

12-20-2018

Monitoring Postoperative Opioid Use Following Simple Arthroscopic Meniscectomy: A Performance-Improvement Strategy for Prescribing Recommendations and Community Safety.

Vance Gardner

Hoag Orthopedics, Irvine, California

David Gazzaniga

Hoag Orthopedics, Irvine, California

Michael Shepard

Hoag Orthopedics, Irvine, California

Robert Grumet

Hoag Orthopedics, Irvine, California

Benjamin Rubin

Hoag Orthopedics, Irvine, California

See next page for additional authors

Follow this and additional works at: <https://digitalcommons.psjhealth.org/publications>

Part of the [Orthopedics Commons](#)

Recommended Citation

Gardner, Vance; Gazzaniga, David; Shepard, Michael; Grumet, Robert; Rubin, Benjamin; Dempewolf, Michael; Bray, Camille; and Prietto, Carlos, "Monitoring Postoperative Opioid Use Following Simple Arthroscopic Meniscectomy: A Performance-Improvement Strategy for Prescribing Recommendations and Community Safety." (2018). *Articles, Abstracts, and Reports*. 1271.
<https://digitalcommons.psjhealth.org/publications/1271>

This Article is brought to you for free and open access by Providence St. Joseph Health Digital Commons. It has been accepted for inclusion in Articles, Abstracts, and Reports by an authorized administrator of Providence St. Joseph Health Digital Commons. For more information, please contact digitalcommons@providence.org.

Authors

Vance Gardner, David Gazzaniga, Michael Shepard, Robert Grumet, Benjamin Rubin, Michael Dempewolf, Camille Bray, and Carlos Prietto

Monitoring Postoperative Opioid Use Following Simple Arthroscopic Meniscectomy

A Performance-Improvement Strategy for Prescribing Recommendations and Community Safety

Vance Gardner, MD, David Gazzaniga, MD, Michael Shepard, MD, Robert Grumet, MD, Benjamin Rubin, MD, Michael Dempewolf, DO, Camille Bray, BA, and Carlos Prietto, MD

Investigation performed at Hoag Orthopedics, Irvine, California

Background: Orthopaedic surgeons are confronted with a difficult dilemma: managing acute pain postoperatively and balancing the risk of prescription opioid use. To our knowledge, a prospective performance-improvement project providing opioid-prescription recommendations based on the actual amounts of usual and customary medication consumed following simple knee meniscectomy has not been described.

Methods: One hundred and two patients undergoing arthroscopic knee meniscectomy prospectively recorded postoperative pain medications in a pain journal. Arthroscopic procedures were performed at 2 centers by 9 fellowship-trained senior surgeons. Various usual and customary prescribing protocols were observed, and the amount of medication consumed was recorded. Prescription and over-the-counter pain medication, quantity, frequency, and visual analog scale (VAS) pain scores were collected.

Results: One hundred and two patients filled a prescription opioid medication and were included in the study. A total of 3,765 pills were prescribed, and a total of 573.5 were consumed. For the 102 patients who filled a prescription, the average time consuming opioid medication was 2 ± 2 days (range, 0 to 13 days) postoperatively. No cases of persistent use were recorded. Of the 102 patients who filled a prescription, 29.4% did not take any prescription opioids postoperatively. A total of 3,191.5 pills (or 22,183.75 morphine milligram equivalents [MME]) were unused and were potentially available to the community.

Conclusions: Following simple knee arthroscopy, the amount of prescribed opioid medication exceeds the need for postoperative pain management. In general, 68% of patients require a maximum of 13 pills postoperatively for 6 days. Surgeons should adjust prescribing standards accordingly to limit the amount of prescription opioids available to the community. Furthermore, a comprehensive response to include increased patient screening and monitoring as well as opioid use and disposal education is recommended.

For surgeons treating postoperative pain, a difficult dilemma has arisen. For years, reports in major publications stated that acute pain was undertreated and addiction rare¹⁻³ and institutional stakeholders recommended a more aggressive use of opioids^{4,5}. Encouraged by breakthroughs in the treatment of chronic pain and motivated by patient satisfaction surveys revealing undertreatment of pain^{6,7}, acute-pain services in hospitals began initiating more aggressive postoperative treatment programs⁸. Eventually, the treatment of pain as a fifth vital sign was initiated⁹ and a subsequent institutional shift of

postoperative pain treatment was promoted⁷ and consequently mandated^{10,11}.

