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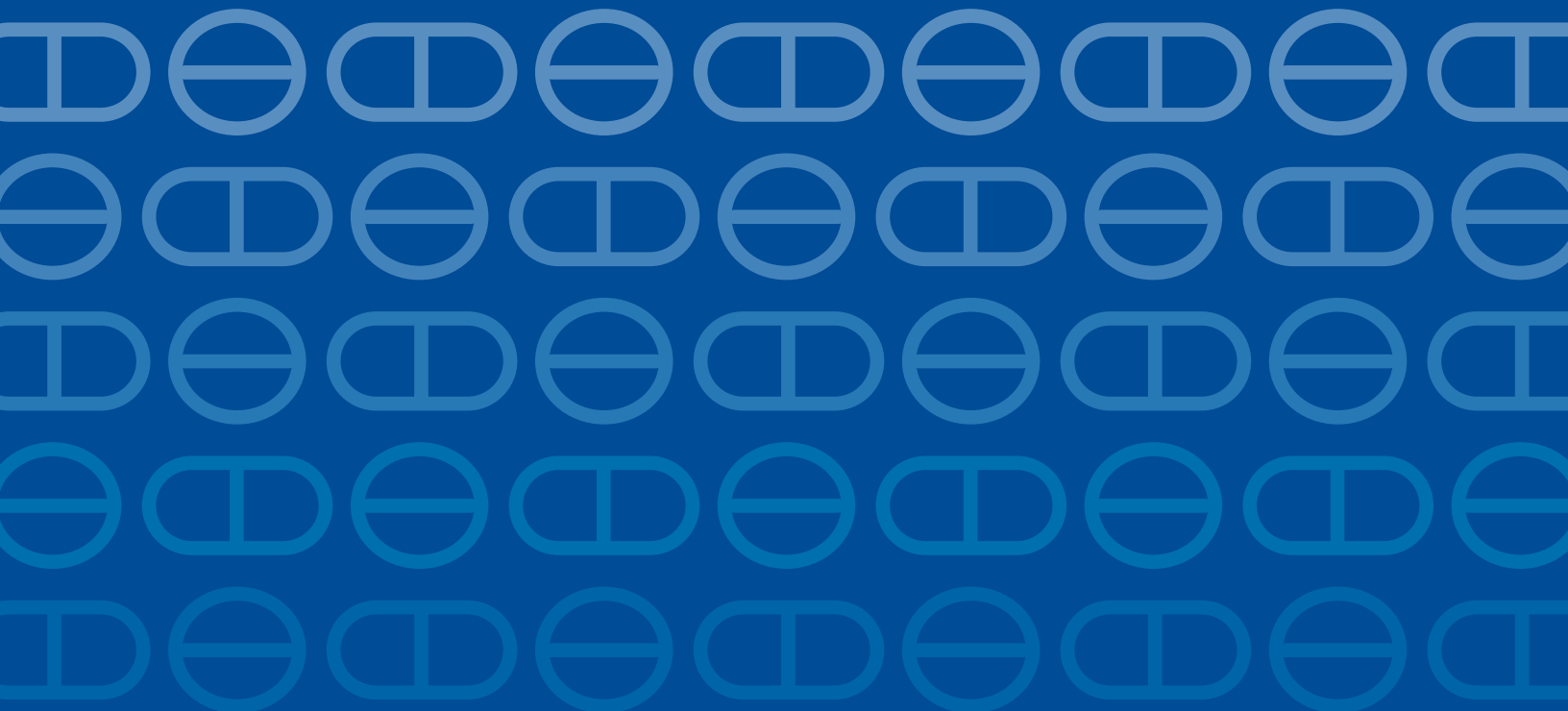
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Balanced information for better care

Pain management in surgical patients

Evidence-based management approaches
for vascular surgery



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Evidence-based management approaches for vascular surgery

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Pain management in surgical patients

Activity Start Date: August 15, 2022

Activity Termination Date: August 14, 2025

This activity offers CE credit for:

1. Medicine (AMA)
2. Nurses (ANCC)
3. Pharmacists (ACPE)
4. Other

All other attendees will receive a Certificate of Attendance

Statement of Need / Activity Overview:

The primary goal of this educational program is to address the need for safe, effective pain relief in the peri-operative setting, which includes the preoperative, intraoperative, and postoperative phases, while minimizing adverse effects of analgesics like opioids.

The educational program has several components, which include:

- Written evidence report (print monograph)
- Summary document of 4-5 key messages
- “Academic detailing” educational sessions in physicians’ offices with trained outreach educators (pharmacists, nurses, physicians) who present the material interactively
- Reference cards for easy access to key materials
- Patient education information (brochure/tear-off sheets)

This program works to synthesize the current clinical information on this topic into accessible, non-commercial, evidence-based educational material, which is taught interactively to providers by specially trained clinical educators.

The typical opioid requirement for patients undergoing vascular surgery has been established, but some prescribers continue to exceed those recommendations. These clinicians benefit from reviewing alternatives for pain management as well as safety recommendations to reduce opioid related harms.

Learning Objectives:

Upon completing this activity, participants will be able to:

- Explain the importance of reducing perioperative opioid use.
- Apply the principles of multi-modal analgesia in the perioperative setting.
- Select alternative approaches to perioperative analgesia that can improve patient-centered outcomes while minimizing opioid needs.
- Utilize recommended principles for prescribing opioids for post-operative pain when opioids are necessary.

- Create realistic expectations for patients about the analgesic effects of different pain treatment options, reduce their concerns, limit demands for opioid analgesics, and teach proper disposal techniques for unused opioids.

Financial Support:

There is no commercial support associated with this activity.

Target Audience:

The educational program is designed for physicians, pharmacists, and nurses whose scope of practice includes inpatient and ambulatory surgical practices.

Credit Information:

In support of improving patient care, this activity has been planned and implemented by CME Outfitters, LLC and Alosa Health. CME Outfitters, LLC is jointly accredited by the Accreditation Council for Continuing Medical Education (ACCME), the

Accreditation Council for Pharmacy Education (ACPE), and the American Nurses Credentialing Center (ANCC), to provide continuing education for the healthcare team



CME Outfitters, LLC, designates this enduring activity for a maximum of 1.5 *AMA PRA Category 1 Credit(s)™*. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

This activity is designated for 1.5 nursing contact hours.

Note to Nurse Practitioners: Nurse practitioners can apply for *AMA PRA Category 1 Credit™* through the American Academy of Nurse Practitioners (AANP). AANP will accept *AMA PRA Category 1 Credit™* from Jointly Accredited Organizations. Nurse practitioners can also apply for credit through their state boards.

California Residents: This continuing nursing education activity was approved by the California Board of Registered Nursing. CME Outfitters LLC's provider number is CEP15510.

Pharmacists (ACPE): This knowledge-based activity is approved for 1.5 contact hours (0.15 CEUs) of continuing pharmacy credit (UAN JA0007185-9999-22-109-H08-P).

