

Substance Use Disorders in Adolescents and Young Adults: History and Perioperative Considerations From the Society for Pediatric Pain Medicine

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Substance use disorders (SUDs) are on the rise in children and young adults in the United States. According to reports, over 40 million people aged 12 and older had a diagnosed SUD in 2020.¹ A recent report from the Centers for Disease Control and Prevention (CDC) found that overdose death in children aged 10 to 19 years old increased 109% from 2019 to 2021.² Given the rapidly increasing prevalence of SUD, anesthesiologists will almost certainly encounter children, adolescents, and young adults with a history of recreational drug use or nonmedical use of prescription opioids in the perioperative period. Since the perioperative period can be a particularly challenging time for patients with SUD, anesthesiologists can tailor their perioperative care to reduce rates of relapse and can serve as both advocates and educators for this vulnerable patient population. This article examines the history of SUD and physiology of substance use in children, adolescents, and young adults, including reasons why young people are more susceptible to the addictive effects of many substances. The coronavirus disease 2019 (COVID-19) pandemic impacted many aspects of life, including increased social isolation and shifted dynamics at home, both thought to impact substance use.³ Substance use patterns in the wake of the COVID-19 pandemic are explored. Although current literature is mostly on adults, the evidence-based medical treatments for patients with SUD are reviewed, and recommendations for perioperative considerations are suggested. The emphasis of this review is on opioid use disorder, cannabis, and vaping particularly because these have disproportionately affected the younger population. The article provides recommendations and resources for recognizing and treating adolescents and young adults at risk for SUD in the perioperative period. It also provides suggestions to reduce new persistent postoperative opioid use. (Anesth Analg 2023;XXX:00–00)

GLOSSARY

AAP = American Academy of Pediatrics; **AYA** = adolescents and young adults; **CDC** = Centers for Disease Control and Prevention; **COVID-19** = coronavirus disease 2019; **CRAFTT** = Car, Relax, Alone, Forget, Friends/Family, Trouble; **DEA** = Drug Enforcement Administration; **ENDSs** = electronic nicotine delivery systems; **ENNDs** = electronic nonnicotine delivery systems; **EVDS** = electronic vapor delivery system; **EVALI** = E-cigarette or vaping use-associated lung injury; **FDA** = Food and Drug Administration; **IM** = intramuscular; **IMF** = illicitly manufactured fentanyl; **MAC** = minimum alveolar concentration; **MI** = myocardial infarction; **MOUD** = medication for opioid use disorders; **NIDA** = National Institute on Drug Abuse; **NIH** = National Institutes of Health; **NMDA** = N-methyl-D-aspartate; **NMUPO** = nonmedical use of prescription opioid; **NNT** = number needed to treat; **OUD** = opioid use disorders; **PFC** = prefrontal cortex; **PONV** = postoperative nausea and vomiting; **PPOU** = persistent postoperative opioid use; **THC** = tetrahydrocannabinol; **SAMHSA** = Substance Abuse and Mental Health Services Administration; **SNRI** = serotonin and norepinephrine reuptake inhibitor; **SPA** = Society for Pediatric Anesthesia; **SUD** = substance use disorder; **S2BI** = Short for Screening to Brief Intervention

According to the 2020 National Survey of Drug Use and Health by Substance Abuse and Mental Health Services Administration (SAMHSA), >40 million Americans, or 14.5% of the

US population 12 years old and older, had a substance use disorder (SUD).¹ In 2020, the Centers for Disease Control and Prevention (CDC) reported the highest recorded number of overdose fatalities in a

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12-month period with 70% of overdose deaths involving opioids.^{4,5} Illicitly manufactured fentanyl (IMF) has ignited the opioid epidemic with an acceleration during the coronavirus disease 2019 (COVID-19) pandemic.⁶ A recent report from the CDC found that overdose deaths in children aged 10 to 19 years old increased by 109% from 2019 to 2021.² Ninety percent of these deaths involved opioids, and 84% involved IMF. The majority had no known history of opioid use (65%) or mental health conditions (59%).

Because recreational drug use is a dynamic phenomenon, the last several decades have brought profound changes to drug markets, including the types of drugs being used, the potency of drugs, mode of sales, and the development of novel psychoactive substances.^{6,7} For example, the tetrahydrocannabinol (THC) concentrations in cannabis products have increased 4-fold in the last 24 years, yet the fraction of adolescents who perceive cannabis as harmful has decreased by 40%.⁷ More recently, the Drug Enforcement Administration (DEA) warned of dramatic increases in counterfeit prescription pills containing fentanyl and methamphetamines.⁸

Because 90% of people with SUD began using illicit substances before age 18 and developed SUD before age 20, adolescent substance use deserves particular attention.⁹ The American Academy of Pediatrics (AAP) recommends medication for opioid use disorders (MOUD) for youths, and there is undeniable evidence that MOUD saves lives.^{4,10} The existing infrastructure for proper identification and treatment of youth with SUDs is inadequate.^{4,10}

Given the prevalence of SUD, anesthesiologists will encounter adolescents and young adults (AYAs) with known, or more commonly unidentified, SUD in the perioperative period. It is important for clinicians to familiarize themselves with the evolving climate and implications of SUD. In this article, we will discuss the evolution of substance use in AYAs, the impact of the COVID-19 pandemic on adolescent SUD, treatment options and gaps in care for adolescents with SUD, and perioperative considerations of the adolescent patient.