The resultant decades-long expansion of medical opioid use in the United States has helped to create an ever-increasing supply of unused and unmonitored “pain meds” that are available to the community through postoperative prescriptions¹². In addition, persistent opioid use following minor surgery has been deemed the most common postoperative surgical complication¹³. During this same time period, non-medical use of prescription opioids increased and correlated with amplified use of

Disclosure: No external funding was used for this study. On the **Disclosure of Potential Conflicts of Interest** forms, which are provided with the online version of the article, one or more of the authors checked “yes” to indicate that the author had a relevant financial relationship in the biomedical arena outside the submitted work (<http://links.lww.com/JBJSOA/A77>).

Copyright © 2018 The Authors. Published by The Journal of Bone and Joint Surgery, Incorporated. All rights reserved. This is an open-access article distributed under the terms of the [Creative Commons Attribution-Non Commercial-No Derivatives License 4.0](https://creativecommons.org/licenses/by-nc-nd/4.0/) (CCBY-NC-ND), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

heroin¹⁴ and even more dangerous fentanyl medications¹⁵. Simultaneously, unintentional opioid overdoses nearly tripled from 1997 to 2007¹⁶ and have become dangerously linked to non-medical use of opioids^{17,18}. With 7.7% of opioid prescriptions originating from orthopaedic surgeons¹⁹, the American Academy of Orthopaedic Surgeons responded to this crisis with a 2015 “information statement” recommending the development of practice-based opioid-prescribing protocols²⁰. However, the question of how much opioid should be ordered following any specific surgery remains unresolved.

Orthopaedic surgeons are confronted with the certainty of creating acute pain with every surgical procedure and opioid medications have been the mainstay of the compassionate treatment of postoperative pain for decades. However, the surgeon has to weigh 2 rare extremes, namely, that the first surgical procedure that a patient undergoes theoretically can be the trigger for either chronic pain²¹ or opioid abuse²². In addition, a third risk can affect not only the patient but potentially his or her family, friends, and community, as 50% of non-medical users receive their drugs from a friend or relative²³. As outpatient procedures require a bulk supply of medications and the risk of non-medical use is greater than ever, the proper amount of opioids that should be prescribed for home use remains unclear. To our knowledge, the relationship between the amount of pain medication prescribed and the amount consumed after outpatient surgery has not been studied. An outpatient performance-improvement project was thought to be the best method for answering this question. This prospective project was conducted to evaluate actual opioid use in order to help determine the proper amount to prescribe following arthroscopic meniscectomy. If the results suggested decreasing the amount of opioids ordered, an additional benefit would be the possibility that fewer unused opioids would be available for non-medical use in the community. We hypothesized that, following simple knee arthroscopy, the amount of prescribed opioids exceeds the amount needed for postoperative pain management.

Materials and Methods

We prospectively monitored the prescription opioid use of patients undergoing simple knee meniscectomy through the use of a patient-recorded, daily pain journal. After approval from the institutional review board, 500 patients were projected for enrollment from 9 fellowship-trained sports medicine surgeons at 2 clinical institutions. An interim safety review of the data was performed after the first 102 patients who completed the pain journal had ceased using prescription opioid medication.

The patients were screened by the surgeon preoperatively, and an informed-consent process with written consent was utilized by our research coordinators. The patients were educated on how to use the pain journal to record their pain level and medication usage. In addition, they were specifically instructed to take pain medication as ordered by their surgeon. Any patient who was solely undergoing arthroscopic meniscectomy (medial and/or lateral) was eligible for inclusion. The exclusion criteria included prior knee surgery, preoperative use

of opioid pain medication, a diagnosis other than meniscal tear, and the use of peripheral nerve block. As per usual and customary practice, meniscectomy (either lateral, medial, or both, with the occasional loose-body removal or debridement) was performed with use of arthroscopic techniques with the patient under general anesthesia, and the investigators prescribed their usual and customary postoperative medication regimen. Postoperatively, patients were provided with crutches for walking assistance and were allowed to bear weight and to proceed to functional recovery as tolerated. Pertinent demographic and medical information was collected, including age, sex, race, body mass index (BMI), date of procedure, name of surgeon, type and dose of local anesthesia used at closure, anti-inflammatory medication, opioid medication prescribed, amount of opioid medication used and dates of use, daily pain level as assessed with a visual analog scale (VAS) (ranging from 1 to 10), and any over-the-counter medication used.

