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A Quality Improvement Checklist for the Perioperative Management of Surgical Patients with Opioid Addiction on Buprenorphine

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A Quality Improvement Checklist for the Perioperative Management of Surgical Patients with
Opioid Addiction on Buprenorphine

A DNP Project Presented to the Faculty of the
Nicole Wertheim College of Nursing and Health Sciences

Florida International University

In partial fulfillment of the requirements
For the Degree of Doctor of Nursing Practice

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ABSTRACT

Background: Buprenorphine is a semisynthetic opioid agonist-antagonist that displays antagonism at kappa receptors and partial agonist at mu receptors.¹ Buprenorphine has the unfortunate effect of interfering with the actions of opioids administered for medical indications.² When patients on buprenorphine present for surgery or procedures requiring anesthesia, it can become a substantial challenge.² Currently, there are no guidelines or checklists that would help the anesthetist to provide adequate pain management for the OUD patient population.

Objectives: (1) Understand the perioperative management of patients with opioid addiction on buprenorphine. (2) Demonstrate increased knowledge and confidence in understanding the challenges, pharmacokinetics, and pharmacodynamics of managing a patient on buprenorphine. (3) Discuss and manage perioperative interventions of patients taking buprenorphine with opioid addiction.

Methodology: The primary methodology of the proposed project was to administer an online Zoom educational module to providers that focus on the perioperative management of patients with OUD who take buprenorphine. The project was implemented by conducting an online pre-assessment test, zoom educational module, and a post-assessment test that assessed the anesthesia providers' knowledge about managing a patient with OUD on buprenorphine during the perioperative period. Pre-assessment and post-assessment testing were used to measure the effects of the educational module. Statistical analysis was applied to assess the effectiveness of the educational module.

Results: There was a total of five Certified Registered Nurse Anesthetists (CRNAs) that participated in the quality improvement project. The results reflected an improvement in knowledge based on the pre-test and post-test scores. Knowledge showed an average gain of (25%). In addition, the post-test demonstrated that participants are most likely (n=4, 80%) or somewhat likely (n=2, 20%) to implement a perioperative checklist for surgical patients with opioid addiction taking buprenorphine.

Conclusion: An evidence-based educational module determined an increase in participants' knowledge of managing surgical patients with OUD taking buprenorphine during the perioperative period. There is no consensus on the management of buprenorphine; however, the recommendation is to continue buprenorphine during the perioperative period.

Keywords: buprenorphine or naloxone or buprenorphine/naloxone, drug use or opioid use disorder or opioid abuse, opioid replacement therapy

BACKGROUND

Introduction

Buprenorphine is a semisynthetic opioid agonist-antagonist that displays antagonism at kappa receptors and partial agonist at mu receptors.¹ The peak-and-valley plasma effects seen with shorter-acting opioids are minimized for patients on buprenorphine because of its long half-life.^{1,3} Additionally, the kappa antagonism of buprenorphine minimizes the euphoric and psychotomimetic effects associated with opioid use.³ Buprenorphine has the unfortunate effect of interfering with the actions of opioids administered for medical indications.² When patients on buprenorphine that present for surgery or procedures requiring anesthesia, it can become a substantial challenge.²

Since 2002, buprenorphine has been used for addiction therapy, opioid detoxification, and acute and chronic pain management.² Buprenorphine has exceptional properties that make it a reliable option for treating OUD and pain management. When comparing buprenorphine to a similar drug such as methadone, buprenorphine has a lower risk for respiratory depression, fewer withdrawal symptoms, sedative effects, and a lower risk of toxicity at high doses.²

Buprenorphine is available in two forms: alone with only buprenorphine (Probuphine®, Sublocade™, Bunavail®) and in a mixture with the opioid receptor antagonist naloxone (Suboxone®, Zubsolv®).^{3,4} Suboxone® is a sublingual formulation of buprenorphine and naloxone, a designated treatment for patients with OUD. Buprenorphine also has off-label uses that include management of opioid withdrawal and chronic pain.⁴ Buprenorphine's comprehensive safety profile, and full agonist properties for analgesia have made it increasingly popular for individuals with chronic pain and addiction.² Buprenorphine precludes perioperative issues the anesthetist may encounter when managing pain for the OUD surgical patient.

Buprenorphine has been developed for patients with long-standing pain with OUD.⁵ There is an increasing number of individuals treated for chronic pain and illegal narcotic use, which means anesthesia providers will begin to see more patients prescribed drugs such as buprenorphine. Over three million people are on or have a history of being treated with buprenorphine; this could be challenging for the anesthetist to provide acute pain management in the operating room.⁵ Currently, there are no guidelines or checklists that would help the anesthetist to provide adequate pain management for the OUD patient population.

