018;38:e238–e244.

3. Manchikanti L, Helm S II, Fellows B, et al. Opioid epidemic in the United States. *Pain Physician*. 2012;15(3 suppl):ES9–E38.

4. Manchikanti L, Fellows B, Ailinani H, Pampati V. Therapeutic use, abuse, and nonmedical use of opioids: a ten-year perspective. *Pain Physician*. 2010;13:401–435.

5. Lemay CA, Lewis CG, Singh JA, Franklin PD. Receipt of pain management information preoperatively is associated with improved functional gain after elective total joint arthroplasty. *J Arthroplasty*. 2017;32:1763–1768.

6. Gangavalli A, Malige A, Terres G, Rehman S, Nwachuku C. Misuse of opioids in orthopaedic postoperative patients. *J Orthop Trauma*. 2017;31:e103–e109.

7. Hero JO, McMurtry C, Benson J, Blendon R. Discussing opioid risks with patients to reduce misuse and abuse: evidence from 2 surveys. *Ann Fam Med*. 2016;14:575–577.

8. Sugai DY, Deptula PL, Parsa AA, Don Parsa F. The importance of communication in the management of postoperative pain. *Hawaii J Med Public Health*. 2013;72:180–184.

9. Holman JE, Stoddard GJ, Horwitz DS, Higgins TF. The effect of preoperative counseling on duration of postoperative opiate use in orthopaedic trauma surgery: a surgeon-based comparative cohort study. *J Orthop Trauma*. 2014;28:502–506.

10. Syed UAM, Aleem AW, Wowkanech C, et al. Neer award 2018: the effect of preoperative education on opioid consumption in patients undergoing arthroscopic rotator cuff repair: a prospective, randomized clinical trial. *J Shoulder Elbow Surg*. 2018;27:962–967.

11. 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.

12. McCarthy DM, Wolf MS, McConnell R, et al. Improving patient knowledge and safe use of opioids: a randomized controlled trial. *Acad Emerg Med*. 2015;22:331–339.

13. de la Cruz M, Reddy A, Balankari V, et al. The impact of an educational program on patient practices for safe use, storage, and disposal of opioids at a comprehensive cancer center. *Oncologist*. 2016;22:115–121.

14. Hasak JM, Roth Bettlach CL, Santosa KB, Larson EL, Stroud J, Mackinnon SE. Empowering post-surgical patients to improve opioid disposal: a before and after Quality Improvement Study. *J Am Coll Surg*. 2018;226:235.e3–240.e3.

15. Rose P, Sakai J, Argue R, Froehlich K, Tang R. Opioid information pamphlet increases postoperative opioid disposal rates: a before versus after quality improvement study. *Can J Anesth*. 2016;63:31–37.

16. Burgess LC, Arundel J WT. The effect of preoperative education on psychological, clinical and economic outcomes in elective spinal surgery: a systematic review. *Healthcare (Basel)*. 2019;7:E48.

17. Daltroy LH, Morlino CI, Eaton HM, Poss R, Liang MH. Preoperative education for total hip and knee replacement patients. *Arthritis Care Res*. 1998;11:469–478.

18. Louw A, Butler DS, Diener I, Puentedura EJ. Development of a preoperative neuroscience educational program for patients with lumbar radiculopathy. *Am J Phys Med Rehabil*. 2013;92:446–452.

19. Louw A, Diener I, Landers MR, Puentedura EJ. Preoperative pain neuroscience education for lumbar radiculopathy: a multicenter randomized controlled trial with 1-year follow-up. *Spine (Phila Pa 1976)*. 2014;39:1449–1457.

20. Shuldham CM, Fleming S, Goodman H. The impact of preoperative education on recovery following coronary artery bypass surgery. A randomized controlled clinical trial. *Eur Heart J*. 2002;23:666–674.