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Introduction

The harms of opioids extend beyond the risks of dependence and overdose

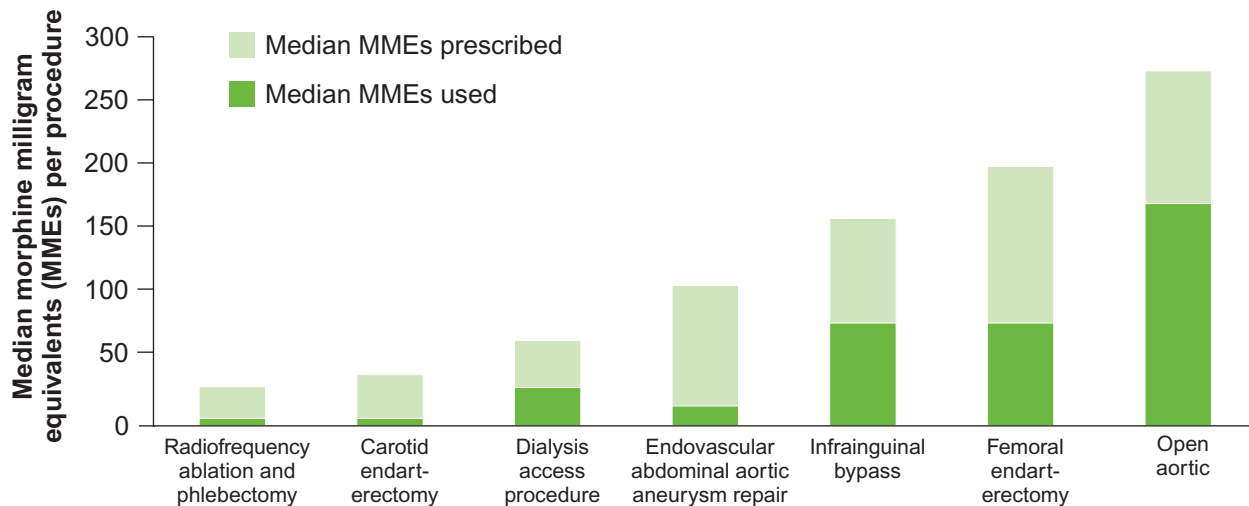
Each year, about 26 million surgeries are performed in hospitals and about 23 million in ambulatory surgical centers in the U.S.¹ A large majority of these surgical patients will receive a prescription opioid. Many of these opioid prescriptions are unnecessary or inappropriate, and such prescriptions can lead to adverse outcomes, including long-term opioid use, opioid use disorder, overdose, and diversion.²⁻⁵ Gastrointestinal, neuropsychiatric, respiratory, and urinary effects of opioids can lead to adverse outcomes, reduced patient satisfaction, and longer hospital stays.⁶

Additionally, the risks posed by prescription opioids extend beyond the individual patients to whom they are prescribed. Opioids prescribed by well-intentioned clinicians can become widely available within communities, where these products can be easily diverted for misuse and abuse, including among household family members.⁶⁻⁸ A study from a large health system in Colorado found that children and adolescents living in the homes of adult patients who were prescribed opioids had higher risks of overdose, regardless of whether they themselves were prescribed opioids, suggesting dangers of opioids as soon as they enter the home.⁹

Opioids are overprescribed after vascular surgery

Compared to patients undergoing general surgery, patients undergoing vascular surgery tend to have more comorbidities, undergo higher-risk procedures, and encounter different types of surgical pain.¹⁰ Still, even in this population of patients where pain may be difficult to manage, opioids are overprescribed.^{11,12} For example, in a survey study of 939 patients undergoing different vascular surgery procedures at an academic medical center (e.g., varicose vein ligation, endarterectomy, bypass, dialysis access procedures), patients were consistently prescribed substantially more opioids than they used (Figure 1).¹³ In that same study, 30% of patients were prescribed opioids that they never used and less than 30% of patients were given instructions on how to dispose of unused opioid pain medications.

Figure 1: Unused prescribed opioids in a study of vascular surgery patients¹³



Quantifying familiar risks of opioids

Rates of new persistent opioid use following surgery can vary by definition and by the surgical population included in the study. New persistent opioid use was seen in the year following 0.7% of surgeries (1 in 142 surgeries) while overdose or diagnosis of opioid use disorder was seen following 0.1% of surgeries (1 in 1,000 surgeries) in on large study of 162,830 opioid-naïve surgical patients.¹⁴ A similar study of 36,177 patients undergoing generally more invasive procedures (ranging from thyroidectomy to laparoscopic abdominal surgery to open bariatric surgery) found the rate of new persistent opioid use to be between 5.9% and 6.5% depending on the procedure.¹⁵ The rate of new persistent opioid use in non-surgical patients, meanwhile, is much lower—about 0.1% to 0.4% in a given year.^{15,16} These adverse events have been seen following many different types of common surgeries (including elective and emergent, major and minor, and open and minimally invasive procedures), and the sum of decades of evidence suggests a strong link between surgery, opioids, and adverse outcomes including long term opioid use, substance use disorder, overdose, post-operative readmissions, falls, and increased health care costs.¹⁷⁻²¹

A retrospective study of over 9 million opioid-naïve patients compared the risk of new chronic opioid use (≥ 10 opioid prescriptions or more than 120 days supplied) in patients who underwent surgery versus those who did not have surgery.¹⁶ Patients who underwent several different procedures had increased odds of long term opioid use. This includes:

- simple mastectomy (odds ratio [OR] 2.65; 95% CI: 2.28-3.08; $p < 0.001$),
- open appendectomy (OR 1.69; 95% CI: 1.24-2.31; $p = 0.001$),
- open cholecystectomy (OR 3.60; 95% CI: 2.80-4.62; $p < 0.001$),
- laparoscopic cholecystectomy (OR 1.62; 95% CI: 1.49-1.76; $p < 0.001$),
- total hip arthroplasty (OR 2.52; 95% CI: 2.11-3.01; $p < 0.001$), and
- total knee arthroplasty (OR 5.10; 95% CI: 4.67-5.58; $p < 0.001$).

Patients undergoing other procedures did not have increased odds of long-term opioid use following surgery (i.e., trans-urethral prostate resection, laparoscopic appendectomy, endoscopic sinus surgery, cataract surgery). Risk factors for long-term opioid use included male sex, age greater than 50, prior

benzodiazepine or antidepressant use, prior diagnosis of depression, and alcohol or other substance use disorder. While this was a retrospective study, results suggested a causal link between many procedures and long-term opioid use, because some of these surgeries are unplanned and randomly timed (e.g., appendectomy). Random timing of these surgeries helps eliminate bias from confounding factors that make it difficult to interpret many retrospective analyses, making this a particularly noteworthy and important study.

Surgeons may not be aware of the long-term outcomes for their patients when opioids prescribed at the time of surgery, making it difficult to adjust prescribing practices based on experience. For example, if a patient overdoses on opioids prescribed for surgery months after routine surgical follow up care is completed, the surgeon may never find out, since at this point care is often provided by other clinicians.²² One study of 5,276 previously opioid-naïve patients who developed long-term opioid use following surgery found that by the time patients are 9 to 12 months out from surgery, only 11% of opioid prescriptions were being provided by the surgeon—while others were being provided by a primary care clinician (53%) and others.²³

Other research into opioid prescribing behaviors more broadly reveals that despite the risks, opioids are not always given for good reasons.²⁴⁻²⁶ Clinicians may prescribe opioids based on out-of-date or non-evidence-based protocols,²⁷ one-size-fits-all approaches, habit, and subconscious factors that results in opioids being prescribed to patients who would otherwise need them.²⁸ For example, one study of opioid prescribing patterns in Michigan found that patients who underwent 22 common non-emergent surgeries and were discharged from teaching hospitals filled larger prescriptions than patients who underwent those procedures at non-teaching hospitals.²⁹ Another study of adolescents presenting for emergency department care found that among patients aged approximately age 18, simply being considered an “adult” versus a “child” in the emergency department—a biologically arbitrary distinction—resulted in teenagers being 9.7% more likely to receive an opioid prescription and 12.6% more likely to experience an opioid-related adverse event (overdose, new long-term use, or diagnosis of opioid use disorder) in the following year.³⁰