Patients were called by telephone within the first 72 hours to remind them to complete the pain journal. Patients were asked to return the pain journal at their first postoperative visit, usually 7 to 10 days after surgery. Patients still taking prescription opioid medications were asked to continue tracking their medication usage. Study procedures concluded when patients returned the journal and finished using medication for the treatment of surgical pain. Opioid use and refill requests were recorded and converted to morphine milligram equivalents (MME²⁴).

No power analysis was performed. The study was designed as an outpatient performance-improvement project to ascertain the amount of unused opioids following “usual and customary” postoperative opioid orders; for this reason, we refer to the participants as *patients* instead of as *subjects*. We empirically submitted a potential enrollment of 500 patients to the institutional review board. However, because leftover opioids have been established as a gateway to opioid abuse and our local county has been seriously affected²⁵, for community-safety reasons we decided that an interim data analysis would occur after approximately 100 patients had filled out the journal. If we discovered a considerable amount of opioids left over, the community risk would be mitigated by halting the study and recommending opioid-prescription practice improvement to the treating physicians.

Results

Study Population

From March 1, 2016, through April 17, 2017, 212 consecutive patients who underwent simple arthroscopic meniscectomy were recruited to record their use of prescribed postoperative pain medication as well as their daily pain level with use of a VAS (ranging from 1 to 10). Of these 212 patients, 3 refused a prescription for postoperative opioid medication, 2 were taking narcotics preoperatively, 3 had additional diagnoses following further work-up, 6 signed the consent after surgery, and 4 had had prior knee surgery. A total of 194 patients were enrolled. Of these, the 102 patients who filled their opioid prescriptions and completed the pain journal were included in the study. The remaining 92 patients did not return the pain journal and were not included in the final analysis.

The 102 patients who completed the pain journal included 44 women (43%) and 58 men (57%) who had a mean age of 54 years (range, 19 to 81 years). Eighty-eight patients were Caucasian/white (86%), 12 were Hispanic/Caucasian (12%) and 2 were African American (2%) (Table I). An interim data analysis was performed on these 102 patients. The surprising quantity of unused opioids potentially available to the community from just these 102 patients was concerning. This finding prompted a performance-improvement action plan to mitigate this risk by halting the study and recommending improved prescription procedures based on the pain journal data.

Opioids Prescribed

Seventy-seven patients received hydrocodone and acetaminophen, 8 received oxycodone and acetaminophen, and 6 received codeine and acetaminophen as per the standard-of-care prescriptions from their surgeons. In addition, 11 of the 102 patients received a prescription for the synthetic opioid tramadol. The total number of opioid pills prescribed was 3,765, equaling a total MME of 26,967.50. The individual amount of postoperative medication (as expressed as capsules or pills) prescribed to each patient ranged from 15 (5 patients) to 60 (10 patients), with a mean of 36.9.

Duration of Opioids Taken

For the 102 patients who filled a prescription, the average time consuming opioid medication (and standard deviation [SD])

was 2 ± 2 days (range, 0 to 13 days) postoperatively. Consequently, 95% of patients who took opioids postoperatively consumed their pain medication within the first 6 days after surgery.

Opioids Taken

Of the 102 patients who filled a prescription, 29 (28.4%) did not require any medication. For all patients, the mean amount taken was 6 pills; for those who actually took medication, the mean was 8 pills. There was no correlation between the amount of opioids taken and BMI, VAS score, or consumption of non-steroidal anti-inflammatory medications. In addition, 83 patients received some type of local anesthesia at closure but, when those patients were compared with patients who received no local anesthesia, there was no correlation between opioid use and VAS pain score, amount of unused opioids, and amount of over-the-counter medications taken.