21. Schmidt M, Eckardt R, Scholtz K, et al; PERATECS Group. Patient empowerment improved perioperative quality of care in cancer patients aged ≥ 65 years - a randomized controlled trial. *PLoS One*. 2015;10:e0137824.

22. Egbert LD, Battit GE, Welch CE, Bartlett MK. Reduction of postoperative pain by encouragement and instruction of patients. A study of doctor-patient rapport. *N Engl J Med*. 1964;270:825–827.

23. Ronco M, Iona L, Fabbro C, Bulfone G, Palese A. Patient education outcomes in surgery: a systematic review from 2004 to 2010. *Int J Evid Based Healthc*. 2012;10:309–323.

24. Gordon DB, de Leon-Casasola OA, Wu CL, Sluka KA, Brennan TJ, Chou R. Research gaps in practice guidelines for acute postoperative pain management in adults: findings from a review of the evidence for an American Pain Society

Clinical Practice Guideline. *J Pain*. 2016;17:158–166.

25. Soffin EM, Waldman SA, Stack RJ, Liguori GA. An evidence-based approach to the prescription opioid epidemic in orthopedic surgery. *Anesth Analg*. 2017;125:1704–1713.

26. Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain–United States, 2016. *JAMA*. 2016;315:1624–1645.

27. Schairer WW, Kahlenberg CA, Sculco PK, Nwachukwu BU. What is the quality of online resources about pain control after total knee arthroplasty? *J Arthroplasty*. 2017;32:3616. e1–3620.e1.

28. McCauley JL, Back SE, Brady KT. Pilot of a brief, web-based educational intervention targeting safe storage and disposal of prescription opioids. *Addict Behav*. 2013;38:2230–2235.

29. Kumar K, Gulotta LV, Dines JS, et al. Unused opioid pills after outpatient shoulder surgeries given current perioperative prescribing habits. *Am J Sports Med*. 2017;45:636–641.

30. Kim N, Matzon JL, Abboudi J, et al. A prospective evaluation of opioid utilization after upper-extremity surgical procedures: identifying consumption patterns and determining prescribing guidelines. *J Bone Joint Surg Am*. 2016;98:e89.

31. Grant DR, Schoenleber SJ, McCarthy AM, et al. Are we prescribing our patients too much pain medication? Best predictors of narcotic usage after spinal surgery for scoliosis. *J Bone Joint Surg Am*. 2016;98:1555–1562.

32. 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. *J Urol*. 2011;185:551–555.

33. Chiu AS, Healy JM, DeWane MP, Longo WE, Yoo PS. Trainees as agents of change in the opioid epidemic: optimizing the opioid prescription practices of surgical residents. *J Surg Educ*. 2018;75:65–71.

34. Weiss BD, Hart G, Pust RE. The relationship between literacy and health. *J Health Care Poor Underserved*. 1991;1:351–363.

35. Weiss BD, Palmer R. Relationship between health care costs and very low literacy skills in a medically needy and indigent Medicaid population. *J Am Board Fam Pract*. 2004;17:44–47.

36. Weiss BD. *Health Literacy and Patient Safety: Help Patients Understand. Manual for Clinicians*. Chicago, IL: AMA Foundation; 2007.

37. Safeer RS, Keenan J. Health literacy: the gap between physicians and patients. *Am Fam Physician*. 2005;72:463–468.

38. Kumar G, Howard SK, Kou A, Kim TE, Butwick AJ, Mariano ER. Availability and readability of online patient education materials regarding regional anesthesia techniques for perioperative pain management. *Pain Med*. 2017;18:2027–2032.

39. Kumar G, Jaremko KM, Kou A, Howard SK, Harrison TK, Mariano ER. Quality of patient education materials on safe opioid management in the acute perioperative period: what do patients find online? *Pain Med*. 2019 January 18 [Epub ahead of print].

40. Mangione MP, Crowley-Matoka M. Improving pain management communication: how patients understand the terms "opioid" and "narcotic". *J Gen Intern Med*. 2008;23:1336–1338.