Benefits of reducing opioid use

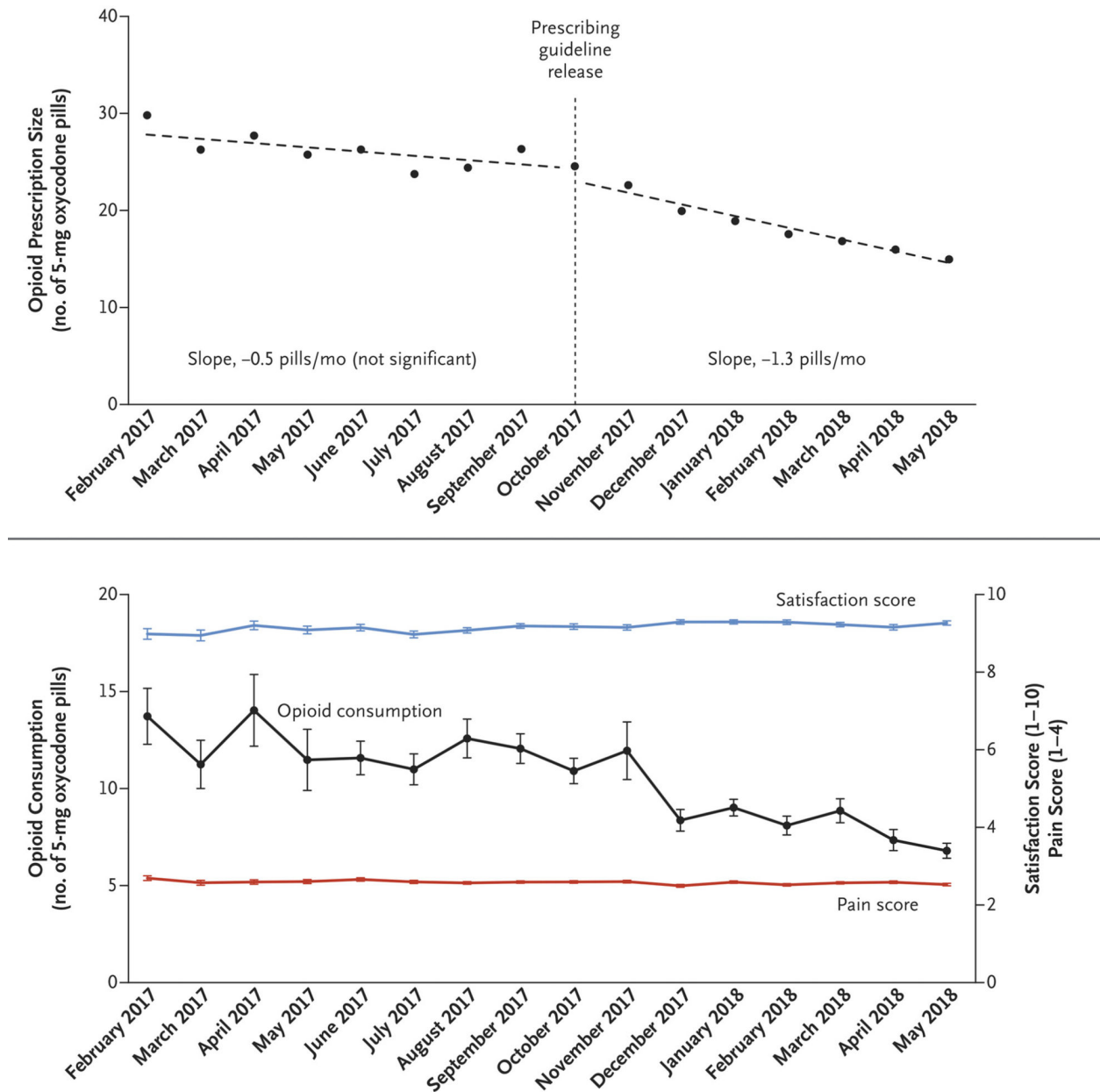
Reducing opioid use in the peri-operative setting can have immediate and direct benefits to surgical patients. Even when opioids are used as prescribed, they may not result in optimal pain control and can lead to predictable adverse effects. De-emphasizing opioids in favor of other modes of analgesia has been associated with better pain control and reduced facility length of stay while lowering rates of adverse effects like nausea, vomiting, constipation, urinary retention, respiratory depression, and sedation^{16,31-33} These clinical benefits can lead to improved patient satisfaction, improved patient safety, and improved performance on quality metrics with financial ramifications. For example, the Merit-based Incentive Payment Service (MIPS), a quality incentive program from the U.S. Centers for Medicare & Medicaid Services, offer financial rewards to physicians who provide multi-modal pain management to patients in the perioperative setting.³⁴

Guideline driven reduction in opioid use

A focus on the harmful effects of prescription opioids appears to have led to a reduction in inappropriate opioid prescribing, though many prior efforts to curb opioid use have emphasized improving management of chronic pain. Efforts to reduce opioid use for chronic pain also appear to have led to reductions in peri-operative opioid use, suggesting an inclination among surgeons and surgical practices to reduce opioid

use among their post-operative patients.³⁵ For example, in Michigan, the 2017 release of new opioid prescribing guidelines was associated with smaller opioid prescription sizes and less opioid use by patients; importantly this reduction in opioid use was *not* associated with any change in patient-reported pain or satisfaction scores, including the Center for Medicare & Medicaid Services' Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores (Figure 2).^{36,37} A study of orthopedic surgery prescribing practices in New York showed reductions in post-operative opioid prescribing after initiation of state-imposed limitations on surgical prescribing, but further reductions in opioid use were seen after surgeon-led initiatives were introduced at the institutions studied.³⁸

Figure 2: Reduction in opioid prescribing after guideline release did not change pain control or patient satisfaction³⁶



While the available evidence makes it clear that, at a minimum, opioids should be prescribed judiciously and only for clinically necessary reasons, surgical best practices surrounding opioid use have not been well established. The opioid epidemic has forced a reconsideration of perioperative pain management, though opioids remain powerful analgesics that can play an important role in pain management in the peri-operative setting. While opioid needs will vary between individual patients and procedures, these needs can be reduced when pain is better controlled by other means. **For this reason, multi-modal analgesia—the simultaneous use of multiple methods of pain control—has been widely accepted by professional societies as the ideal approach to peri-operative pain management.**³⁹

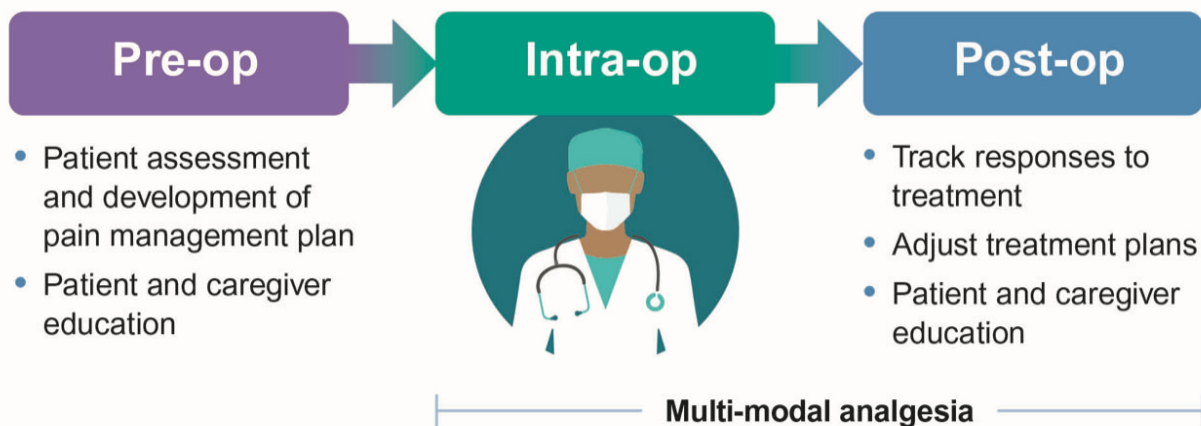
While simply reducing opioid prescriptions is one step, surgical practices should constantly strive to improve pain control while also subjecting patients to even fewer risks of opioids. The information in this document is provided to demonstrate the ways in which superior pain control can be achieved and help surgeons and other providers involved in surgical care minimize opioid prescriptions.

BOTTOM LINE: Opioid use has historically been common in the surgical setting. Optimal analgesic plans will use multiple methods and provide improved pain control while minimizing or eliminating the need for opioids.

A framework for peri-operative pain management

Surgical pain management should begin in the pre-operative setting, where surgical teams work with patients to create personalized pain management plans based on their medical history, risk factors, type of surgery, and anticipated pain. Patients and caregivers should be educated about pain management as part of the surgical informed consent process. Multiple modes of analgesia should be used prior to, during, and following surgery to minimize pain and opioid use. Patients' response to treatment should be measured, addressed, and accompanied by ongoing education about expectations for pain control and safe disposal of unused drugs. Consultation with a pain specialist, when appropriate and available, should be considered at any time in the cycle of care.