EVOLUTION OF SUD IN ADOLESCENCE: THE HISTORY AND PHYSIOLOGY

From the use of morphine in Mrs Winslow's Syrup, for soothing fussy or teething babies in 1845, to coca leaf extract included in Coca-Cola until 1903, children have been far from sheltered from the use of drugs in American history. While cannabis became an icon for the counterculture movement of the Vietnam War, many young military troops abroad became victims of SUDs. Nearly 1 in 5 soldiers became a regular heroin user by 1973.¹¹ The current US opioid epidemic is characterized as having

3 waves.¹² Beginning in the 1990s, the first wave of opioid epidemic involved nonmedical use of prescription opioids (NMP), which disproportionately affected young, rural, and White populations. The second and third waves were from heroin use beginning in 2010 and synthetic opioids beginning in 2013, respectively.¹³ A fourth wave involving the use of stimulants in combination with opioids has been described.¹⁴ With the COVID-19 pandemic, there have been global repercussions, including the proliferation of the "dark web" Internet sales market, increasing ease of access.^{2,7} Most recently, the DEA described a new formulation of fentanyl being trafficked, "rainbow fentanyl," colorful pills frequently packaged in boxes that resemble sidewalk chalk that may appeal to children and adolescents.¹⁵

While reported rates of opioid use among youth have been declining, people between the ages of 15 and 24 had the greatest increase in deaths due to drug overdose in recent years.^{16,17} With a 3- to 5-fold increased risk of serious medical outcome compared to other children presenting with opioid exposure, the adolescent population is disproportionately affected by the opioid crisis.¹⁶⁻¹⁸ Adolescence is a period of active brain growth, synaptogenesis, and maturation. This period of change is second only to the growth and development that occurs during infancy. Adolescents are particularly susceptible to drug use and the development of SUDs as compared to adults due to developmental differences in the prefrontal cortex (PFC), striatal cortex, and limbic system. The PFC, the center for reasoning and decision-making, grows during childhood but remains immature in adolescence.¹⁷ Furthermore, the responsiveness of the striatal cortex to immediate rewards, such as sugar, money, and potential drugs of abuse, peaks during the adolescent period.¹⁷ The limbic region stores and retrieves events that evoke a strong emotional response, like pleasure in response to various substances. This center for processing emotions and memories matures sooner in adolescence compared to the reasoning center.¹⁷ Hence, adolescents are biologically primed to make decisions based on emotion and immediate rewards rather than reasoning through long-term consequences. Furthermore, studies suggest that 62% of adolescents with severe SUD will continue to experience SUD in adulthood.¹⁷

COVID-19 AND ADOLESCENT SUD

The COVID-19 pandemic has had a significant impact on recreational drug use worldwide. The economic consequences that resulted from global shutdown have disproportionately affected low-income countries. Economically unstable populations began growing drug crops, drug trafficking, and dabbling in drug

sales as a source of income.⁷ Prolonged social isolation, disrupted daily routines, resultant economic hardships, and the effect of the virus itself all contributed to increased mental illness and psychological distress.¹⁹

Epidemics are known to impact mental health, resulting in a “parallel epidemic” of a viral outbreak and mental health crisis.²⁰ Studies have demonstrated a steep increase in fatal and nonfatal overdoses across the United States during COVID-19.^{2,21–24} In fact, opioid overdose deaths exceeded 75,000 for the first time in a 12-month period from April 2020 to April 2021.²⁵ Among AYAs between the ages of 10 and 19 years, the median overdose deaths per month more than doubled from July to December 2019 compared with July to December 2021.² Two-thirds of deaths occurred in the decedent’s home and, just as disturbing, there were potential bystanders in two-thirds of these deaths.² It has been argued that the intersection of the opioid epidemic with the COVID-19 pandemic places the youth at even higher risk of NMUPO and overdose.^{3,20} Social instability from disrupted school schedules and shifting interpersonal interactions has resulted in escalating friction in the home environment while also stifling adolescent development of peer relationships, personal autonomy, and identity.^{3,20} Such heightened psychological stress in conjunction with increased vulnerability has been implicated in the rise in alcohol and cannabis use in Canadian youth during the pandemic.³ Stay-at-home mandates and shutdowns reduced the exposure of vulnerable adolescents to mandated reporters of maltreatment, likely resulting in more unrecognized at-home abuse, which can perpetuate mental illness and SUD.¹⁹

Interestingly, studies of adolescent behavior during the COVID-19 pandemic have yielded mixed results regarding substance use with some reporting increased alcohol and cannabis use, while others less binge drinking and vaping behaviors.²⁶ Considering that adolescent substance use is commonly a social behavior, it has been suggested that social distancing and stay-at-home orders may have reduced drug experimentation and recreational use among this age group.²⁶ Others argue that pandemic-driven stress, anxiety, depression, and boredom may have bred a new cohort of adolescents with potential for SUD.²⁶ Considering the rise in opioid-related overdoses, social distancing may have resulted in people with serious SUD using in isolation, putting themselves at higher risk for serious medical consequences and death.²² Furthermore, Alinsky et al²⁷ reported reductions in paid buprenorphine prescriptions in AYAs, suggesting unmet treatment needs. Although there was an initial reduction in availability of mental health

treatment during the shutdown, a robust response triggered innovation and adaptation including expansion of telemedicine services and electronic systems for prescriptions to increase accessibility and improve timely treatment.⁷