Patients 1 SD above the mean consumed 13 pills, and patients 2 SDs above the mean consumed 20 pills. Thus, 68% of the patients consumed ≤ 13 pills and 95% of the patients consumed ≤ 20 pills. In other words, 95% of patients would only require 20 opioid pills for the postoperative medication order. Furthermore, the majority of patients consumed a small percentage of the opioids from the prescriptions that they filled.

Medication Left Over from the Entire Population

Overall, only 573.5 opioid pills were consumed, leaving 3,191.5 pills left over. It is not clear how and if patients discarded excess medication appropriately, but since proper disposal was not part of any preoperative education process, we doubt that many pills were discarded. Therefore, potentially 22,183.75 MME of prescribed opioids were made available for non-medical use following 102 arthroscopic procedures.

Discussion

Orthopaedic surgeons are becoming aware that postoperative opioid treatment is fraught with challenges and that reforms to postoperative prescribing protocols are needed. It was recently revealed that a 1-paragraph letter to *The New England Journal of Medicine* in 1980 may have sparked the overcoverage of acute pain by arguing that hospital-based opioids offer minimal chance of addiction²⁶. The medical community now recognizes that this conclusion was not correct. In June 2016, the American Medical Association (AMA) voted to remove pain as the “fifth vital sign” because of concerns that this long-heralded approach may have unwittingly contributed to the opioid crisis in America, with the AMA president stating that physicians were part of the problem by overprescribing and should now be part of the solution²⁷.

Because of the nature of their work, orthopaedic surgeons are on the front line of postoperative pain management, and opioids are commonly prescribed after orthopaedic procedures. Individual requirements can be modified depending on patient needs, risks, and past usage, but evidence-based guidelines for various surgical procedures are not readily obtainable. The compassionate treatment of postoperative pain

TABLE I Demographic Characteristics

Characteristic	No. of Patients (N = 102)
Sex	
Male	58 (57%)
Female	44 (43%)
Age, per decade	
<21yr	1 (1.0%)
21-30 yr	6 (5.9%)
31-40 yr	7 (6.9%)
41-50 yr	18 (17.6%)
51-60 yr	36 (35.3%)
61-70 yr	29 (28.4%)
71-80 yr	4 (3.9%)
81-90 yr	1 (1.0%)
Race	
African American	2 (2%)
Caucasian/white	88 (86%)
Hispanic	12 (12%)
BMI	
Underweight (18.3 kg/m ²)	1 (1%)
Normal or healthy weight (18.7-24.9 kg/m ²)	24 (23.5%)
Overweight (25.0-29.9 kg/m ²)	44 (43.1%)
Obese (30.0-53.2 kg/m ²)	33 (32.4%)

with opioids is essential to good health care. However, recent reports have demonstrated that postoperative opioids can be misused in 2 ways. First, appropriate medications prescribed for postoperative pain can be abused by a small percentage of patients, and persistent opioid use by first-time users has been documented^{28,29}. Second, unused opioids can be diverted into the hands of family, friends, or unknown users. This population is a growing factor in the opioid crisis³⁰.

Our analysis focuses on the latter, as the postoperative use of opioids by patients who had undergone simple arthroscopic meniscectomy was surprisingly low. However, the amount of unused opioids was startlingly high and, because of the risk to the community, we decided to halt the project and recommended that the practices develop improved prescription procedures.

We found that most patients who used the medications did so only through the first week after surgery. Consequently, almost all patients had finished taking prescription opioid medication by the time of the first postoperative visit, within 10 days. Furthermore, our analysis demonstrated that it is safe and effective to prescribe 13 opioid pills to meet the needs of 68% of patients who have undergone arthroscopic meniscectomy.