41. Owen H, McMillan V, Rogowski D. Postoperative pain therapy: a survey of patients' expectations and their experiences. *Pain*. 1990;41:303–307.

42. Apfelbaum JL, Chen C, Mehta SS, Gan TJ. Postoperative pain experience: results from a national survey suggest postoperative pain continues to be undermanaged. *Anesth Analg*. 2003;97:534–540.

43. Kehlet H, Dahl JB. Anaesthesia, surgery, and challenges in postoperative recovery. *Lancet*. 2003;362:1921–1928.

44. Wojahn RD, Bogunovic L, Brophy RH, et al. Opioid consumption after knee arthroscopy. *J Bone Joint Surg Am*. 2018;100:1629–1636.

45. As-Sanie S, Till SR, Mowers EL, et al. Opioid prescribing patterns, patient use, and postoperative pain after hysterectomy for benign indications. *Obstet Gynecol*. 2017;130:1261–1268.

46. Kurd MF, Kreitz T, Schroeder G, Vaccaro AR. The Role of multimodal analgesia in spine surgery. *J Am Acad Orthop Surg*. 2017;25:260–268.

47. Beverly A, Kaye AD, Ljungqvist O, Urman RD. Essential elements of multimodal analgesia in Enhanced Recovery After Surgery (ERAS) guidelines. *Anesthesiol Clin*. 2017;35:e115–e143.

48. Hebl JR, Dilger JA, Byer DE, et al. A pre-emptive multimodal pathway featuring peripheral nerve block improves perioperative outcomes after major orthopedic surgery. *Reg Anesth Pain Med*. 2008;33:510–517.

49. Halawi MJ, Grant SA, Bolognesi M. Multimodal analgesia for total joint arthroplasty. *Orthopedics*. 2015;38:616–625.

50. Jin F, Chung F. Multimodal analgesia for postoperative pain control. *J Clin Anesth*. 2001;13:524–539.

51. Chou R, Gordon DB, de Leon-Casasola OA, et al. Management of postoperative pain: a clinical practice guideline from the American Pain Society, the American Society of Regional Anesthesia and Pain Medicine, and the American Society of Anesthesiologists' Committee on Regional Anesthesia, Executive Committee, and Administrative Council. *J Pain*. 2016;17:131–157.

52. Vora MU, Nicholas TA, Kassel CA, Grant SA. Adductor canal block for knee surgical procedures: review article. *J Clin Anesth*. 2016;35:295–303.

53. Sehmbi H, Brull R, Shah UJ, et al. Evidence basis for regional anesthesia in ambulatory arthroscopic knee surgery and anterior cruciate ligament reconstruction: part II: adductor canal nerve block-A systematic review and meta-analysis. *Anesth Analg*. 2019;128:223–238.

54. Kim DH, Lin Y, Goytizolo EA, et al. Adductor canal block versus femoral nerve block for total knee arthroplasty: a prospective, randomized, controlled trial. *Anesthesiology*. 2014;120:540–550.

55. Parikh RP, Sharma K, Guffey R, Myckatyn TM. Preoperative paravertebral block improves postoperative pain control and reduces hospital length of stay in patients undergoing autologous breast reconstruction after mastectomy for breast cancer. *Ann Surg Oncol*. 2016;23:4262–4269.

56. D'Ercole F, Arora H, Kumar PA. Paravertebral block for thoracic surgery. *J Cardiothorac Vasc Anesth*. 2018;32:915–927.

57. Pirrera B, Alagna V, Lucchi A, et al. Transversus abdominis plane (TAP) block versus thoracic epidural analgesia (TEA) in laparoscopic colon surgery in the ERAS program. *Surg Endosc*. 2018;32:376–382.