TREATMENT OPTIONS AND CURRENT GAPS IN OPIOID USE DISORDER CARE

Traditionally, treatment for SUD is centered around pharmacological and psychological interventions. MOUD is associated with reduced mortality, fewer relapses, and improved retention in addiction care.²⁸ Despite MOUD being standard of care for adults with opioid use disorders (OUDs), a significant gap remains between those diagnosed with OUD and those receiving MOUD. This is particularly pronounced in younger patients with OUD, with <25% of AYAs being prescribed MOUD and <2% of patients <18 years receiving MOUD.¹¹ Multiple barriers to care exist, including insufficient prescribers of MOUD, prohibitive cost to patients, and limited availability of youth-specific SUD programs. Adult programs that will accept adolescents frequently do not offer MOUD to patients <18 years of age.¹⁰ Furthermore, most adult programs neglect to address the complexities of adolescence and young adulthood, including the psychosocial dyad of the child-guardian relationship. AYAs treated with MOUD might be eligible to receive 1 of 3 Food and Drug Administration (FDA)-approved medications for the treatment of OUD: methadone, buprenorphine, and naltrexone (Table 1).

Methadone is a full μ -opioid receptor agonist with *N*-methyl-D-aspartate (NMDA) antagonism and serotonin and norepinephrine reuptake inhibitor (SNRI) activity. Developed in the 1960s, the federal methadone treatment program was established for adults, particularly aimed at young Vietnam veterans returning with OUD. Methadone for OUD continues to be restricted to federally certified opioid treatment programs. Access for youth <18 years old is further restricted; US federal policies require adolescents to prove that they have had 2 unsuccessful treatment attempts in the past 12 months before initiation of methadone, and they must obtain written permission from a parent or guardian.²⁸ Younger adolescents in some states may also need state approval to access a methadone program. Furthermore, methadone treatment requires daily travel to specialized facilities, commonly referred to as a “methadone clinic,” which can be quite arduous for the adolescent’s and guardian’s daily lives.

Buprenorphine, the most commonly prescribed medication for teens with OUD, is a high-affinity partial agonist at the μ -opioid receptor, while maintaining antagonistic properties to reduce respiratory depression and euphoria.²⁹ It competitively displaces other

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Table 1. Summary of Perioperative Considerations for FDA-Approved MOUD

Drug	Perioperative concerns	Recommendations
Methadone	<ul style="list-style-type: none"> • Half-life has considerable interindividual variability • QTc prolongation • Hepatotoxicity • Opioid withdrawal or oversedation • Constipation 	<ul style="list-style-type: none"> • Continue home dose • Consider preoperative ECG to check QTc • Avoid other QT-prolonging medications • Multimodal analgesia • Close postoperative monitoring and discharge follow-up • Provide safe postoperative opioid taper • Provide naloxone nasal spray with counseling
Buprenorphine	<ul style="list-style-type: none"> • Antagonist properties could reduce full opioid agonist effect • Hepatotoxicity • Oversedation when combined with other CNS depressants • Possible QTc prolongation 	<ul style="list-style-type: none"> • Continue home dose • Use high-affinity opioids such as fentanyl and hydromorphone when opioids are indicated • Multimodal analgesia • Close postoperative monitoring and discharge follow-up • Provide safe postoperative opioid taper • Provide naloxone nasal spray with counseling
Naltrexone	<ul style="list-style-type: none"> • Hepatotoxicity • Eosinophilic pneumonia • Hypersensitive reaction • Accidental opioid overdose 	<ul style="list-style-type: none"> • Discontinue preoperatively: 72 h for oral and 30 d for the intramuscular dose • Multimodal analgesia • Close postoperative monitoring and discharge follow-up • Provide safe postoperative opioid taper

Abbreviations: CNS, central nervous system; ECG, electrocardiogram; FDA, Food and Drug Administration; MOUD, medication for opioid use disorder.

μ receptor agonists, with its long μ receptor fixation half-life, contributing to its long duration of action. Initially created for pain relief, it provides potent analgesia despite being a partial μ-opioid agonist.⁴ The initiation of buprenorphine treatment has been shown to be very effective in preventing death with a number needed to treat (NNT) of <3.³⁰ Buprenorphine is available as a single agent or in combination with naloxone, added to deter misuse. Buprenorphine is currently available in injectable, sublingual tablet, sublingual film, and transdermal delivery systems. The FDA approved the use of the buprenorphine-naloxone films, tablets, and subcutaneous injection for use in children 16 years old and older. Before January 2023, prescribing buprenorphine was strictly regulated, requiring completion of additional training to obtain an X-waiver if one intended to treat >30 patients.^{4,10,31} As a result, there is significant geographic variability in the availability of providers licensed to prescribe buprenorphine, and only 1% of waived providers are pediatricians.³² There is more buprenorphine prescribed in the Mid-Atlantic Appalachian region, the New England region, and a few areas in the Western and Southwestern United States.³³ The Consolidated Appropriations Act, 2023, removed the federal requirement for the X-waiver, allowing practitioners with standard DEA Schedule III prescribing authority to prescribe buprenorphine without caps on the number of patients a prescriber can treat for OUD with buprenorphine.^{31,34} It is too early to determine the impact of these new regulations.