Consequences of the problem

Patients on buprenorphine are often mismanaged in the operating room. There are no perioperative guidelines or checklists provided to the anesthetist to manage the OUD patient population. If patients with OUD are mismanaged, it can pose a significant risk to long-term health, including the risk of relapsing.⁶ Patients that have a history of OUD or chronic pain frequently have other comorbidities that lead to surgery.⁶ Often, anesthesia providers are unaware of the special considerations necessary when a patient is on buprenorphine; this creates uncertainty in managing the patient's pain intraoperatively.⁶

The goal of managing the OUD patient is to efficiently manage postoperative pain, to improve patient satisfaction, surgical outcomes, and to reduce the cost of healthcare.² Providing effective postoperative pain management increases patient satisfaction, improves patient outcomes, and lowers healthcare costs. The anesthetist is the common denominator in providing care for the patient from the preoperative, intraoperative, and postoperative periods. Therefore, the anesthetist should stay well-informed on how to manage patients on long-term opioid therapy, such as buprenorphine, presenting for surgery. If the anesthesia provider is unaware of

how to manage individuals on buprenorphine, it will decrease patient satisfaction, can cause the patient to relapse, and increase healthcare costs.⁶

Knowledge gaps

The perioperative management of patients on buprenorphine therapy is not precise, and there are no current guidelines or checklists on how to manage patients on buprenorphine.² Currently, understanding the risks versus benefits of continuing or stopping buprenorphine perioperatively is inadequate due to a lack of high-quality evidence.² Many anesthesia providers lack the knowledge and education about how to manage pain on the perioperative surgical setting for patients on buprenorphine.⁶

Often there is a shared misperception about the stopping or continuing buprenorphine during the perioperative period.⁵ Common barriers are due to the confusion about whether or not to continue buprenorphine and need to take the following into consideration, adequate pain control postoperatively, reduce opioid cravings, improvements of overall well-being, and increased engagement in discharge planning.⁵ Amongst anesthesia providers, there is a lack of knowledge required to manage pain in patients on buprenorphine.⁵ A strategic plan must be developed for OUD patients to achieve adequate pain control. The development of guidelines and a preoperative checklist can help the anesthetist create a plan of care for this patient population.

Proposal solution

Formulation of guidelines and a checklist will guide the anesthetist to provide adequate analgesia and anesthesia to patients on buprenorphine.⁶ Clinical practice guidelines (CPGs) and checklists offer a way of bridging the gap between best practice, policy, and the patient's choice. The Institute of Medicine (IOM) defines "CPGs as a statement that includes recommendations

intended to optimize patient care that is informed by systematic reviews of evidence and an assessment of the benefits and harms of alternative care options." ⁶ Providing guidelines to anesthetists on how to care for patients on buprenorphine will help to improve overall outcomes for OUD patients. Guidelines and a checklist will improve the effectiveness and quality of care, decrease cost, and decrease variations in the clinical practice in managing patients on buprenorphine.⁶

The following PICO was formulated: (P) For adult surgical patients on buprenorphine (I) does the use of an evidence based preoperative checklist (C) compared to no checklist (O) increase the CRNA's knowledge and confidence in understanding the challenges, pharmacokinetics and pharmacodynamics of managing patients on buprenorphine?

METHODOLOGY

Information Sources and Search Strategy

A literature search was conducted to identify studies on patients taking buprenorphine and undergoing a surgical procedure. To direct the search and format of the systematic review, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist was used.⁷ The importance of a systemic review relies on what was done, what was discovered, and the clarity of the documentation, as well as the research.⁷ The PRISMA checklist ensures that the systematic review will serve as a useful resource for clinicians.⁷

The search utilized Cochrane Database of Systematic Reviews, Medline (ProQuest), Cumulative Index of Nursing and Allied Health Literature (CINAHL), and PubMed electronic database. A PICO format question was used to help develop the keywords and concepts used to search each electronic database. The search terminology included block terms for (buprenorphine or naloxone or buprenorphine/naloxone), (drug use or opioid use disorder or opioid abuse) (relapse), (opioid replacement therapy), (peri-operative or preoperative or post-operative terms or

surgery). The literature search and screening methodology is outlined in Figure 1 in a PRISMA flow diagram.⁷ As of 22 October 2020, the search was current. The Medline (ProQuest) database yield 113 articles, CINAHL resulted in 142, and the PubMed database revealed 92 results. A total of 347 articles were retrieved from all 3 databases. Duplicates were removed, leaving 172 to be evaluated.