Instead of revealing persistent use of opioids, as has been shown in studies of total knee arthroplasty²⁸, our data on 102 arthroscopic meniscectomies revealed a substantial amount of leftover medication, with >3,000 new opioid pills (or 22,183.75 MME) being available for non-medical use if proper disposal was not performed by the patient. A recent systematic review of 7 clinical trials with available data on opioid use demonstrated that two-thirds of patients reported unused opioids following surgery³¹. The authors stated that most patients stored unused opioids in unlocked medicine cabinets and recommended a “data driven response” instead of “one size fits all” approach, with education being needed to instruct patients on the proper disposal of opioids and “take back” events. In addition, risk factors need to be identified preoperatively^{32,33}. Physician resources in California include the CURES (Controlled Substance Utilization Review and Evaluation System) web site that can help to detect persistent use and is helpful for monitoring outliers²³. Overprescribed opioid medication following simple orthopaedic procedures may lead to negative consequences in the community. Opioid-related drug overdoses in the U.S. numbered 33,091 in 2015, with one-half involving prescription opioids³⁴. Sabatino et al., in a 2018 retrospective chart review with patient call-back, studied the variation in opioid prescriptions for 5 common orthopaedic procedures in a northern New England practice. The authors found that unused opioids remained after postoperative pain management and recommended prescribing slightly less than the median value³⁰. However, it is unclear if that institution implemented changes to the practice on the basis of those findings. We are unaware of any investigators who have prospectively measured how much opioid medication is actually consumed following arthroscopic meniscectomy and then used that information to provide positive change in the local practice and community.

The present study had some limitations. First, 92 patients did not return the pain journal, and only 102 compliant patients were studied. However, the discovery of so many leftover opioids following these procedures warranted halting the study, recommending improved prescribing practices, and reporting our results. Second, we also recognize the potential weakness of different prescribing patterns. However, our goal was to observe the usual and customary practice of 9 surgeons and not to recommend a standard postoperative prescription until we had completed our interim study analysis. Finally, even though we were dependent on patients to record their pill use prospectively, which required trust in their record-keeping, this method minimized recall bias that would have occurred from a retrospective “call-back” protocol.

Because of the reality of the public health crisis in our community³⁵, we were concerned with our findings. In the patient population studied, we believe that 13 opioid pills (slightly more than 1 SD above the mean) are adequate for postoperative pain control following simple arthroscopic knee surgery.

Our institution is in the process of creating a response to the growing crisis of unused opioids for the safety of our patients and the general public. This response has 5 areas of focus:

- (1) Physician education about the proper amount of opioid pills for arthroscopic meniscectomy and the development of a Postoperative Pain Management Protocol following arthroscopic surgery. We plan on developing this type of protocol for all surgical categories (including anterior cruciate ligament [ACL], arthroplasty, spine, foot, and hand).
- (2) Improved patient screening for risk factors for opioid dependence.
- (3) Patient education about the addiction potential of postoperative opioids.
- (4) Greater monitoring of opioid use.
- (5) Patient education about proper disposal.

The participating investigators are in the early stages of implementing these system-wide practice changes. Hoag Orthopedics plans on reporting the outcome in a later publication. In addition, the performance-improvement process is continuing with pain journal reports for total knee arthroplasty, rotator cuff repair, and ACL reconstruction.

The overprescription of opioid medication can create negative effects in the community caused by non-medical consumption and abuse. Thirteen pills of prescription opioid medication should be sufficient for postoperative pain management following an uncomplicated arthroscopic knee meniscectomy, and non-opioid alternatives should be considered. Positive changes to preoperative screening, prescribing practice, patient education, and proper disposal are needed. Moreover, additional studies that elucidate proper dosing for other common procedures of orthopaedic and other medical specialties are essential to address the current opioid epidemic. ■

Note: The authors thank Miguel Prietto, MD, Scott Fischer, MD, Russell Petrie, MD, Alan Beyer, MD, Julia Boyer, PA-C, Lorraine Clement, PA-C, Stacy Summa, PA-C, and Jon Onosaki, PA-C, for their

contributions to study enrollment and data interpretation. Furthermore, we thank Ryan Helber, MBA, Marie-Claire Fickenscher, AS, Edward Quilligan, BA, and Vanessa Glotzbach, BA, at Hoag Orthopedics for their research support and expertise.