Naltrexone is a competitive μ-opioid receptor antagonist that is available as an oral tablet or a once-monthly intramuscular injection for treatment of opioid and alcohol use disorders. It can be administered by any physician but is not often accessible to

teens, as there are no FDA-approved pediatric indications. It also reduces alcohol cravings and may serve a dual purpose for AYAs with coexisting alcohol use disorder.¹⁰

Despite options for MOUD and the support of the AAP, there is profound underutilization of existing pharmacologic options in adolescents with SUD.¹⁰ Other barriers to SUD treatment in the US health care system include lack of familiarity with treatment options, previous authorization requirements for buprenorphine and IM naltrexone, lack of health insurance in many AYAs, and high copays for clinical visits and pharmacologic treatment.²⁸ Advocating for access to developmentally appropriate counseling in community settings, the AAP has called on pediatricians to screen all AYAs for SUD and consider offering MOUD in the clinic setting.¹⁰ General practitioners, pain medicine physicians, and anesthesiologists should screen AYA patients.^{4,10} See the Figure for a summary of Short for Screening to Brief Intervention (S2BI) screen tool questions with evidence-based recommendations of clinical actions.³⁵ It has also been suggested that anesthesiologists can initiate buprenorphine in the perioperative setting in patients with untreated OUD and acute pain to reduce the risk of opioid recurrence and overdose-related death.⁴ Meaningful changes to the current barriers and gaps in care will require significant legislative support. With public attention on the current opioid and overdose epidemic, there is hope that policymakers will create an agenda to address this societal issue.

THE YOUTH VAPING EPIDEMIC AND RISE IN CANNABIS USE

In 2021, 1 in 9 high school students and 1 in 35 middle school students reported using e-cigarettes.³⁶ In

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S2BI algorithm

In the past year, how many times have you used:
Tobacco? Alcohol? Marijuana?



Figure. Summary of S2BI questionnaire with evidence-based recommendations of clinical actions based on child’s response. Preliminary data have shown that brief physician interventions whether it is positive reinforcement or brief advice may prevent or delay adolescent initiation of recreational substances. Printed with permission from Levy and Shrier.³⁵ S2BI indicates Short for Screening to Brief Intervention.

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another study, 27.5% of high school students (mean age, 16.1 years) and 10.5% of middle school students (mean age, 12.7 years) self-reported using e-cigarettes.³⁷ Of those users, 34.2% of high school students and 18.0% of middle school students reported frequent use. Children that use tobacco products have higher odds of vaping cannabis compared with nontobacco users.³⁸ Of note, children aged 13 to 24 years who only vaped were 5 times more likely to be diagnosed with COVID-19, and those who smoked and vaped were 7 times more likely to be diagnosed with COVID-19 compared with nonusers.³⁹ With legalization and increased availability in many states, cannabis is now the most commonly used recreational drug in the United States.^{5,40} In states where recreational cannabis use is legal, the legal age for purchase and use is 21 years old, and in most Canadian provinces, it is legal at 19 years old.⁴¹ An estimated 10% of the US population use cannabis products monthly, with a higher prevalence in younger populations.^{6,40} Interestingly and startling, SAMHSA reports that 1 in 6 people that use cannabis before the age of 18 become addicted.⁴²

An e-cigarette or vape pen is the battery-powered device used to vape. E-cigarettes are the product, while vaping is the act of or the use of the product. Electronic vapor delivery system (EVDS; also referred to as electronic nicotine delivery systems [ENDSs] and electronic nonnicotine delivery

systems [ENNDSs]) use has increased exponentially, particularly in AYAs, outpacing the speed at which evidence-based medicine can be published and legislative changes can be made.⁴³ As a result, there is a paucity of literature available, and many of the health side effects of vaping and e-cigarette use are still unclear. Vaping is known to cause tachycardia, hypertension, chest pain, and arrhythmia in adults.⁴⁴ E-cigarette or vaping-associated lung injury (EVALI) has been observed in teenagers vaping THC and vitamin E, but can also be associated with vaping nicotine. Nearly 3000 cases of EVALI and 68 deaths in the United States had occurred by February 2020, nearing the peak of e-cigarette use.⁴⁵ Recent cannabis use is associated with increased risk of perioperative acute myocardial infarction (MI), while chronic use may be associated with increased postoperative pain and postoperative nausea and vomiting (PONV).^{40,46} To date, there are no published studies that investigated cardiac issues specifically among adolescents who vaped.⁴⁷ Studies in adolescents who use e-cigarettes have found a higher incidence of asthma, wheezing, or chronic bronchitis symptoms including chronic cough, phlegm, or bronchitis.⁴⁷ In a 2022 systematic review of 38 studies, Novelli et al⁴⁸ described pulmonary repercussions of EVDS. These include alterations in pulmonary function tests, disrupted ventilation, impaired mucociliary clearance, tissue destruction,

a disrupted immune response, and oxidative stress with DNA fragmentation, which may lead to chronic pulmonary disease. Vaping has been demonstrated to reduce cutaneous blood flow in humans and is associated with poor wound healing and increased risk of flap necrosis.³⁹ Medication interactions are possible, since cannabis is metabolized in the liver using the CYP3A4 and CYP2C9 systems.^{40,46}