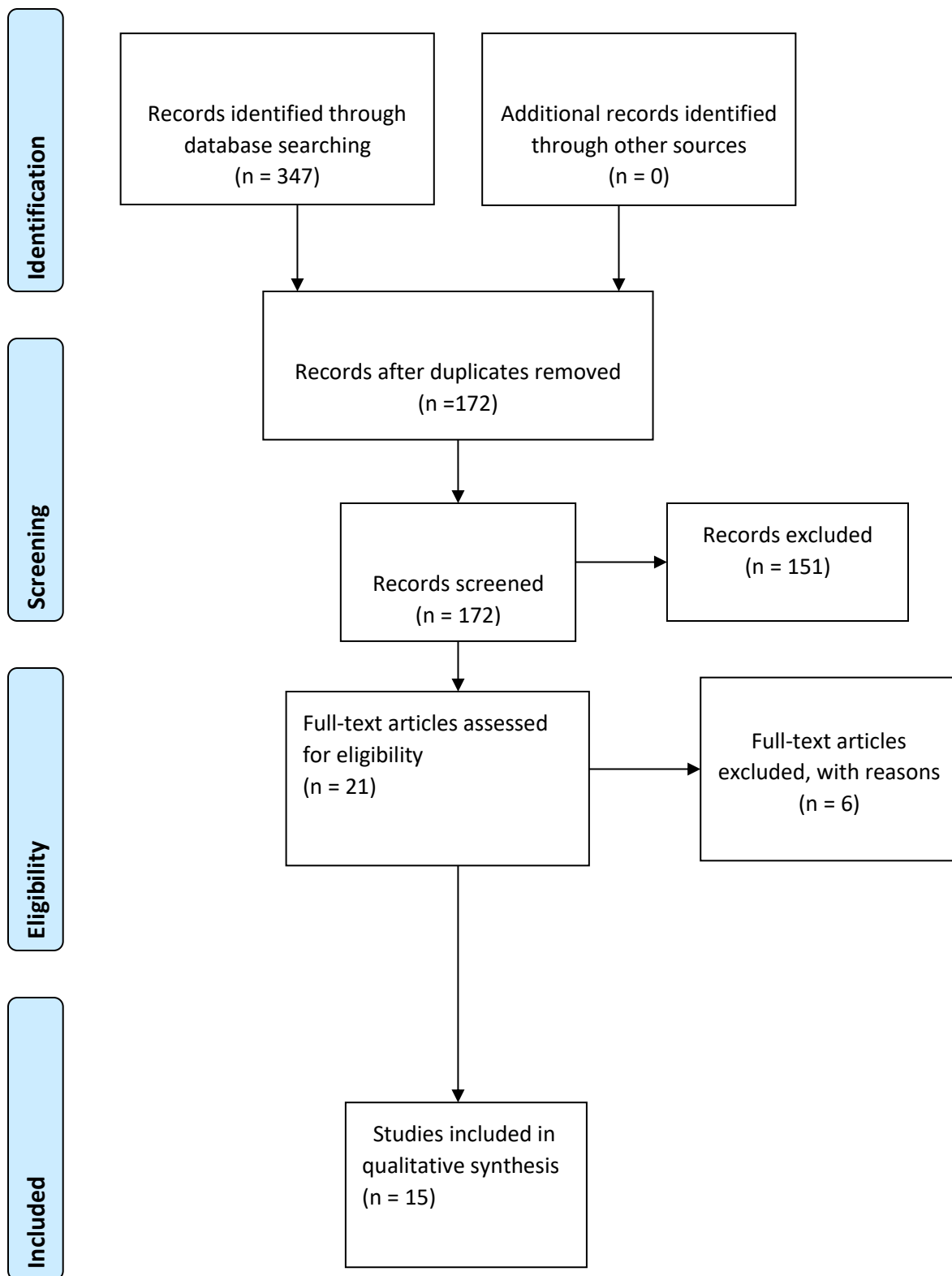


Figure 1. PRISMA Flow Diagram

Study Selection and Screening Method with Inclusion/Exclusion Criteria

The preliminary PICO question was used to determine appropriate article titles and abstracts that were found. The search strategies were not limited by study type and level of evidence. The retrieved citations were imported to Endnote and checked for duplicates. Full-text screening was conducted on the 15 articles that were based on strict inclusion and exclusion criteria.

The inclusion criteria included articles published in English, and articles published 2010 to present day, RCTs, observational studies including case-control studies and cohort studies, as well as case series and CR. The inclusion criteria also included patients taking buprenorphine for chronic pain or OUD. In any case in which buprenorphine was extended after 12 hour postoperatively, it was known to be in the buprenorphine "continuous" group.⁸ Other information on management classifications was obtained where possible, including:

1. Maintenance dosage and buprenorphine preparation
2. Reasons for the pre-operative use of buprenorphine
3. The mode of continuity or discontinuation depends on the author's proposed management technique.

The exclusion criteria included studies where patients were administered buprenorphine exclusively in the intraoperative or postoperative period. For all other inclusion and exclusion criteria, refer to Table 1. OUD for the systemic review was defined as the misuse of prescribed opioid medications or the use of illicitly obtained opioids.⁴ Chronic pain was defined as any pain that lasts longer than three months.⁴

Table 1. Inclusion and Exclusion Criteria

Inclusion	Exclusion
Population: <ul style="list-style-type: none"> • OUD patients taking buprenorphine. • Chronic pain patients taking buprenorphine Intervention <ul style="list-style-type: none"> • All studies involving the peri-operative treatment of patients taking buprenorphine in the preoperative period to manage OUD or pain were included. Outcomes: <ul style="list-style-type: none"> • Qualified effectiveness of either continuing buprenorphine or discontinuing buprenorphine in the peri-operative period and successful pain management. • Pain control and patient-reported outcomes were noted when available. • Long-term follow-up, including information about OUD relapse and chronic pain statistics, were noted when presented. Type of study: <ul style="list-style-type: none"> • observational studies including case-control studies and cohort studies, as well as case series and CR. • RCTs 	Population: <ul style="list-style-type: none"> • Non-OUD patients • Non-surgical patients on buprenorphine Intervention: <ul style="list-style-type: none"> • Any patients receiving buprenorphine only preoperative or postoperative for pain management. Outcomes: <ul style="list-style-type: none"> • Anything other than peri-operative management for patients taking buprenorphine for OUD or chronic pain Type of study: <ul style="list-style-type: none"> • Publication date pre-2010 • Dissertations/theses • Questionnaire • Animal studies