Vance Gardner, MD¹
David Gazzaniga, MD¹
Michael Shepard, MD¹
Robert Grumet, MD¹
Benjamin Rubin, MD¹
Michael Dempewolf, DO²
Camille Bray, BA¹
Carlos Prietto, MD¹

¹Hoag Orthopedics, Irvine, California

²Mid-America Orthopedics Kansas City, Leawood, Kansas

E-mail address for V. Gardner: vance.gardner@hoagorthopedics.org

ORCID iD for V. Gardner: [0000-0002-0725-5116](https://orcid.org/0000-0002-0725-5116)
ORCID iD for D. Gazzaniga: [0000-0002-5612-6169](https://orcid.org/0000-0002-5612-6169)
ORCID iD for M. Shepard: [0000-0001-9599-2521](https://orcid.org/0000-0001-9599-2521)
ORCID iD for R. Grumet: [0000-0002-4743-3116](https://orcid.org/0000-0002-4743-3116)
ORCID iD for B. Rubin: [0000-0002-1410-4260](https://orcid.org/0000-0002-1410-4260)
ORCID iD for M. Dempewolf: [0000-0002-1470-8232](https://orcid.org/0000-0002-1470-8232)
ORCID iD for C. Bray: [0000-0002-4554-1025](https://orcid.org/0000-0002-4554-1025)
ORCID iD for C. Prietto: [0000-0002-5976-6911](https://orcid.org/0000-0002-5976-6911)