PERIOPERATIVE IMPLICATIONS OF THE ADOLESCENT PATIENT

The perioperative period can be a particularly perilous time for patients with SUD, whether treated or untreated. Patients with OUD are at increased risk for recurrence and relapse at discharge. Opioid exposure for the treatment of perioperative pain may serve as a priming event for persistent opioid use.²⁵ Given the rising prevalence of SUD in the pediatric population, it is increasingly common to encounter pediatric surgical patients with SUD. For these reasons, pediatric anesthesiologists need to be familiar with the impact of perioperative care on the development of persistent postoperative opioid use (PPOU) and possible misuse. AYAs should be screened for possible SUD.⁴⁰ Car, Relax, Alone, Forget, Friends/Family, Trouble (CRAFFT) and S2BI are screening tools that were specifically designed for the youth and young adults. Recommended by the AAP, CRAFFT is an evidence-based screening tool for patients between the ages of 12 and 21 and is available for free at crafft.org. S2BI is recommended by SAMHSA and the National Institutes of Health (NIH) National Institute on Drug Abuse (NIDA) and is also available online for free (<https://nida.nih.gov/s2bi>) and summarized in the Figure.

PPOU, defined as continued opioid prescription use between 90 days and 180 days after surgery, in previously opioid-naïve patients has been identified in nearly every surgical cohort, including pediatric patients. It has been reported that 2.4% to 4.8% of pediatric patients had opioid prescriptions refilled during this window after common pediatric surgeries.^{18,49,50} PPOU does not automatically translate to SUD. However, Brat et al²⁹ reported total duration of opioid prescription is the strongest predictor of misuse in adults. The risk of nonprescription use of opioid medications doubled with the first refill and increased by 20% with each additional week of opioid use.²⁹ Although opioid prescription rates have decreased by nearly 50% over the last decade, children continue to receive prescriptions; 1 in 10 girls and 1 in 12 boys report having at least 1 opioid prescription filled within the previous year.^{51,52}

Brummett et al⁵³ concluded that new PPOU was not significantly different between minor and major surgeries, but related to behavioral and pain disorders. In a focused review of adult patients, Larach et al²⁵

suggested current opioid use, previous history of opioid use, current or previous SUD, smoking, coexisting psychiatric disease with specific mention of anxiety and depression, complex medical comorbidities, history of chronic pain, younger age, and possibly female sex can increase the risk of PPOU. Cina et al⁵² reported similar risk factors for persistent opioid use in children undergoing appendectomy including non-naïve opioid status, previous use of antidepressants/antipsychotics, rehospitalization >30 days following surgery, multiple opioid prescribers, and teenage age. Looking specifically at patients between the ages of 13 and 21 years, Harbaugh et al^{18,50} reported an association with older age, female sex, previous SUD, chronic pain, preoperative opioid fill, and family members with long-term opioid use. These risk factors of PPOU should be identified in the preoperative evaluations and considered in their perioperative pain management (Table 2).

In addition to identifying risk factors for PPOU (Table 2), anesthesiologists should screen patients for SUDs in their preoperative evaluation, with particular emphasis on OUD, vaping, cannabis, and illicit drug use. An annual survey conducted by the NIH showed that opioid, cannabis, and hallucinogen use reached an all-time high in 2021 in AYA.⁵⁴ Considering there are a variety of substances that are commonly used recreationally, it is important to determine the specific substance(s) the patient is using and their anesthetic implications⁵⁵ (Table 3). Furthermore, there is a broad range of substances that can be vaped, including nicotine, caffeine, cannabis products, cocaine, heroin, a variety of synthetic drugs called novel psychoactive substances, vitamins, and supplements.⁵⁶ Referral to tobacco cessation therapy should be considered as perioperative smoking cessation that has been promoted as a modifiable risk factor for improving overall patient outcomes.³⁹ Patients on long-term methadone will need a recent ECG due to its risk of QT prolongation and caution that should be exercised with the use of other QT-prolonging medications (Table 1). Chest X-ray and a more comprehensive evaluation may be warranted for patients with suspected EVALI. It should

Table 2. Risk Factors for Persistent Postoperative Opioid Use in Adolescents and Young Adults

- Past opioid use
- Current opioid use
- Older age
- Use of antidepressants/antipsychotics
- Female sex
- Chronic pain
- Hospital readmission within 30 d
- Multiple opioid prescribers
- History of or current SUD
- Family history of SUD

Information based on Cina et al 2022⁵² and Harbaugh et al 2018, 2019.^{18,50}
Abbreviation: SUD, substance use disorder.