Figure 3: Peri-operative pain management



Principles of peri-operative pain management

Based on the best available evidence and recent guidelines issued by a consortium of 14 professional healthcare societies commissioned by the U.S. Health and Human Services Pain Management Best Practices Inter-Agency Task Force, the following core principles of modern peri-operative pain management have emerged:³⁹

- Pain should be a consideration throughout **all phases of surgical care**.
- Clinicians should conduct a **pre-operative evaluation** to guide the pain management plan, which includes assessment of medical and psychological conditions, medication use, history of chronic pain, presence of substance use disorder, and previous post-operative treatment regimens and responses.
- Clinicians should offer **multi-modal analgesia** (the use of a variety of analgesic medications and techniques combined with non-pharmacologic interventions).
- Clinicians should **track responses to treatments** and **adjust** treatment plans appropriately.
- Clinicians should **consider consultation with a pain specialist, pre- or post-operatively**, for high-risk patients and patients with difficult-to-control pain

In vascular surgery

Although management will vary from procedure to procedure and patient to patient, multi-modal pain management should still be the guiding principle of peri-operative pain management in patients undergoing vascular surgery. Moreover, since the vascular surgery patient population has generally higher rates of medical comorbidities, higher risks of surgery and general anesthesia, and higher risk of adverse opioid-related events, an emphasis on multi-modal pain management can help reduce overall procedural risks and risks of opioid pain medication.^{40,41}

Role of the surgeon

The surgeon is often the leader of a large team of clinicians who will ultimately participate in the complete patient journey from pre-operative clinic visits to the operating room and eventually the post-operative setting. Optimizing pain control while minimizing risks to patients through individualized care can be challenging, time-consuming, and humbling—particularly with medically complex patients. Surgeons looking to provide ideal peri-operative pain management to their patients should:

- oversee the creation of a multi-disciplinary pain management plan; patients want to avoid adverse opioid-related events and trust their surgeons to control their pain safely⁴²
- set expectations pre-operatively with patients and identify potential challenges (pain reduction to manageable levels—not elimination—is the goal)
- work with anesthesiologists and, when needed, other pain management specialists to employ alternate modes of analgesia in the pre-, intra-, and post-operative settings
- determine if uncontrolled post-operative pain warrants additional modes of analgesia, including the use of higher-risk medications like opioids, or other non-pharmacologic interventions

Pre-operative assessment

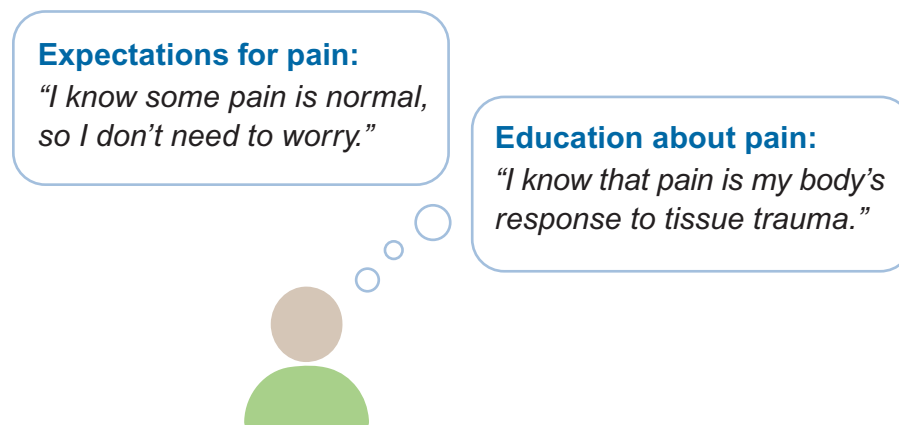
A pre-operative pain management assessment includes several important components: 1) **education and expectation setting** around anticipated peri-procedural pain as part of the informed consent

process; 2) **evaluation for risks of challenging pain management**; and 3) development of a **plan for peri-operative analgesia** including how the patient and care team will ensure satisfactory pain control.

Education and expectation setting

While each patient experiences pain in unique ways, surgical teams can paint a realistic picture of the typical experience for patients undergoing the planned procedure. Importantly, patients should understand prior to surgery that “zero pain” is not the goal, but that their surgical team will work with them to manage their pain in a way that makes them comfortable while minimizing the risks of pain medications.⁴³ This not only makes for a more complete informed consent process, it also serves to set expectations and establish a sense of what is “normal” following the procedure. This includes setting expectations for the type, severity, and duration of pain that is typical following a given procedure. Post-operatively, patients should expect pain reduction to satisfactory levels, not necessarily elimination. Communicating such expectations for pain following surgery has been associated with increased post-operative patient satisfaction.⁴⁴ For example, in a trial of 96 women who underwent breast cancer surgery, patients who were randomized to receive optimal counseling on analgesia expectations reported better pain scores and satisfaction with analgesia.⁴⁵

Figure 4: Framing patient expectations



Tips for discussing expectations

Address common questions from surgical patients. A study of patients after aortic aneurysm repair found patients most wanted to know:⁴⁶

- What is the recovery time for the procedure?
- What can I expect for post-operative pain and energy levels?
- How long will it take until I walk normally?
- When will I get my appetite back?
- What will the incisions look like and where will they be?
- Will there be other complications, such as difficulty urinating, constipation, discomfort, or leg numbness?
- What should caregivers expect in terms of hospital length of stay and discharge planning?

Individualize the message to the patient.⁴⁷

- Surgeries have different pain expectations.
- Patients have different pain tolerance and expectations. Higher pre-operative pain expectations were linked to moderate- to severe-post-operative pain.⁴⁸
- The goal is not to be pain free, but to have pain adequately controlled.

Talk about the impact of pain management strategies that will be used.

- Regional anesthesia can help alleviate post-operative pain. A small study of patients reported significantly less pain than expected post-operatively, especially if they received regional anesthesia.⁴⁹
- Discuss the transition plan for pain management as patients progress through recovery.
- *“This is a painful operation. Most people need multiple pain medications for at least the first few days, though each patient is unique. However, as soon as your pain is well controlled, you should start to cut back on opioid pain medication and transition to a combination of acetaminophen and ibuprofen.”⁴⁷*
- Opioid minimizing pain management plans do not impact patient satisfaction or pain scores.³⁶ Patients can be reassured that pain will be addressed even if opioids are not prescribed.

Ask patients in post-operative appointments about their pain medication use and how the pre-operative expectations aligned with their post-operative course.

- Talking to patients about expectations allows retooling of the pre-operative conversation to respond to specific procedures or pain management strategies.
- What can the caregiver expect? For example, how long the patient would be in the hospital, what the discharge

Assessing the risk of challenging pain management

Risk factors for challenging pain management include pre-existing chronic pain, chronic use of pain medications, opioid tolerance, medical comorbidities, impaired functional status, and psychological conditions including substance use.^{39,50,51} Pre-operative involvement of a pain specialist should be considered for patients at high risk for challenging pain management;⁵² such specialists can assist with the development and execution of an optimal multi-modal pain management plan. Unfortunately, access to pain specialists may be limited, particularly among underserved patients.⁵³ In studies of patients in the Veterans Affairs system, Black veterans receiving opioid prescriptions were less likely than white veterans to be referred to a pain specialist and more likely to be referred for substance use assessment.⁵⁴ Meanwhile, veterans living in rural areas had less access to pain specialists than those living in urban areas, and those who were evaluated by pain specialists were more likely to substitute telehealth visits for in-person visits.⁵⁵

Table 1: Risk factors to prompt possible referral to a pain specialist

Risk factors
pre-existing chronic pain (with or without opioid use)
history of challenging pain management
existing substance use (including alcohol and opioids of any type)
other psychiatric disorders
medical comorbidities raising the risk of adverse opioid-related events
impaired functional status

Developing an individualized analgesic plan

The patient, surgical team, and pain specialist (if involved) should work together to develop an *individualized* analgesic plan based on the principles of multi-modal analgesia as further described below. While there are some aspects of pain management that can be reasonably incorporated into protocols and “default” order sets (e.g., regional anesthesia for extremity surgeries or acetaminophen for abdominal procedures), focusing on the specific risks and care needs for the unique combination of patient and surgical characteristics is key for achieving satisfactory pain relief while minimizing harm.