Collection, Analysis, and Data Items

A systematic method was used to extract the selected studies. The selected studies were attentively evaluated using the Johns Hopkins research evidence appraisal tool.⁹ John Hopkins' rating structure includes 5 levels of evidence. Level 1 involves RCTs and systematic review of RCTs with or without meta-analysis.⁹ Due to the lack of high-quality evidence,⁹ only two RCT (Level 1) was included within the quality improvement project. Level 2 includes quasi-experimental studies.⁹ Level 3 are nonexperimental studies and systematic reviews of a combination of RCTs and quasi-experimental studies.⁹ Level 4 involves the opinions of respected authorities and nationally recognized experts of scientific evidence.⁹ Level 5 includes case reports, clinician experience, and literature reviews.⁹ John Hopkins also describes each

evidence level as high, good, or low quality of evidence. 'High' quality consists of data that is reliable, widespread, enough control, appropriate sample size for the form of analysis, and definitive findings.⁹ If it has relatively precise results with a reasonable sample size, some monitoring, and definite conclusions, an article gets a 'good' ranking.⁹ A 'poor' standard ranking has no evidence with findings that are not accurate, insufficient sample size for the analysis, and a conclusion that cannot be drawn.⁹

An evaluation table was made to summarize and categorize each study's characteristics; refer to table 2. Each study was assigned a ranking based on the John Hopkins research evaluation tool. The information obtained and evaluated from each article included: (1) study type and sample size, (2) whether or not buprenorphine was continued or discontinued in the peri-operative phase, (3) analgesic success, (4) success of deterrence against opioid abuse, and (5) if guidelines were provided. The evaluation table's headers included the author and date, the details collected, and the ratings based on the Johns Hopkins Research Evidence evaluation tool.⁹

Table 2. Summary of RCT, Observational Studies, and Case Reports

Author (Year) & Level of Evidence	Indications for Buprenorphine use	Study type/ Sample size	Was buprenorphine continued perioperatively or discontinued	Analgesia success	Success of deterrence against opioid abuse	Guidelines provided
Anderson <i>et al.</i> (2018) Level 1 Quality B	Chronic pain or OUD	Systematic review	Both options were observed.	Pain was well controlled in patients who continued buprenorphine perioperatively. Poorly controlled in patients who discontinued buprenorphine perioperatively.	Non-reported	Suggested that guidelines would improve management of patients taking buprenorphine.

<p>Jonan <i>et al.</i> (2018)</p> <p>Level 4 Quality A</p>	<p>Chronic pain or OUD</p>		<p>Recommendations for preoperative management of buprenorphine was based on urgency and type of surgical procedure.</p>	<p>Poorly controlled pain</p>	<p>High risk of a relapse if buprenorphine is held for an extended period prior to the procedure .</p>	<p>Yes</p>
<p>Chern <i>et al.</i> (2013)</p> <p>Level 5 Quality A</p>	<p>Chronic pain</p>	<p>Vaginal mesh removal and cystoscopy X2</p> <p>Sample Size: 1</p>	<p>Both methods were conducted,</p>	<p>Buprenorphine was discontinued five days before surgery and the patient was switched to hydromorphone 4 mg PO q4-6 hours. The patient experience "unbearable" pain 8/10.</p> <p>Patient experience poorly controlled pain when buprenorphine was continued perioperatively.</p>	<p>Non-reported</p>	<p>Yes</p>
<p>Hansen <i>et al.</i> (2016)</p> <p>Level 3 Quality B</p>	<p>Study group (patients with a history of OUD) compared to a control group (patients</p>	<p>Total hip (n = 8) and knee (n = 9) arthroplasty, continuing Buprenorphine /naloxone</p>	<p>Buprenorphine/naloxone was continued in the patients with a history of OUD.</p>	<p>There was no significant difference in pain scores between groups studied</p>	<p>Relapse rate of heroin addiction has been shown up to 50%.</p>	<p>No</p>

	without a history of OUD)					
Anderson et al. (2017) Level 3 Quality A	Chronic pain or OUD		Elective versus urgent/emergent surgery determined if buprenorphine was continued or discontinued perioperatively.	Pain control was adequate when comparing management of patients on Buprenorphine for elective versus urgent/emergent surgery	Suggests abrupt discontinuation of buprenorphine in highly stressful preoperative period increases risk for relapsing	Yes (refer to figures 1 and 2)
Kornfeld et al. (2010) Level 5 Quality A	Chronic pain or OUD	Five patients who underwent seven major surgical procedures including colectomy, total knee replacement, small bowel resection and mastectomy.	There were no interruptions of daily buprenorphine therapy.	All had successful analgesia reported.	Non-reported	No, however, emphasized the need for perioperative guidelines.
Macintyre et al. (2013) Level 4 Quality B	OUD	22 patients, Any surgery, taking buprenorphine or methadone.	Partial: buprenorphine continued POD 0 in 14/22 patients (64%) and POD 1 in 11/22 patients (50%).	Well controlled pain, no significant differences between groups or between continuation	Non-reported	No, suggested continuing buprenorphine perioperatively