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Table 3. Summary of Perioperative Considerations for Common Substances of Misuse

Substance	Perioperative concerns	Recommendations
Opioids	<ul style="list-style-type: none"> • Opioid tolerance • Inadequate pain control • Increased risk of OUD recurrence • Respiratory depression • Opioid withdrawal or oversedation • Constipation • Health concerns related to IV drug use 	<ul style="list-style-type: none"> • Continue home MOUD regimen • Multimodal analgesia • Close postoperative monitoring and discharge follow-up • Discharge with naloxone nasal spray • Provide resources for cessation
Nicotine	<ul style="list-style-type: none"> • Chronic bronchitis or reactive airway disease • Nicotine withdrawal 	<ul style="list-style-type: none"> • Consider B-agonist preoperatively • Offer smoking cessation counseling • Nicotine replacement therapy
Cannabis products	<ul style="list-style-type: none"> • Chronic bronchitis or reactive airway disease • Tachyarrhythmias • Increased risk of MI • Drug interactions with many medications, including anticoagulants • Decrease MAC requirement with acute intoxication • Possible increased risk of PONV with chronic use • Possible increased postoperative pain and development of postoperative hyperalgesia with chronic use • Cannabis withdrawal 	<ul style="list-style-type: none"> • Consider B-agonist preoperatively • Provide resources for cessation • Delay elective surgery for a minimum of 2 h after cannabis smoking because of increased perioperative risk of acute MI • See ASRA 2023 guidelines for more details
Vaping	<ul style="list-style-type: none"> • Chronic bronchitis, reactive airway disease, EVALI • Tachycardia, arrhythmias, and hypertension • Vaped substance specific concerns 	<ul style="list-style-type: none"> • Consider B-agonist preoperatively • Provide resources for cessation
Cocaine	<ul style="list-style-type: none"> • Epistaxis, nasal septal, and soft palate necrosis • Tachyarrhythmias, hypertension • Hemodynamic instability • Health concerns related to IV drug use • Agitation, hallucinations, and uncooperative behavior • Increased MAC requirement with acute intoxication • Stimulant withdrawal 	<ul style="list-style-type: none"> • Caution with nasopharyngeal airway use • Avoid unopposed alpha blockade • Close postoperative monitoring and discharge follow-up • Provide resources for cessation
Methamphetamines	<ul style="list-style-type: none"> • Poor dentition • Tachyarrhythmias and hypertension • Hemodynamic instability and cardiac arrest • Agitation, hallucinations, and uncooperative behavior • Increased MAC requirement with acute intoxication • Stimulant withdrawal 	<ul style="list-style-type: none"> • Delay elective surgery for 14 d after last use • Close postoperative monitoring and discharge follow-up • Provide resources for cessation
Hallucinogens	<ul style="list-style-type: none"> • Tachycardia and hypertension • Hemodynamic instability • Agitation, hallucinations, uncooperative behavior • Increased MAC requirement with acute intoxication 	<ul style="list-style-type: none"> • Close postoperative monitoring and discharge follow-up • Provide resources for cessation
Alcohol	<ul style="list-style-type: none"> • Benzodiazepine tolerance • Decreased MAC requirement with acute intoxication • Alcohol withdrawal 	<ul style="list-style-type: none"> • Multimodal analgesia • Postoperative withdrawal protocol if inpatient • Close postoperative monitoring and discharge follow-up • Provide resources for cessation
Benzodiazepines	<ul style="list-style-type: none"> • Benzodiazepine tolerance • Decreased MAC requirement with acute intoxication • Benzodiazepine withdrawal 	<ul style="list-style-type: none"> • Multimodal analgesia • Postoperative withdrawal protocol if inpatient • Close postoperative monitoring and discharge follow-up • Provide resources for cessation

Information based on Beaulieu 2017,⁵⁵ Flannery et al 2019,⁴⁶ Shah et al 2023,⁴⁰ and NIDA NIH.⁵⁴
 Abbreviations: EVALI, e-cigarette or vaping use-associated lung injury; IV, intravenous; MAC, minimum alveolar concentration; MI, myocardial infarction; MOUD, medication for opioid use disorders; OUD, opioid use disorder; PONV, postoperative nausea and vomiting.

be noted that patients who smoke and/or use EVDS may develop nicotine withdrawal in the perioperative period, which can manifest with symptoms similar to opioid or benzodiazepine withdrawal. Nicotine replacement therapy should be considered preemptively. Anesthesiologists should counsel patients and caregivers on these signs and symptoms, including headaches, sweating, restlessness, tremors, digestive issues, irritability, anxiety, and mood swings.³⁹

A key component of successful postoperative pain management is setting realistic expectations during

the preoperative period. It has been reported that between 10% and 36% of adult postsurgical patients expect pain medication to provide full analgesia.²⁵ In a pediatric patient, parental expectations and participation in postoperative pain management are critical to the child’s postoperative experience. In a small survey of parents of presurgical pediatric patients, parents had high expectations of good pain relief and prompt administration of effective analgesia.⁵⁷ The surgeon and anesthesiology care team should set realistic expectations for pain management before the

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operation. There are encouraging data demonstrating that adult surgical patients that received brief preoperative opioid education and pain expectation counseling had significantly reduced postoperative opioid use compared to control with no difference in pain scores.^{25,58} A summary of perioperative recommendations to reduce new PPOU is available in Table 4.