Special considerations for patients with chronic opioid use and opioid use disorder

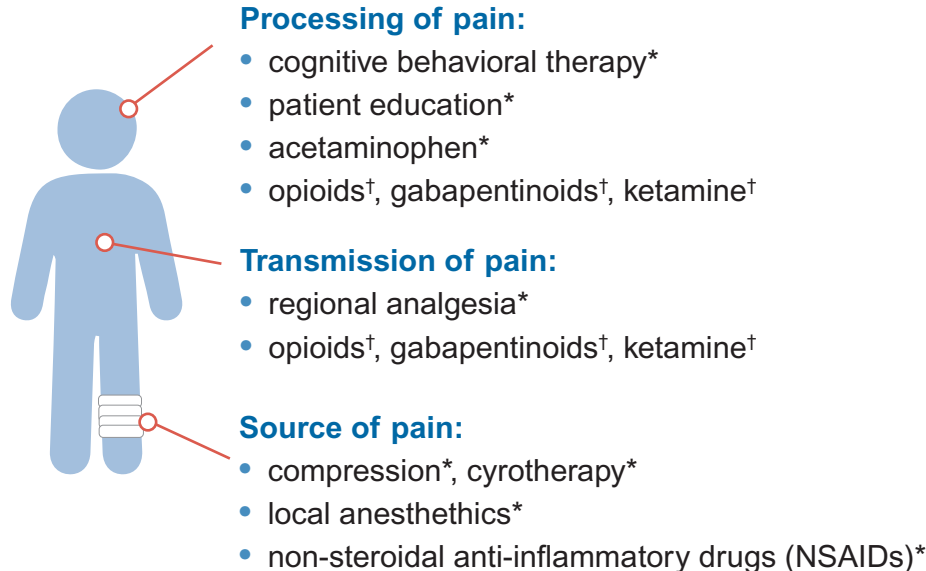
The *overall* approach to patients with chronic opioid use or opioid use disorder (OUD), regardless of whether they are receiving treatment, should be the same as with any other patient; additional opioids may not be necessary, and multi-modal pain management.^{5,56} However, use of prescribed opioids and pharmacotherapy for OUD make it all the more critical that an individualized care plan be developed using a team approach, ideally with a pain management specialist and/or the patient’s OUD treatment provider.

Education, expectation setting, and planning is particularly important in this population, as pre-operative use of opioids has been associated with more post-operative complications and costs.^{57,58}

Regardless of whether a patient is using opioids or receiving pharmacotherapy for OUD, it is essential to remember that opioids target only part of the pathway from the source of pain to the transmission and processing of pain (Figure 4, from Mariano et al⁵⁹). Interventions that target the pain pathway in other ways (e.g., nerve blocks, NSAIDs, acetaminophen) should be no less effective in patients using opioids or with opioid use disorder and should be the first consideration in patients with (and without) OUD.⁶⁰ Should other modes of analgesia besides opioids be inadequate to manage the patient’s pain, special considerations must be given to the use of opioids for perioperative pain management.

A study of patients with chronic *pre-operative* opioid use highlights the way in which a team approach to pain management can be helpful in this population. In the study of 5,749 patients who did not have a usual opioid prescriber (i.e., received prescriptions from multiple doctors) pre-operatively were more likely to have multiple prescribers post-operatively (OR 2.23; 95% CI: 1.75-2.83) and receive new long-acting opioid prescriptions (OR 1.69; 95% CI: 1.05-2.71).⁶¹ Those with a usual prescriber pre-operatively were less likely to have multiple prescribers post-operatively (OR 0.80; 95% CI: 0.68-0.95), suggesting that enhanced care coordination prior to surgery could have post-operative benefits.

Figure 5: Components of the pain pathway and targeting therapies⁵⁹



The purpose of pharmacotherapy for opioid use disorder (OUD) is to allow patients to feel normal without symptoms of opioid withdrawal or cravings. While these drugs have opioid agonist (e.g., methadone) or partial-agonist (e.g., buprenorphine) activity, they do not provide pain relief for acute surgical pain. They do, however, complicate the use and dosing of opioids in the peri-operative period.

Patients using opioids chronically or being treated for OUD can safely receive additional opioids, but commonly this entails increased doses given at shorter intervals, which places patients at increased risk of overdose. As such, the use of opioids in these patients should be done in consultation with a pain management and/or OUD specialist, and may require more intensive and prolonged monitoring in a health care setting compared to other patients. Patient caregivers or family members should have easy access to naloxone, regardless of the care setting, in the event of an accidental overdose.

Peri-operative multi-modal analgesia

The goal of multi-modal analgesia is to target different parts of the pain signaling pathways using a variety of analgesic medications and techniques.⁵⁹ While no single mode of pain relief alone may be sufficient, multiple modes targeting the pain transmission pathway can relieve pain synergistically—with an effect of better pain control with less opioid use. Analgesic targets can include the source of pain at the tissue level (targeted by anti-inflammatory drugs and local anesthetics, for example), neural transmission pathways (targeted by regional anesthesia, opioids, and other drugs), and pain processing pathways in the brain (targeted by education and expectation setting, drugs like acetaminophen and opioids, and cognitive behavioral therapy).

In a study of 1.5 million hip and knee replacement surgeries, the use of each additional mode of analgesia was associated with reductions in opioid use, adverse events (respiratory, gastrointestinal, and urinary complications), and hospital lengths of stay.⁶² Notably in this study, use of additional modes of analgesia was *not* associated with increased costs.

Common modes of analgesia used over the course of the operative periods are outlined below. Understanding the strengths and limitations of each mode can help clinicians choose the right mix of approaches for a given case.

Pre- and intra-operative modes of analgesia

Regional anesthesia

Pre- and intra-operative anesthesia decisions can have long-term effects on post-operative pain control. Regional anesthesia, used with or without general anesthesia intraoperatively and/or postoperatively, has numerous pain management benefits as outlined below.

Epidural anesthesia

For many procedures, epidural anesthesia, nerve blocks, and other regional methods can provide the anesthetic effects necessary during and after surgical procedures while carrying fewer risks than other anesthetic options, such as general anesthesia during cases or systemic opioids following cases.

Epidural analgesia in particular has proven to be a powerful tool for peri-operative pain management. One meta-analysis of randomized controlled trials found that patients receiving epidural analgesia for a variety of surgeries (including abdominal, cardiac, thoracic, vascular, gynecological, urological, and orthopedic surgeries) had lower risks of mortality, atrial fibrillation and supraventricular tachycardia, deep vein thrombosis, respiratory depression, pneumonia, ileus, nausea and vomiting than patients who received general anesthesia.⁶³ While epidural anesthesia also led to increases in known side effects (hypotension, urinary retention, itching, and motor blockade), the reduction in mortality suggests that these effects were not life threatening and were less severe than effects of general anesthesia. Another meta-analysis of 100 randomized trials comparing epidural analgesia to parenteral opioids for post-operative pain control found that epidurals provided better pain control (approximately 10 mm reduction in pain score on the visual analog scale) across all types of surgeries studied both at rest and with activity (with the exception of thoracic surgery only at rest where there were not significant differences); epidurals were also associated with reduced nausea, vomiting, and itching.⁶⁴ A German study of over 18,000 patients comparing epidural patient controlled analgesia (PCA) to a traditional intravenous PCA showed improved pain control for major abdominal surgery, particularly on post-operative days 0 and 1.⁶⁵