				without stopping.		
Quaye <i>et al.</i> (2020) Level 2 Quality B	OUD	55 patients, who had surgery from March-October 2018. Minor procedures such as colonoscopies and endoscopies were excluded.	Partial: 38 continued buprenorphine versus 17 held buprenorphine	The number of opioid prescriptions dispensed was significantly higher with buprenorphine discontinuation. PACU pain scores were higher with buprenorphine discontinuation.	Non-reported	No, suggest continuing buprenorphine perioperatively
Hassamal <i>et al.</i> (2017) Level 5 Quality A	OUD	Tricuspid and Aortic valve repair Sample Size: 1	Discontinued and restarted postoperatively; timing of change was not reported.	Well controlled pain	Six months after surgery refrained from opioids	No
Huang <i>et al.</i> (2014) Level 5 Quality B	Chronic pain	Clagett window closure Sample size: 1	Continued buprenorphine by 50% postoperatively, with subsequent tapering to 0 mg before discharge.	Pain was poorly controlled; Improved after postoperative decrease	Abstained from opioids at three week follow-up	No
Martine <i>et al.</i> (2019) Level 5 Quality A	OUD	Various surgeries and type of anesthesia included in the study. Sample size: 32	19 patients continued sublingual-buprenorphine, 13 discontinued sublingual-buprenorphine 1 to 30 days before surgery.	patients who received long-term treatment with sublingual-buprenorphine had high opioid requirements through POD1, regardless of type of anesthesia used or whether sublingual-buprenorphine was	The use of opioids increased substantially after discharge from the PACU, and by 24 hours after PACU discharge, no	No

				preoperatively continued or discontinued.	differences in opioid requirements were noted between patients who underwent surgical procedures with general anesthesia only versus combined general/regional anesthesia.	
Goul <i>et al.</i> (2019) Level 4 Quality A	Chronic pain or OUD		Recommendations to continue buprenorphine in the peri-operative period.			Yes, several guidelines from difference authors were included in the article.
Hoflich <i>et al.</i> (2012) Level 2 Quality B	OUD	37 + 80 controls; (three females had a second child and switched to the opposite group, totaling 40 cases)	Continued perioperatively	Non-released	Non-released	No
Scholzen <i>et al.</i> (2019) Level 5 Quality B	OUD or Chronic Pain		Continue perioperatively for minor elective surgeries.	Pain well controlled.	Non-released	Suggests will improve pain management for patients on Buprenorphine.

			Discontinue buprenorphine postoperatively for emergent surgery.			
Meyer <i>et al.</i> (2010) Level 2 Quality B	OUD	Vaginal (n = 44) and Cesarean (n = 19) delivery taking buprenorphine	Continued perioperatively	Pain was well controlled, Significantly higher pain scores in study group versus controls postpartum	Non-released	No
Li <i>et al.</i> (2020) Retrospective Cohort Study		50 trial patients	Compared continued, tapered, and discontinued	Results determined continue buprenorphine in the perioperative period whenever possible	Non-released	No
Fiellin <i>et al.</i> (2014) RCT	OUD	113 patient who were studied over an 18 week period	The study consisted of introduction and maintenance of buprenorphine therapy for patients with OUD		Patients in the taper group reported more days per week of illicit opioid use than those in the maintenance group once they were no longer receiving buprenorphine.	No: The RCT did not consider surgical patients on buprenorphine, however, the findings concluded that tapering is less efficacious than ongoing maintenance treatment in patients with OUD who receive buprenorphine therapy.

RESULTS

Analgesia Success

Chern et al conducted a case report in 2013 on a 37-year-old woman, ASA II, 170 cm, 88 kg, with chronic pelvic pain on buprenorphine, 8 mg sublingual every 8 hours, lorazepam 1 mg every 6 hours, and zolpidem 10 mg at bedtime.¹⁰ The patient underwent two separate surgeries to remove a vaginal mesh with two different pain management regimens who was on buprenorphine for chronic pain management.¹⁰ For the first surgery, the patient continued buprenorphine at 8 mg sublingual every 8 hours. A full opioid receptor agonist was used to control postoperative pain. However, during the postoperative phase, the patient complained of inadequate pain management. Buprenorphine was switched to a full opioid agonist five days before the second surgery. Postoperative pain was managed with full opioid receptor agonists. Despite significantly elevated doses of opioids, the patient again reported suboptimal pain management. The patient was in severe pain in the postoperative period when buprenorphine was continued during the perioperative period. When the patient withheld buprenorphine 5 days prior to the second surgery, the patient reported suboptimal pain control in the postoperative period. The case study highlights the challenge of pain control in perioperative patients on chronic buprenorphine and emphasizes the need for additional investigation.