A multidisciplinary approach encompassing the surgeon/proceduralist, anesthesiologist, and pain and/or addiction medicine specialists is optimal. For patients who are on chronic opioids preoperatively, coordination of postoperative transitions of care by engaging the patient’s usual prescriber and follow-up within 30 days of surgery is recommended.^{25,59} Continuity of care and prompt postoperative follow-up with their usual pain medicine prescriber is associated with a reduction in high-risk prescribing practices, such as multiple prescribers, coprescribing of benzodiazepines, high-dose opioid prescriptions, and new long-acting prescriptions.²⁵ Patients with chronic pain or history of SUD should be referred to a specialist to establish care and aid postoperative pain management. For those without established pain medicine providers, specialized services such as transitional pain clinics, if available, should be considered and have demonstrated success with postoperative opioid weaning.^{25,58,60} Weaning of preoperative opioids in adult patients with high morphine equivalent requirements has been associated with worse surgical outcomes—that is, increased risk of infection, poor wound healing, and reduced surgical success.^{25,61–63}

Patients who are opioid tolerant should have their home chronic pain medications continued, including long-acting opioids like methadone and

extended-release opioids. Generally, partial/mixed μ -agonists, such as buprenorphine, butorphanol, and nalbuphine, should be continued throughout the perioperative period^{64,65} (Table 1). Previously, it was advised that patients on preoperative buprenorphine should discontinue their buprenorphine before surgery due to the risk of inadequately controlled pain in the perioperative period. However, a recent recommendation based on a multisociety expert panel now recommends continuing buprenorphine in the perioperative period to reduce the risk of OUD recurrence.⁴ The authors acknowledge that while buprenorphine has a strong affinity for the μ -opioid receptor, there remain free opioid receptors available for binding of full μ -agonists even at standard doses of buprenorphine. While prospective data are lacking regarding analgesia adequacy with concomitant use of buprenorphine and opioids, these recommendations emphasize maximization of nonopioid and non-pharmacological agents in combination with opioids for management of acute postoperative pain. It has been suggested that buprenorphine can be initiated by anesthesiologists and pain medicine physicians in adult patients who are identified to have untreated OUD and acute pain in the perioperative setting as a bridge to further treatment and in an effort to decrease the risk of opioid death and overdose.⁴

Perioperative providers caring for patients receiving medications for OUD should follow the recommendations for management as listed in Table 1. Enteral naltrexone should be held for 72 hours, and the IM form should be held for 30 days before anesthesia.^{25,64} Buprenorphine and methadone should be continued.⁶⁴ During the preoperative evaluation, the

Table 4. Recommendations to Reduce New PPOU

Time period	Recommendation
Preoperative interventions	<ul style="list-style-type: none"> • Set realistic expectations that the goal is return to function, pain that is tolerable, and not zero pain • Educate patients/families regarding opioid and nonopioid management, including the importance of maximizing nonopioid medications • Optimize shared decision-making • Identify high-risk patients early and refer for support and planning • Teach and encourage use of coping skills • Engage pain psychologist, child life, and social worker involvement
Intraoperative interventions	<ul style="list-style-type: none"> • Use multimodal analgesia with nonopioid adjuncts • Optimize regional and neuraxial anesthesia when clinically indicated • Encourage integrative medicine techniques if available • Involve pain psychology, child life, and social work
Postoperative interventions	<ul style="list-style-type: none"> • Reinforce education on opioid and nonopioid options for pain management • Review expected duration of pain and need for analgesics • Create plan to taper opioid and nonopioid medications • Encourage use of behavioral techniques (eg, deep breathing, self-hypnosis, biofeedback, and relaxation exercises) • Integrative medicine where appropriate (eg, acupuncture, acupressure, massage, and aromatherapy) • Arrange close and appropriate follow-up for high-risk patients • Follow opioid prescribing best practices: check PDMP; prescribe naloxone nasal spray if high-dose opioid or opioid + benzodiazepine is prescribed, and advise how to discard opioid medications when done with use • Implement procedure-specific prescribing guidelines for discharge

Abbreviations: PDMP Prescription Drug Monitoring Program; PPOU, persistent postoperative opioid use.

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time of the last dose of μ -opioid receptor medications should be identified so opioid dosing can be adjusted.