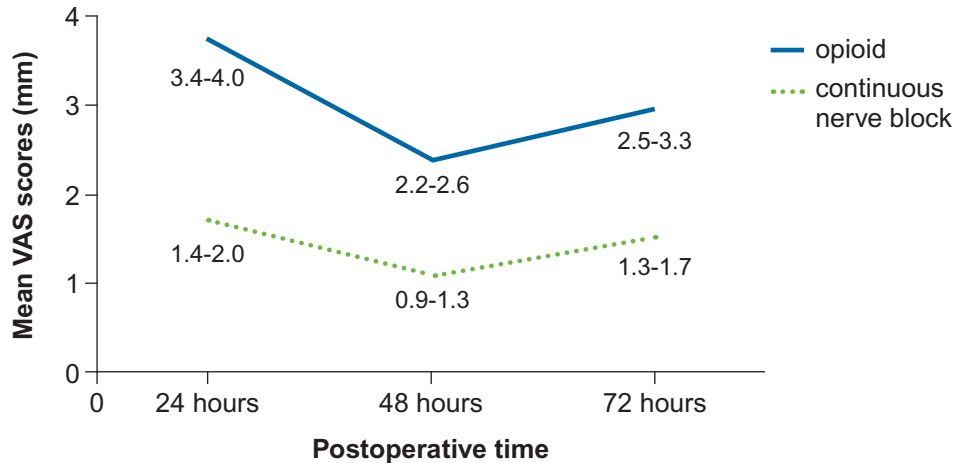
Because of its superior performance and better safety profile, epidurals for intra- and post-operative analgesia have been used for major abdominal surgery.⁴⁹ A retrospective study of Medicare patients undergoing hepatic and pancreatic surgery showed that epidurals were used in 6.2% of cases and were associated with reduced inpatient mortality with similar costs as other forms of analgesia.⁶⁶ While there may be many procedures for which epidural analgesia is the best analgesic option, it may not be beneficial or cost effective for all procedures, such as minimally invasive procedures where less pain is anticipated.⁶⁷

For many patients—particularly medically complex patients for whom systemic analgesia carries more risk—the benefits of epidural or other regional analgesia may outweigh the procedural risks. Individualized analgesic plans should consider epidural analgesia if appropriate and warranted by anticipated pain.

Nerve blocks and local anesthesia

For procedures where it is anatomically possible, continuous peripheral nerve blocks can provide better pain control compared to systemic opioids. A meta-analysis of 19 small randomized controlled trials enrolling a total of 603 patients receiving extremity surgery compared continuous peripheral nerve blockade to systemic opioids alone. Results showed better pain control at 24, 48, and 72-hour periods (figure below) as well as reduced nausea and vomiting, reduced sedation, and reduced opioid use.⁶⁸

Figure 6: Pain scores significantly reduced with continuous nerve block vs. opioids⁶⁸



Transversus abdominus plane (TAP) block, which uses local anesthetic injected in between abdominal muscles for broader anesthesia during abdominal surgeries, has been shown to be generally safe. While the short term effects of TAP block are similar to local surgical site anesthesia, TAP block provides superior pain control at rest and with movement 24 hours postoperatively.⁶⁹

Local anesthetic injected directly into surgical sites at the time of surgery, with or without a subsequent continuous tissue infusion, when reasonably feasible (e.g., bupivacaine injected into a laparoscopic trocar site³²) can also be a simple and effective way to reduce needs of other modes of analgesia that carry higher risk.⁷⁰

Post-operative modes of analgesia

Analgesic choices in the pre- and intra-operative period can substantially impact post-operative control of pain. As discussed above, epidural analgesia can be particularly effective in the immediate post-operative period, while placement of a continuous peripheral nerve block can provide days of benefit.^{63,65,68}

However, as patients prepare for discharge following surgery, oral medications become the most practical modes of analgesia. Still, principles of multimodal analgesia should still apply to oral pain regimens.

Pharmacologic options

Analgesic drugs can have powerful synergistic effects when used in combination with one another and/or other modes of analgesia. While opioids have historically been a cornerstone of analgesic pharmacotherapy following surgery, a large evidence base now suggests that using multiple diverse

modes of analgesia can provide better, safer pain control while reducing or eliminating the need for opioid pain medications.

Acetaminophen

While its exact mechanism of action is unknown, acetaminophen provides analgesia by acting upon the central nervous system and **should be considered a first-line pain medication** (in combination with non-steroidal anti-inflammatory drugs [NSAIDs]; see below). When used at appropriate doses orally or intravenously, acetaminophen has an excellent safety profile and can reduce postoperative opioid needs.⁷¹ A trial of patients who underwent colorectal surgery found that, compared to placebo, administration of acetaminophen was associated with better pain control, reduced opioid use, reduced post-op ileus and time to return of bowel function, and shorter hospital length of stay.⁷²

Because of its excellent safety profile compared to other analgesic drugs, acetaminophen should be given on a scheduled, around-the-clock basis to reduce the need for other analgesics with higher risks of adverse effects. A trial of post-partum patients who underwent cesarean delivery found that scheduled acetaminophen administration was associated with lower opioid needs compared to as-needed acetaminophen.⁷³

While hepatic toxicity is a concern when administered in excess of recommended daily maximum doses, acetaminophen can be safely used in patients with mild to moderate liver disease and/or alcohol use.⁷⁴ Use in patients with advanced cirrhosis should be guided by a hepatologist. Among patients with liver disease, appropriately dosed acetaminophen carries a favorable safety profile compared to other analgesic drugs, many of which carry elevated risk of adverse effects in patients with liver disease.

Non-steroidal anti-inflammatory drugs

NSAIDs, which include ibuprofen, ketorolac, naproxen, diclofenac, meloxicam, and celecoxib, should be considered **first-line pain medications in combination with acetaminophen**. When used in combination, acetaminophen and NSAIDs provide better pain relief than either one alone, appear to have synergistic effects on pain, and reduce opioid needs.^{71,75-77} In a meta-analysis of trials comparing combination acetaminophen and ibuprofen to placebo, the number needed to treat to achieve 50% or more pain relief within 6 hours was less than 2.⁷⁶ While caution should be used in patients with kidney or gastric disease, this combination should be routinely used for most patients.

The main mechanism of action of NSAIDs is inhibition of the cyclooxygenase (COX) enzyme, which is also involved in platelet function. This has led to concerns regarding surgical site bleeding with the use of NSAIDs. However, NSAID use has generally not been associated with increased surgical site or other bleeding in the post-operative setting.^{78,79} One notable surgical risk that has been associated with NSAID use and remains an area of active investigation is intestinal anastomosis dehiscence, suggesting NSAIDs should be used with caution following such procedures.⁸⁰

NSAIDs in vascular surgery

NSAIDs play an important role in the management of post-operative pain for patients undergoing vascular surgery and should be considered a standard mode of analgesia unless contraindications are present. Though they may be contraindicated in patients with renal disease, which is often comorbid with vascular disease,⁸¹ risks of NSAIDs in a given patient may be substantially lower than the risks of other analgesic options—opioids in particular.

NSAIDs and contrast-associated kidney injury

The relationship between NSAIDs, iodinated contrast use (such as for angiography), and acute kidney injury is not well understood. Because NSAIDs are known risk factors for development of kidney injury, it is commonly recommended that NSAIDs be avoided altogether in patients with known kidney disease and be held prior to administration of iodinated contrast agents for all patients.⁸² However, the use of NSAIDs in the post operative period is not well studied.

Early studies finding an association between iodinated contrast use and kidney injury were observational, and further research has struggled to fully characterize and quantify the causal relationship between contrast and kidney injury, namely because many other factors can contribute to the risk of kidney injury in the time period following contrast administration.^{83,84} Although the risks of both acute kidney injury and clinically-meaningful long term impacts of contrast remain difficult to quantify, patients with pre-existing kidney disease and diabetes—common in the vascular surgery patient population—may be at elevated risk of acute kidney injury after contrast.⁸⁵⁻⁸⁷

Though current guidelines recommend NSAIDs be held prior to a procedure involving iodinated contrast media, this recommendation is based on the known nephrotoxic properties of NSAIDs and has not been sufficiently investigated in any population including patients undergoing vascular surgery.⁸⁸ Notably, one retrospective study of 236 patients in Brazil found that use of NSAIDs prior to cardiac catheterization procedures was not associated with an increased risk of contrast-induced kidney injury.⁸⁹

While many patients undergoing angiographic procedures may not need extensive pain management, NSAIDs should be considered, particularly in combination with acetaminophen, with risks/benefits weighed as a mode of anesthesia for patients without existing kidney disease.