Li et al conducted a retrospective cohort study of surgical patients on buprenorphine whose baseline dose had been preoperatively continued, tapered, or discontinued.¹¹ The sample size included 1200 patients on buprenorphine; out of the 1200 patients, 121 had surgery. A total of 50 were admitted and included in the study. Charts of patients on buprenorphine were reviewed who had received elective surgery at Stanford Healthcare from January 1, 2013, to June 30, 2016.¹¹ Out of 50 trial patients 21, 42 percent, were on transdermal buprenorphine, 13

patients were continued on the baseline buprenorphine dosage, seven were discontinued, and one was tapered. In the remaining 29 patients, 58 percent, on an SL buprenorphine, 15 patients had their dose continued, six patients had their dose tapered, and eight patients had their dose discontinued.¹¹ The primary outcome of interest was the change in pain score, defined as mean postoperative pain score and preoperative pain score.¹¹ The continuity of transdermal buprenorphine during periodical procedures resulted in comparatively smaller post-operative improvements in pain score, 0.606 ± 0.878 , relative to discontinuation, 4.83 ± 1.23 , $P=0.012$.¹¹ In patients taking SL buprenorphine, there was no statistically significant difference in the change in pain score between those who were tapered to a nonzero dose versus discontinued, $P=0.55$.¹¹ The continuation of SL buprenorphine resulted in fewer non-buprenorphine scheduled opioid prescriptions than its taper or discontinuation, $P=0.028$.¹¹ As pain is a subjective experience, the primary outcome measured were the change in pain score per patient via the self-reported numerical pain rating scale of a score from zero to ten.¹¹ The preoperative score was collected on the day of the procedure in the preoperative area whereas postoperative scores were collected every 4 to 6 hours up to 24 hours after the procedure as a part of the vital sign checks for medication administration.¹¹ In conclusion, postoperative pain scores were improved in patients whose transdermal buprenorphine had been continued perioperatively and lower morphine milligram equivalents (MME) in scheduled opioid prescriptions for patients whose SL buprenorphine had been continued perioperatively.¹¹

Fiellin et al conducted a single site, RCT, from February 2009 through February 2013. The RCT included 113 patients who were studied over 18 weeks.¹² The study consisted of introducing and maintaining buprenorphine therapy for patients with OUD. Of the 113 patients who were randomized to the taper, $n= 57$, and maintenance, $n= 56$.¹² Patients in the taper group

reported more days per week of illicit opioid use than those in the maintenance group once they were no longer receiving buprenorphine. Patients in the taper group were less likely to complete the trial, $P < .001$.¹² Sixteen patients in the taper group reinitiated buprenorphine treatment after the taper owing to relapse. The RCT did not consider surgical patients on buprenorphine. However, the findings concluded that tapering is less productive than ongoing maintenance treatment in patients with OUD who receive buprenorphine therapy.

Hansen et al conducted a prospective matched cohort study in 2016 to compare clinical outcomes of patients undergoing elective total knee arthroplasty (TJA) while being treated with buprenorphine for OUD versus patients without OUD.¹³ Data collected was from electronic medical records. Perioperative data were retrospectively obtained from patient charts.¹³ Postoperative functional outcomes were prospectively collected at follow-up visits. The study group included 17 TJA patients, eight underwent total hip arthroplasty, and nine underwent total knee arthroplasty. Seventeen of the study group patients took buprenorphine, and 35 matched controls were identified.¹³ A change in morphine dosing at the time of discharge decreased in the study group, -203.5, and increased in the control group, 84.3.¹³ The study showed statistically significantly higher amounts of MME and referrals to the inpatient acute pain service in the buprenorphine/naloxone therapy patients than matched controls.¹³ Nine patients in the study group were referred to the pain service for stubborn pain compared to one patient in the control group, $P < .05$.¹³ Study group patients received an MME dose of opioids that were roughly 8-fold higher than that of the control group patients.¹³ Study group patients were prescribed 793 MME on narcotics per 24-hour period, range, 120-1920, compared with 109 MME, range, 45-210 in the control group, $P = 1.4 \times 10^{-9}$.¹³ There were no significant differences in mean pain, 87.6 for the study group versus 84.4 for controls. There was no significant difference in pain scores

observed at one year, 2.8 for the study group versus 2.1 for controls.¹³ Overall, patients who used buprenorphine/naloxone preoperatively and underwent a TJA had similar clinical experiences to the control group concerning the length of stay, functional outcomes, and complications.¹³

Macintyre et al performed a retrospective cohort study including data collected from 51 patients. Out of the 51 patients, 29 were taking methadone and 22 buprenorphine.¹⁴ The study showed no difference in patient-controlled analgesia (PCA) morphine equivalents or pain scores when comparing perioperative continuation versus cessation of buprenorphine.¹⁴ There was no significant difference in days requiring acute pain service or PCA. The study showed higher sedation rates in buprenorphine continued patients, but this did not correlate with lower respiratory rates. However, the continuation of buprenorphine in this study was inconsistent with 14 out of 22 continuing on the day of surgery and 11 out of 22 continuing on post-operative day (POD) one.¹⁴ Patients on buprenorphine who were not given buprenorphine the day after surgery had significantly higher, $P=0.02$, PCA requirements in the first 24 hours after surgery, compared with those who were given the usual dose.¹⁴ The study concluded that PCA opioid requirements were less in patients who continued buprenorphine perioperatively than those whose regular dose of buprenorphine was discontinued.¹⁴ Therefore, the study suggested buprenorphine should not be withheld in patients undergoing surgery. The administration of buprenorphine reduces the amount of PCA opioids required in order to achieve the same degree of pain relief.