References

- Marks RM, Sachar EJ. Undertreatment of medical inpatients with narcotic analgesics. *Ann Intern Med.* 1973 Feb;78(2):173-81.
- Porter J, Jick H. Addiction rare in patients treated with narcotics. *N Engl J Med.* 1980 Jan 10;302(2):123.
- 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 Aug;97(2):534-40.
- NIH Consensus Development Conference. The integrated approach to the management of pain. *J Pain Symptom Manage.* 1987 Winter;2(1):35-44.
- Max MB. Improving outcomes of analgesic treatment: is education enough? *Ann Intern Med.* 1990 Dec 1;113(11):885-9.
- Sriwatanakul K, Weis OF, Alloza JL, Kelvie W, Weintraub M, Lasagna L. Analysis of narcotic analgesic usage in the treatment of postoperative pain. *JAMA.* 1983 Aug 19;250(7):926-9.
- American Pain Society Quality of Care Committee. Quality improvement guidelines for the treatment of acute pain and cancer pain. *JAMA.* 1995 Dec 20;274(23):1874-80.
- Ready LB, Oden R, Chadwick HS, Benedetti C, Rooke GA, Caplan R, Wild LM. Development of an anesthesiology-based postoperative pain management service. *Anesthesiology.* 1988 Jan;68(1):100-6.
- Campbell JN. APS 1995 presidential address. *J Pain.* 1996 Spring;5(1):85-8.
- Phillips DM; Joint Commission on Accreditation of Healthcare Organizations. JCAHO pain management standards are unveiled. *JAMA.* 2000 Jul 26;284(4):428-9.
- Department of Veterans Affairs. Pain as the 5th vital sign toolkit. Washington, DC: Department of Veterans Affairs; 2000.
- 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 Apr;265(4):709-14.
- Brummett CM, Waljee JF, Goesling J, Moser S, Lin P, Englesbe MJ, Bohnert ASB, Kheterpal S, Nallamothu BK. New persistent opioid use after minor and major surgical procedures in US adults. *JAMA Surg.* 2017 Jun 21;152(6):e170504. Epub 2017 Jun 21.
- Murthy VH. Ending the opioid epidemic — a call to action. *N Engl J Med.* 2016 Dec 22;375(25):2413-5. Epub 2016 Nov 9.
- Baker DW. History of The Joint Commission's pain standards: lessons for today's prescription opioid epidemic. *JAMA.* 2017 Mar 21;317(11):1117-8.
- Muhuri PK, Gfroerer JC, Davies MC. Associations of nonmedical pain reliever use and initiation of heroin use in the United States. In: CBHSQ data review. Rockville: Substance Abuse and Mental Health Services Administration; 2013. p 1-17.
- Ahmsbrak R, Bose J, Hedden SL, Lipari RN, Park-Lee E, Porter JD. Key substance use and mental health indicators in the United States: results from the 2016 National Survey on Drug Use and Health. 2017 Sep. <https://www.samhsa.gov/data/sites/default/files/NSDUH-FRR1-2016/NSDUH-FRR1-2016.htm>. Accessed 2018 Sep 19.
- Okie S. A flood of opioids, a rising tide of deaths. *N Engl J Med.* 2010 Nov 18;363(21):1981-5.
- Morris BJ, Mir HR. The opioid epidemic: impact on orthopaedic surgery. *J Am Acad Orthop Surg.* 2015 May;23(5):267-71.
- American Academy of Orthopaedic Surgeons. Information statement: opioid use, misuse, and abuse in orthopaedic practice. 2015 Oct. https://www.aaos.org/uploadedFiles/PreProduction/About/Opinion_Statements/advistmt/1045%20Opioid%20Use,%20Misuse,%20and%20Abuse%20in%20Practice.pdf. Accessed 2018 Sep 19.
- Carr DB, Goudas LC. Acute pain. *Lancet.* 1999 Jun 12;353(9169):2051-8.
- Clarke H, Soneji N, Ko DT, Yun L, Wijesundera DN. Rates and risk factors for prolonged opioid use after major surgery: population based cohort study. *BMJ.* 2014 Feb 11;348:g1251.
- Lipari RN, Hughes A. How people obtain the prescription pain relievers they misuse. In: The CBHSQ report. Rockville: Substance Abuse and Mental Health Services Administration; 2017.
- Agency Medical Directors' Group. Opioid dose calculator. 2015. <http://www.agencymeddirectors.wa.gov/calculator/dosecalculator.htm>. Accessed 2018 Sep 19.
- State of California Department of Justice. Controlled substance utilization review and evaluation system. 2018. <https://oag.ca.gov/cures>. Accessed 2018 Sep 19.
- Leung PTM, Macdonald EM, Stanbrook MB, Dhalla IA, Juurlink DN. A 1980 letter on the risk of opioid addiction. *N Engl J Med.* 2017 Jun 1;376(22):2194-5.
- Anson P. AMA drops pain as vital sign. 2016 Jun 6. <https://www.painnewsnetwork.org/stories/2016/6/16/ama-drops-pain-as-vital-sign>. Accessed 2018 Sep 19.
- Namba RS, Inacio MCS, Pratt NL, Graves SE, Roughead EE, Paxton EW. Persistent opioid use following total knee arthroplasty: a signal for close surveillance. *J Arthroplasty.* 2018 Feb;33(2):331-6. Epub 2017 Sep 13.
- Sun EC, Darnall BD, Baker LC, Mackey S. Incidence of and risk factors for chronic opioid use among opioid-naive patients in the postoperative period. *JAMA Intern Med.* 2016 Sep 1;176(9):1286-93.
- Sabatino MJ, Kunkel ST, Ramkumar DB, Keeney BJ, Jevsevar DS. Excess opioid medication and variation in prescribing patterns following common orthopaedic procedures. *J Bone Joint Surg Am.* 2018 Feb 7;100(3):180-8.
- Bicket MC, Long JJ, Pronovost PJ, Alexander GC, Wu CL. Prescription opioid analgesics commonly unused after surgery: a systematic review. *JAMA Surg.* 2017 Nov 1;152(11):1066-71.
- Bedard NA, Pugely AJ, Westermann RW, Duchman KR, Glass NA, Callaghan JJ. Opioid use after total knee arthroplasty: trends and risk factors for prolonged use. *J Arthroplasty.* 2017 Aug;32(8):2390-4. Epub 2017 Mar 16.
- Webster LR, Webster RM. Predicting aberrant behaviors in opioid-treated patients: preliminary validation of the Opioid Risk Tool. *Pain Med.* 2005 Nov-Dec;6(6):432-42.
- Schuchat A, Houry D, Guy GP Jr. New data on opioid use and prescribing in the United States. *JAMA.* 2017 Aug 1;318(5):425-6.
- Orange County Health Care Agency and Sheriff-Coroner. 2017 opioid overdose and death in Orange County. 2017 Aug. <http://www.ochealthinfo.com/civicax/filebank/blobload.aspx?BlobID=67355>. Accessed 2018 Sep 19.