Ketamine

Ketamine can be used either intra-operatively (anesthetic dose) or post-operatively (sub-anesthetic-dose), but it has a limited evidence base to support its use for pain control. However, society guidelines recommend consideration of sub-anesthetic doses of ketamine following painful surgery.⁹⁰ Ketamine may be particularly helpful in patients with difficult to control pain and opioid tolerance. It should be avoided in patients with cardiovascular disease, pregnancy, psychosis, cirrhosis, and elevated intracranial pressure. A trial of 102 patients with back pain comparing patients who received placebo to patients who received ketamine undergoing back surgery showed that ketamine use was associated with significantly reduced post-operative pain scores and opioid use.⁹¹

Gabapentinoids

Gabapentin and pregabalin have been shown to reduce pain scores and opioid use in the post-operative setting; however, they have also been associated with increased sedation, dizziness, and visual disturbances.^{92,93} In lower-risk patients, gabapentinoids can be a potentially effective additional mode of analgesia when neuropathic type pain is suspected, such as after nerve injury or irritation, if pain is unresponsive to other types of analgesia, or if patients experience hyperalgesia, paresthesia, dysesthesia, or radicular pain.^{94,95} It should be noted that recent guidelines caution against initiation of postoperative gabapentinoids and only recommend them to be continued if patients were previously receiving them.³⁹

Dexamethasone

Dexamethasone is commonly used peri-operatively to prevent nausea and vomiting associated with general anesthesia. However, it has also been shown to help reduce post-operative pain at moderate doses (>0.1 mg/kg).⁹⁶ Dexamethasone and other corticosteroids may thus be helpful in certain patients and procedures, though caution should be used in patients with diabetes.

Opioids

Opioids should only be used in conjunction with other modes of analgesia, starting with the lowest effective dose when other modes do not (or will not) provide adequate pain relief. Naloxone should be co-prescribed to patients at risk of overdose (history of overdose, history of substance use disorder, high opioid prescriptions, and concomitant benzodiazepine use); naloxone co-prescription has increased in recent years but remains under-prescribed.⁹⁷

In the immediate post-operative setting, compared with intermittent nursing administered IV bolus opioids, patient-controlled analgesia (PCA) leads to better pain control and better patient satisfaction.⁹⁸ In some surgeries, PCAs were associated with more opioid use without an increase in adverse events. PCAs should not have basal rates; they should only deliver medication when requested by the patient. If PCAs are still needed, doses should be limited to the minimum effective dose, and patients and clinicians should aim to taper the drug as able.

Opioids often do not need to be prescribed at discharge, and they should be avoided when pain can be adequately controlled using other modes of analgesia. If a patient's pain is not well controlled using other methods of analgesia when it is time for them to return home and an opioid is necessary, prescriptions should be written for short duration using the minimum effective dose with an eye on tapering and discontinuation of the drug. A plan for evaluating response to therapy is critical, as patients who do not feel comfortable tapering their medications may require additional interventions—such as introduction of a new mode of analgesia—rather than prolonged opioid therapy.

In a review of 6 studies comprising 810 patients, a majority of post-operative patients who were prescribed opioids will stop using them when pain is controlled, though a quarter of patients stop due to side effects.⁹⁹ Most patients will have excess unused opioids and many had more left unused than they used by the time they discontinue the drug (another larger study of 2,392 patients in Michigan finding patients used only 27% of the opioids prescribed to them¹⁰⁰). However, a majority of patients did not have plans to dispose of unused opioids or know how to safely dispose of them.⁹⁹ Education on self-tapering, discontinuation, and disposal of unused opioids should be provided to all patients for whom they are prescribed.

The optimal duration of opioid therapy varies between individual patients and procedures, and in practice, higher intensity surgeries are associated with larger initial prescriptions and more refills.^{101,102} Refill requests are signs that opioids are not being excessively prescribed, but when patients request refills, consideration should be given as to whether other modes of analgesia should be added. Notably, one study of 1,520 patients found that there was no association between the size of an opioid prescription (in oral morphine equivalents) and patient satisfaction scores, suggesting that smaller prescriptions following surgery can be given without affecting patient satisfaction.¹⁰³ Furthermore, another study of 26,520 opioid-naïve patients found that the amount of opioid prescribed in the initial prescription did not correlate with the probability of refilling a prescription, suggesting that other factors are at play in the need for

additional opioids and that again, smaller initial prescriptions can be given without negative effects on subsequent pain control.¹⁰⁴

Cannabis

Cannabinoids are not part of current consensus guidelines for peri-operative pain control. However, use is common, and it has been shown to potentially improve pain control. Limited studies suggest potential benefit of cannabis use for chronic neuropathic pain, but otherwise there does not appear to be major benefit in non-cancer chronic pain.^{105,106} The extremely limited research in peri-operative use does not suggest a benefit of cannabis use.¹⁰⁷

Despite this lacking evidence base, many patients use cannabis, and some will ask their doctor about it. The current evidence base does not disprove that cannabinoids, used in complement with other modes of analgesia in select patients, may be helpful, particularly among those who report deriving other benefits from cannabinoids. Patients planning on using cannabinoids as a mode of analgesia should be cautioned about effects of cannabinoids which can include impaired short-term memory, motor coordination, and judgment that may create additional risks, particularly among older patients.

Non-pharmacologic options

Although the nature and intensity of surgical pain may not always be amenable to non-pharmacologic interventions, these adjunctive treatments may be used in lieu of or in combination with therapies described above in appropriate patients¹⁰⁸:

- interdisciplinary rehabilitation from physical and occupational therapists, including physiotherapy and therapeutic exercise
- Cognitive Behavioral Therapy,^{109,110} mindfulness, distraction/guided imagery, or specialized therapies such as mirror therapy for phantom limb pain
- social interventions to assist with functioning at home (e.g., assistance with activities of daily living)
- self-guided exercise
- cold and heat therapy
- compression and elevation
- acupuncture
- massage
- movement therapies like yoga or tai chi
- spiritual interventions
- transcutaneous electric nerve stimulation (TENS)
- music therapy^{111,112}

Considerations for common vascular procedures

Endovascular vs. open approach

Vascular surgeons may consider post-operative pain control in decisions surrounding endovascular versus an open surgical approach, as endovascular procedures. One study of 77,767 opioid-naïve Medicare beneficiaries undergoing a variety of vascular surgeries found that rates of new persistent

opioid use occurred post-operatively in about 2.6% of all patients.¹¹³ While there were no differences between patients undergoing endovascular compared to open procedures for peripheral arterial disease or abdominal aortic aneurysms, patients undergoing endovascular carotid or venous surgery were at higher risk of new persistent opioid use.

Abdominal aortic surgery

In a Cochrane metaanalysis of trials comparing epidural analgesia to primary systemic opioid analgesia alone after abdominal aortic surgery, which contained 1,498 patients enrolled in 15 trials, the use of epidural analgesia led to¹¹⁴:

- better pain control at rest and with movement
- earlier extubation
- less respiratory failure
- shorter ICU length of stay
- reduced rates of myocardial infarction
- no difference in mortality

Carotid endarterectomy (CEA)

Regional anesthesia (e.g., brachial plexus block) has been shown to have similar outcomes to general anesthesia for CEA, yet general anesthesia is associated with longer operating room time, longer hospital length of stay, and higher costs.¹¹⁵⁻¹¹⁹ In a large randomized controlled trial of 3,500 patients across 24 countries undergoing CEA (the GALA trial), patients were randomized to regional versus general anesthesia.¹²⁰ Surgical outcomes were similar across both groups, with similar rates of death, stroke, and myocardial infarction. Of the 1,730 patients randomized to regional anesthesia, only about 4% had to convert to general anesthesia, mostly due to discomfort, anxiety, or claustrophobia. While post-operative pain control and opioid use was not measured in this trial, other studies have shown that overprescribing of opioids is common with carotid surgeries under general anesthesia, with one single center study showing 79% of opioids prescribed for carotid surgery going unused¹²¹; experience in other surgeries suggests that multimodal analgesia, including regional nerve blocks, would be likely to reduce opioid needs in CEA.