58. Hutchins JL, Grandelis AJ, Kaizer AM, Jensen EH. Thoracic paravertebral block versus thoracic epidural analgesia for post-operative pain control in open pancreatic surgery: a randomized controlled trial. *J Clin Anesth*. 2018;48:41–45.

59. Malik T, Mass D, Cohn S. Postoperative analgesia in a prolonged continuous interscalene block versus single-shot block in outpatient arthroscopic rotator cuff repair: a Prospective Randomized Study. *Arthroscopy*. 2016;32:1544–1550.e1.

60. Tawfik MM, Mohamed YM, Elbadrawi RE, Abdelkhalek M, Mogahed MM, Ezz HM. Transversus abdominis plane block versus wound infiltration for analgesia after cesarean delivery: a randomized controlled trial. *Anesth Analg*. 2017;124:1291–1297.

61. Kessler J, Marhofer P, Hopkins PM, Hollmann MW. Peripheral regional anaesthesia and outcome: lessons learned from the last 10 years. *Br J Anaesth*. 2015;114:728–745.

62. Singh PM, Borle A, Kaur M, Trikha A, Sinha A. Opioid-sparing effects of the thoracic interfascial plane blocks: a meta-analysis of randomized controlled trials. *Saudi J Anaesth*. 2018;12:103–111.

63. De Oliveira GS Jr, Castro-Alves LJ, Nader A, Kendall MC, McCarthy RJ. Transversus abdominis plane block to ameliorate postoperative pain outcomes after laparoscopic surgery: a meta-analysis of randomized controlled trials. *Anesth Analg*. 2014;118:454–463.

64. Brogi E, Kazan R, Cyr S, Giunta F, Hemmerling TM. Transversus abdominal plane block for postoperative analgesia:

a systematic review and meta-analysis of randomized-controlled trials. *Can J Anesth*. 2016;63:1184–1196.

65. Kumar K, Kirksey MA, Duong S, Wu CL. A review of opioid-sparing modalities in perioperative pain management: methods to decrease opioid use postoperatively. *Anesth Analg*. 2017;125:1749–1760.

66. Dinges HC, Otto S, Stay DK, et al. Side effect rates of opioids in equianalgesic doses via intravenous patient-controlled analgesia: a systematic review and network meta-analysis. *Anesth Analg*. 2019;129:1153–1162.

67. Benyamin R, Trescot AM, Datta S, et al. Opioid complications and side effects. *Pain Physician.* 2008;11:S105–S120.

68. 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.

69. Mercadante S, Arcuri E. Hyperalgesia and opioid switching *Am J Hosp Palliat Care*. 2005;22:291–294.

70. Pud D, Cohen D, Lawental E, Eisenberg E. Opioids and abnormal pain perception: new evidence from a study of chronic opioid addicts and healthy subjects. *Drug Alcohol Depend*. 2006;82:218–223.

71. Gupta K, Nagappa M, Prasad A, et al. Risk factors for opioid-induced respiratory depression in surgical patients: a systematic review and meta-analyses. *BMJ Open*. 2018;8:e024086.

72. Mulier JP. Perioperative opioids aggravate obstructive breathing in sleep apnea syndrome: mechanisms and alternative anesthesia strategies. *Curr Opin Anaesthesiol*. 2016;29:129–133.

73. Cozowicz C, Poeran J, Zubizarreta N, et al. Non-opioid analgesic modes of pain management are associated with reduced postoperative complications and resource utilisation: a retrospective study of obstructive sleep apnoea patients undergoing elective joint arthroplasty. *Br J Anaesth*. 2019;122:131–140.

74. Khan U, Bloom RA, Nicell JA, Laurenson JP. Risks associated with the environmental release of pharmaceuticals on the US Food and Drug Administration "flush list". *Sci Total Environ*. 2017;609:1023–1040.

75. Shaikh AA, Hussain SM, Rahn S, Desilets DJ. Effect of an educational pamphlet on colon cancer screening: a randomized, prospective trial. *Eur J Gastroenterol Hepatol*. 2010;22:444–449.