A retrospective observational study was performed by Quaye et al on surgical patients taking buprenorphine from March 2018 to October 2018. Emergency cases and minor procedures, such as endoscopies and colonoscopies, were excluded from the analysis.¹⁵ Postoperative outpatient opioid dispensing and post-anesthesia care unit (PACU) pain scores were compared in patients where buprenorphine was continued or held perioperatively.¹⁵ The

study included 55 patients, 38 continued buprenorphine versus 17 held buprenorphine. There was no difference in postoperative buprenorphine treatment adherence, 91% continued versus 88% held, $P=0.324$.¹⁵ The number of opioid prescriptions dispensed was significantly higher with buprenorphine discontinuation, 53% continued versus 82% held, $P < 0.011$, as was MME dispensed, mean of 229 continued versus mean of 521 held, $P < 0.033$.¹⁵ PACU pain scores were higher with buprenorphine discontinuation, mean 2.9 continued versus mean 7.6 held, $P < 0.001$.¹⁵ Patients who continued buprenorphine had a significant reduction in opioid prescriptions filled and PACU pain scores in patients than patients who held buprenorphine perioperatively.¹⁵ Evidence was provided to support that buprenorphine can be continued perioperatively and that continuation is associated with decreased postoperative pain and decreased outpatient opioid dispensing.¹⁵ The results contribute to the existing literature supporting the perioperative continuation of buprenorphine.¹⁵

An RCT conducted by Höflich et al in 2011 compared parturient patients on buprenorphine or methadone.¹⁶ The RCT included 40 pregnancies of 37 with OUD. These patients participated in the Maternal Opioid Treatment: Human Experimental Research (MOTHER) study.¹⁶ The retrospective investigation used data collected as part of the MOTHER trial, focused on associated analgesic medication, including buprenorphine, administered during and after delivery.¹⁶ The comparison group included 80 nonopioid dependent women delivered in the same period as the opioid-dependent females. Participants were randomized to one of two treatment groups, buprenorphine or methadone.¹⁶ Levels of the double-blind, double-dummy medication were adjusted as required with a maximum level of 32 mg buprenorphine and 140 mg methadone.¹⁶ Following cesarean section opioid maintained women received significantly less opioid analgesics, day 0: $P = 0.038$; day 1: $P = 0.020$; however, on day 3 a trend toward a

significant difference in the frequency of non-steroidal anti-inflammatory drug (NSAID) application was revealed, $P= 0.089$.¹⁶ The study also showed that the rates of Cesarean delivery were higher in methadone continued patients 68.4%, than buprenorphine continued patients 31.8%, although this result was not statistically significant. Pain scores and relapse rates were not reported.¹⁶

Martin et al conducted a case series on adult surgical patients from December 31, 2004, to January 1, 2016, who received SL-buprenorphine within 30 days before procedures performed with general, regional, or combined general/regional anesthesia.¹ Opioid use during the procedure was recorded in the PACU and during the 24 hours following PACU discharge.¹ Opioid use was examined in those who continued SL-buprenorphine until the day of surgery compared to those who preoperatively discontinued SL-buprenorphine.¹ The sample size included thirty-two patients who underwent surgery while being treated with SL-buprenorphine.¹ Three patients had regional anesthesia only, and opioid requirements were case dependent.¹ Requirements were minimal for creation of an arteriovenous fistula and high following knee replacement and cesarean section.¹ Twelve patients received combined general and regional anesthesia, and 17 received general anesthesia only. Intraoperative and PACU opioid use in these 2 groups were not significantly different, $P = .10$ and $P = .93$, respectively.¹ Opioid requirements were analyzed by using log transformation and compared groups with the 2-sample t-test.¹ All tests were 2-sided, and $P < .05$ was considered significant. Analyses were performed with statistical software.¹ The main finding was that patients who received long-term treatment with SL-buprenorphine had high opioid requirements through POD1, regardless of the type of anesthesia used or whether SL-buprenorphine was preoperatively continued or discontinued.¹ In both groups opioid use increased after discharge from the PACU, and remained

comparable between the general and combined general and regional group through the first 24 h after PACU discharge, $P = .78$.¹ Although median 24 hour opioid doses were higher among patients who discontinued SL- buprenorphine, the difference was not statistically significant in the general anesthesia.¹ Regardless of the type of anesthesia used, physicians treating patients with SL-buprenorphine must be prepared to administer large doses of opioids during the early postoperative period.¹ No difference in opioid requirements was noted between patients who perioperatively stopped SL-buprenorphine versus those who continued SL-buprenorphine.¹

Kornfeld et al conducted a case series extracted from hospital and clinic charts with patient consents in 2010. The case series included five patients who underwent seven major surgical procedures, including colectomy, total knee replacement, small bowel resection, and mastectomy.¹⁷ The case series included a 60-year-old male diagnosed with a hepatic flexure carcinoma who underwent a right colectomy and cholecystectomy; due to obesity, the patient experienced prolonged intubation.¹⁷ Postoperative analgesia included an epidural containing morphine and an IV PCA, containing morphine, with doses at the high end of 27 mg/day gradually reduced to 6 mg/day before discharge.¹⁷ The patient's dose of sublingual buprenorphine was increased to 32 mg/day during the hospitalization.¹⁷ After being extubated, the patient reported that pain was well controlled throughout the remainder of the hospitalization. The patient was discharged on the increased dose of buprenorphine.