Perioperative multimodal analgesia and regional/neuraxial anesthesia should be used to minimize perioperative opioid requirements since patients may have significant opioid tolerance. Caution should be exercised when considering opioid-free anesthetics as evidence of advantages in postoperative outcomes is equivocal.²⁵ Rather, a balanced, opioid-sparing perioperative pain management plan with nonopioid pharmacologic adjuncts is recommended. This may include the use of acetaminophen, nonsteroidal anti-inflammatory medications, low-dose ketamine and lidocaine infusions, gabapentinoids, alpha2-receptor agonists (dexmedetomidine and clonidine), and magnesium.⁶⁴⁻⁶⁶ Comorbid anxiety and depression should be addressed not only by continuing the patient's home medications, but also by providing additional psychological support. If available, Child Life Specialists and pain psychologists are ideal for teaching coping techniques and cognitive-behavioral therapy to pediatric patients.⁶⁷

It is essential that at-risk patients and their guardians are provided clear, detailed discharge instructions for pain management and postoperative follow-up, which should involve close follow-up with their primary prescriber or pain specialist. Such patients require careful surveillance to ensure adequate treatment of their acute postoperative pain while also preventing inadvertent opioid complications or opioid relapse. This is particularly important for patients previously on preoperative long-term naltrexone as these patients are at risk for acute opioid withdrawal if the naltrexone is restarted prematurely, while patients on chronic buprenorphine are at higher risk for postoperative relapse if their buprenorphine is not continued in the perioperative period.^{25,65}

Excessive opioid prescriptions should be avoided, since increased doses and longer duration of postoperative opioid use are strongly associated with PPOU and opioid misuse.²⁵ Quantity of medication dispensed and number of allowed refills should be limited, and opportunities provided for patients to be seen by their physician if pain appears to be excessive, persistent, or require additional opioids.⁶⁶ Prescribing protocols that are procedure-specific and evidence-based have been shown to reduce postdischarge opioid consumption in previously opioid-naïve patients.⁵⁸ Opioid-prescribing guidelines and resources have been developed by various national organizations, including the Society for Pediatric Anesthesia (SPA), CDC, and US Department of Health and Human Services.^{66,68-70} Technological advancements, such as centralized electronic medical records and mobile electronics apps, may facilitate prescription monitoring and postdischarge tracking, allowing for more feasible long-term studies to identify the impact of perioperative preventative measures and modifications in prescribing practices.⁵⁸

The perioperative period is a stress-inducing time for any patient. Patients who misuse substances whether treated or untreated may experience apprehension about navigating postoperative pain while avoiding OUD/SUD recurrence. This critical time of patient care is a window of opportunity to teach patients and families about the risks of nonmedical use of substances and provide resources (Table 5).

CONCLUSIONS

Recreational use of drugs is increasing in children and adolescents. The rise in opioid overdose deaths among adolescents during the COVID-19 pandemic has focused the limelight of the opioid crisis

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Resource name	Media	Description of information	Information
National Institutes of Health (NIH) National Institute on Drug Abuse (NIDA)	NIDA clinical resources website	Website with links to 2 validated screening tools for adolescent substance use disorder	https://nida.nih.gov/nidamed-medical-health-professionals/screening-tools-resources/screening-tools-adolescent-substance-use
NIH NIDA	NIDA clinical resources website	Website with childhood and adolescent specific prevention and education	https://nida.nih.gov/nidamed-medical-health-professionals/screening-tools-prevention
Substance Use Treatment Locator	Locator search website	Database of substance treatment programs	Findtreatment.gov
Substance Abuse and Mental Health Services Administration (SAMHSA)	National helpline phone number	Confidential, 24/7, 365-day-a-year treatment referral and information service for individuals and families	(800) 622-HELP
SAMHSA	Evidence-based practices resource website	Website with links to SAMHSA's advisories, statements, and educational information	https://www.samhsa.gov/resource-search/ebp
National Clinician Consultation Center (NCCC)	Substance abuse warmline telephone number	Clinician to Clinician Advice Center Available: Monday–Friday 9:00 AM–8:00 PM EST	(855) 300-3595
American Academy of Pediatrics (AAP)	Policy website	Website provides a list with hyperlinks to all AAP policies related to child and adolescent substance abuse	https://www.aap.org/en/patient-care/substance-use-and-prevention/aap-policies-related-to-substance-use

on youth and the gaps in care for AYA.⁷¹ While the pandemic catalyzed the telemedicine revolution, allowing greater accessibility to nearly all medical specialties, there are shortcomings in identifying and treating adolescents with SUDs, leaving many youths undiagnosed and without evidence-based treatment. The opioid crisis continues to evolve, with a recent study noting fentanyl as the primary agent in pediatric opioid deaths, with a nearly 3-fold increase in deaths among older adolescents and a nearly 6-fold increase among children <5 years old from 2018 to 2021.⁷¹

Anesthesiologists can play a distinctive role in identifying youth at risk for SUDs and in optimizing the perioperative care of these patients. This may be an opportunity to discuss the risks of recreational drug use and impact lifelong health outcomes. In daily practice, it means performing preoperative screening to identify at-risk patients and counseling patients and families about perioperative pain management expectations. In addition to optimizing the anesthetic plan with a goal to reduce PPOU and non-medical use of opioids, anesthesiologists have the opportunity to educate patients, families, and other clinicians about patient-centered pain management approaches, including multimodal analgesia and nonpharmacologic therapy, in the perioperative period. Anesthesiologists can serve as patient advocates outside of the operating room, stressing the importance of close and consistent follow-up for patients on MOUD so they may safely reestablish treatment for their SUD, manage their pain, and reduce risk of opioid misuse and other SUDs in this critical period. As experts in pain management and pharmacology, anesthesiologists can lead efforts to make a significant impact on a patient's life in a brief preoperative interaction and ameliorate this national crisis. ■■

DISCLOSURES

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