76. Chetty C, Ehlers VJ. Orthopaedic patients' perceptions about their pre-operative information. *Curationis*. 2009;32:55–60.

77. Jlala HA, French JL, Foxall GL, Hardman JG, Bedforth NM. Effect of preoperative multimedia information on perioperative anxiety in patients undergoing procedures under regional anaesthesia. *Br J Anaesth*. 2010;104:369–374.

78. Luck A, Pearson S, Maddern G, Hewett P. Effects of video information on precolonoscopy anxiety and knowledge: a randomised trial. *Lancet*. 1999;354:2032–2035.

79. Bondy LR, Sims N, Schroeder DR, Offord KP, Narr BJ. The effect of anesthetic patient education on preoperative patient anxiety. *Reg Anesth Pain Med*. 1999;24:158–164.

80. Oliva EM, Christopher MLD, Wells D, et al; Veterans Health Administration Opioid Overdose Education and Naloxone Distribution National Support and Development Workgroup. Opioid overdose education and naloxone distribution: development of the Veterans Health Administration's national program. *J Am Pharm Assoc (2003)*. 2017;57:S168.e4–S179.e4.

81. Chakravarthy B, Somasundaram S, Mogi J, et al. Randomized pilot trial measuring knowledge acquisition of opioid education in emergency department patients using a novel media platform. *Subst Abus*. 2018;39:27–31.

82. Di Noia J, Schwinn TM, Dastur ZA, Schinke SP. The relative efficacy of pamphlets, CD-ROM, and the Internet for disseminating adolescent drug abuse prevention programs: an Exploratory Study. *Prev Med*. 2003;37:646–653.

83. Webb TL, Joseph J, Yardley L, Michie S. Using the internet to promote health behavior change: a systematic review and meta-analysis of the impact of theoretical basis, use of behavior change techniques, and mode of delivery on efficacy. *J Med Internet Res*. 2010;12:e4.

84. Johansson K, Nuutila L, Virtanen H, Katajisto J, Salanterä S. Preoperative education for orthopaedic patients: systematic review. *J Adv Nurs*. 2005;50:212–223.

85. Giraudet-Le Quintrec JS, Coste J, Vastel L, et al. Positive effect of patient education for hip surgery: a randomized trial. *Clin Orthop Relat Res*. 2003;112–120.

86. Butler GS, Hurley CA, Buchanan KL, Smith-VanHorne J. Prehospital education: effectiveness with total hip replacement surgery patients. *Patient Educ Couns*. 1996;29:189–197.

87. Lin PC, Lin LC, Lin JJ. Comparing the effectiveness of different educational programs for patients with total knee arthroplasty. *Orthop Nurs*. 1997;16:43–49.

88. Vetter TR, Kain ZN. Role of the perioperative surgical home in optimizing the perioperative use of opioids. *Anesth Analg*. 2017;125:1653–1657.

89. Onishi E, Kobayashi T, Dexter E, Marino M, Maeno T, Deyo RA. Comparison of opioid prescribing patterns in the United States and Japan: primary care physicians' attitudes and perceptions. *J Am Board Fam Med*. 2017;30:248–254.

90. Lindenhovious ALC, Helmerhorts GTT, Schnellen AC, Vrahas M, Ring D, Kloen P. Differences in prescription of narcotic pain medication after operative treatment of hip and ankle fractures in the United States and the Netherlands. *J Trauma Inj Infect Crit Care*. 2009;67:160–164.

Funding
None.

Glossary
AMA = American Medical Association; **CPAP** = continuous positive airway pressure; **FDA** = Food and Drug Administration; **NSAIDs** = nonsteroidal anti-inflammatory drugs; **OSA** = obstructive sleep apnea; **PEMs** = patient education materials; **VHA** = Veterans Health Administration

Anesth Analg. 2020;130(3):574-581.