Limb ischemia

There are no definitive evidence-based strategies specific to pain management for patients with critical limb ischemia.¹²² However, multiple modes of pain control are worth considering in these patients, including epidural analgesia, nerve blocks, gabapentinoids (particularly when neurogenic pain is suspected) and intravenous local anesthetics.

Limb amputations

Phantom pain is a unique consideration for amputation surgeries, occurring in up to 85% of amputees, which can be quite severe and often decreases over time.^{123,124} Because limb pain is an indication for amputation, patients may go into surgery with considerable pain and have pre-existing complex pain management regimens; these patients should be considered for consultation with a pain specialist if they have not already been evaluated.³⁹ Though gabapentinoids are a mainstay of pharmacotherapy and opioids can be effective in treatment of phantom limb pain, other modes of pain management can also be effective (Table 2).

Table 2: Analgesic options for limb amputations¹²⁵

Mode of analgesia	Example
regional anesthesia	<ul style="list-style-type: none"> • central neuraxial block • peripheral nerve block • local anesthetic via single-shot or continuous catheter +/- local infiltration
non-opioid analgesics	<ul style="list-style-type: none"> • acetaminophen • NSAIDs • gabapentin/pregabalin • ketamine • dextromethorphan
glucocorticoids	(variety, e.g., dexamethasone)
others	<ul style="list-style-type: none"> • antidepressants • topical agents (capsaicin, cannabinoid, lidocaine) • alpha-2 adrenergic agents (clonidine)
opioid analgesics	(variety, e.g., morphine, oxycodone)

Local anesthesia such as through regional nerve blocks, as well as mirror therapy, biofeedback, and other non-pharmacologic should be considered to reduce opioids and their associated risks and side effects.^{123,125} For example, in a small randomized trial of 65 patients undergoing lower limb amputation, *pre-operative* epidural or PCA starting 48 hours prior to surgery and lasting 48 hours after surgery was associated with substantially reduced pain and phantom pain compared with meperidine/codeine/acetaminophen.¹²⁶

Post-discharge care

Post-operative pain tracking & plan adjustment

A pain management plan is not complete without a well-communicated plan to monitor response to treatment. The expectation for both the surgeon and the patient should be a two-way dialogue regarding the effectiveness of the current analgesic regimen and the plan to de-escalate therapy over time—recognizing that this will vary from patient to patient and procedure to procedure. Considering that patients may be experiencing temporary disability as a result of their surgery, lowering barriers to communication between the surgeon, their team, and the patient is critical. Postoperative telemedicine programs may be particularly helpful for this purpose.¹²⁷

Going home

Education and expectation setting should occur frequently in the post operative setting, but it is particularly important as patients return home after surgery. Patients with chronic pain who use opioids regularly should have care coordinated with any provider with whom they have a signed opioid use agreement (coordination that ideally has been in place since before the surgery).

Counseling provided at the transition home and at early follow up visits, which can be either done in person or by telemedicine, should:

- Assess current pain levels and trends over time.
- Screen for complications, which may be the cause of poorly controlled pain.
- Avoid the use of “just in case” prescriptions for high-risk medications like opioids.
- Adjust the pain management plan based on the patient’s progress, including removing or adding modes of analgesia.
- Counsel patients on tapering of medications and appropriate disposal methods.
- Make indicated referrals to other clinicians, such as a pain management specialist or physical therapist, as adjuncts to pharmacotherapy.

Prescribing Opioids

If patients are to be prescribed an opioid for post-operative pain, in Michigan, state law¹⁰⁶ requires that the prescriber do the following with patients, caregivers, and/or guardians:

- Counsel about the dangers of opioid addiction (and opioid use during pregnancy for reproductive age female patients).
- Provide instructions on how to properly dispose of an expired, unused, or unwanted controlled substance.
- Sign a “Start Talking” form, available at [Michigan.gov/opioids](https://www.michigan.gov/opioids), and save it in the patient’s medical record.
- Follow up closely with the patient and/or ensure that each patient has follow-up with a primary care or other provider.
- Obtain and review a report from the prescription drug monitoring program (PDMP) prior to prescribing a supply of more than 3 days duration.
- Refrain from prescribing a supply of more than 7 days’ duration at a time.

Patients should be provided clear instructions on how to safely dispose of leftover medications, which pose a hazard to patients, family members, and communities.^{7,9,128} The Food and Drug Administration and state and local agencies provide resources for patients on the proper disposal of unused drugs.¹²⁹

Measuring pain

While there are several familiar ways for patients to rate their pain levels, the most important consideration in eliciting pain levels from patients is to *be consistent in the way patients are asked to measure their pain*. Clearly, there is variation between different patients that make it different to compare one patient’s pain rating to another’s. However, using a consistent measurement tool is helpful to track pain levels over time *for a given patient*; changes on a single scale make it easy to know if pain is getting better or worse. However, as patients move across care environments, receive care from different clinicians, different scales may be used—e.g., numbers, a visual sliding scale, or pictures—which are not only difficult to compare but can be confusing for some patients.

The visual analog scale (VAS) is a simple, consistent, validated pain measurement scale that asks patients to mark a point along a line that goes from “least pain” to “most pain” and can be administered on paper, on a computer, or on a smartphone app.¹³⁰ One advantage of digital symptom reporting tools is that they can be tracked and automatically incorporated into a patient’s electronic health record with minimal use of resources. The VAS can be used for clinical, research, and quality improvement purposes.

Adjusting pain management plans

While pain levels are generally expected to fall over time in the post-operative setting, there is of course substantial patient-to-patient variation in how this occurs. Post-operative regimens should allow patients to de-escalate and taper their current use of medication based as quickly as their symptoms allow. Patients should be provided clear instructions on how to safely dispose of leftover medications, which pose a hazard to patients, family members, and communities.^{7,9,128} The Food and Drug Administration as well as state and local agencies provide resources for patients on the proper disposal of unused drugs.¹²⁹ One randomized controlled trial of 396 patients found that providing patients with a bag of activated charcoal designed for disposal of unneeded opioids at home led to significantly increased odds of opioid disposal (OR 3.8; 95% CI: 1.7-8.5) compared to usual care.¹³¹

However, when patients are unable to de-escalate therapy as anticipated and pain persists, a comprehensive post-operative evaluation should be performed to determine potential causes for unexpected and/or persistent pain, including surgical complications, and possible therapies, which may range from adding modes of analgesia to focusing on the current modes of analgesia that seem most effective, or referral to other clinicians such as pain management specialists. Opioids are effective mode of analgesia and adding them or increasing their dose may be appropriate; however, striving to minimize opioid use in the post-operative period by utilizing other modes of analgesia serves to minimize risk to patients while enhancing their recovery.

Take home points

Planning for pain management should start in the pre-operative setting and continue throughout the intra- and post-operative periods, with regular reassessment and adjustment to meet patients' needs.

Multi-modal pain management using multiple different types of procedural, pharmacologic, and non-pharmacologic strategies is effective at reducing or eliminating the need for opioids without compromising—and even improving—pain control and patient satisfaction.

Appropriate modes of analgesia will vary from procedure to procedure and patient to patient.

Pain specialists, when available, should be consulted for challenging cases.

Expectation setting and patient education are critical components to pain management throughout the cycle of surgical care.

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About this publication

These are general recommendations only; specific clinical decisions should be made by the treating clinician based on an individual patient's clinical condition.



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