The case series included a 43-year-old male who underwent a right total knee replacement. Postoperative analgesia was provided by epidural morphine and bupivacaine, IV and oral hydromorphone, ketamine, sustained-release, and immediate-release oxycodone, and sublingual buprenorphine. The epidural morphine was limited to a single dose of 0.2 mg, given in the recovery room, and epidural bupivacaine was maintained for 48 hours. IV hydromorphone

was provided on POD 1 to 3 at an average dose of less than 1 mg/hour.¹⁷ Oral hydromorphone and oxycodone were introduced on POD 2 and 3, sublingual buprenorphine was continued during the hospital stay, and the patient was discharged on 16 mg of buprenorphine and on oral hydromorphone for breakthrough pain.¹⁷ Throughout the hospital stay, the pain and orthopedic services reported excellent analgesia.

The same patient, 2 years later, underwent a left total knee replacement. The patient postoperative pain management included epidural opioids and bupivacaine, IV and oral opioids, and IV and oral ketamine. Epidural hydromorphone averaged 7 mg per day for the first 2 days, after which the epidural was discontinued. Epidural bupivacaine was also given during this timeframe, and additional epidural fentanyl was given as a PCA, averaging 70 mg/day.¹⁷ On the day of surgery, the patient received 5 mg IV morphine. After the epidural was discontinued, oral opioids, both short and long-acting, were provided at low dosages. Ketamine was given IV both intra-operatively and later on surgery and was continued orally during POD 1 to 3 before discharge.¹⁷ Pain was well managed with this regimen. In this case, SL-buprenorphine was not given during this brief hospitalization but was restarted without difficulty at discharge at the preoperative dose.

The case series included a 60-year-old male who was admitted for surgery with a small bowel stricture with a peritoneal mass. A malignancy was removed.¹⁷ The surgery was uneventful. The pain was easily managed in the recovery room and throughout the postoperative period with uniformly favorable pain ratings on POD 1 to 4. Full agonist opioids were used without difficulty at conventional doses. For example, fentanyl 150 mg was given intraoperatively, and hydromorphone 1 mg was used in the recovery room. An epidural catheter delivered bupivacaine and hydromorphone until POD 3, and an average of 0.2mg per hour of

epidural hydromorphone was infused. PCA IV hydromorphone was also used through POD 4 and averaged between 5 and 10 mg per day. Parenteral buprenorphine was restarted on POD 3 without difficulty, and the patient was discharged on sublingual buprenorphine at his preoperative dose.¹⁷

The case series included a 42-year-old female diagnosed with ductal carcinoma in situ of the breast underwent bilateral subcutaneous mastectomy with reconstruction and implantation of tissue expanders. The patient was maintained on 2 mg of sublingual buprenorphine throughout the hospitalization. Postoperatively, the patient had an IV PCA containing hydromorphone averaging 26 mg/day, discontinued on POD 2.¹⁷ The patient required both substantial doses of oral hydromorphone and additional IV hydromorphone on POD 2. Pain scores were higher in this case but responded well to the hydromorphone. The patient was discharged on SL-buprenorphine at the preoperative dose and on oral hydromorphone for breakthrough pain. The same patient, 8 months later, underwent removal of bilateral tissue expanders with subsequent placement of implants. The patient received 350 mg fentanyl intraoperatively. On the day of surgery, the patient received 4 mg of sublingual buprenorphine, 5.4 mg of IV hydromorphone, and 16 mg of oral hydromorphone. The pain was well controlled.¹⁷ Before discharge midday on POD 1, the patient received 6 mg of hydromorphone orally and 2 mg buprenorphine sublingually. The patient was discharged on the day after surgery. The patient was discharged on SL-buprenorphine at the preoperative dose and on oral hydromorphone for breakthrough pain.

The case series included a 58-year-old male with a significant history of back pain and chronic pain syndrome, underwent surgical removal of two X-Stop spacer devices from his lumbar spine, inserted two years previously.¹⁷ The current procedure also involved lumbar decompression at two levels. Intra-operatively, the patient received 600 mg of fentanyl, and in

the recovery room, he received an additional 200 mg of fentanyl IV and 4 mg of IV hydromorphone. On POD 1, the patient received 28 mg of oral hydromorphone and was discharged on the morning of POD 2 with a reduced need for hydromorphone for breakthrough pain on his preoperative dose of sublingual buprenorphine. Reported pain control was excellent, and he progressed to physical therapy.¹⁷

In conclusion, all five patients were stabilized on SL-buprenorphine for at least one year before any significant surgeries. Of the five patients and seven major surgeries, there were no significant adverse effects, and all had successful analgesia reported. Intraoperative medication reported were opioids, ketamine, and buprenorphine. All patients underwent surgery without interruption of buprenorphine therapy. The case series supported the practice of maintaining stable buprenorphine dosing for patients who require major surgery. Patients taking buprenorphine, 2-24 mg/day, reported good postoperative pain was obtained by using full agonist opioids.¹⁷

Perioperative management of Patients using Buprenorphine

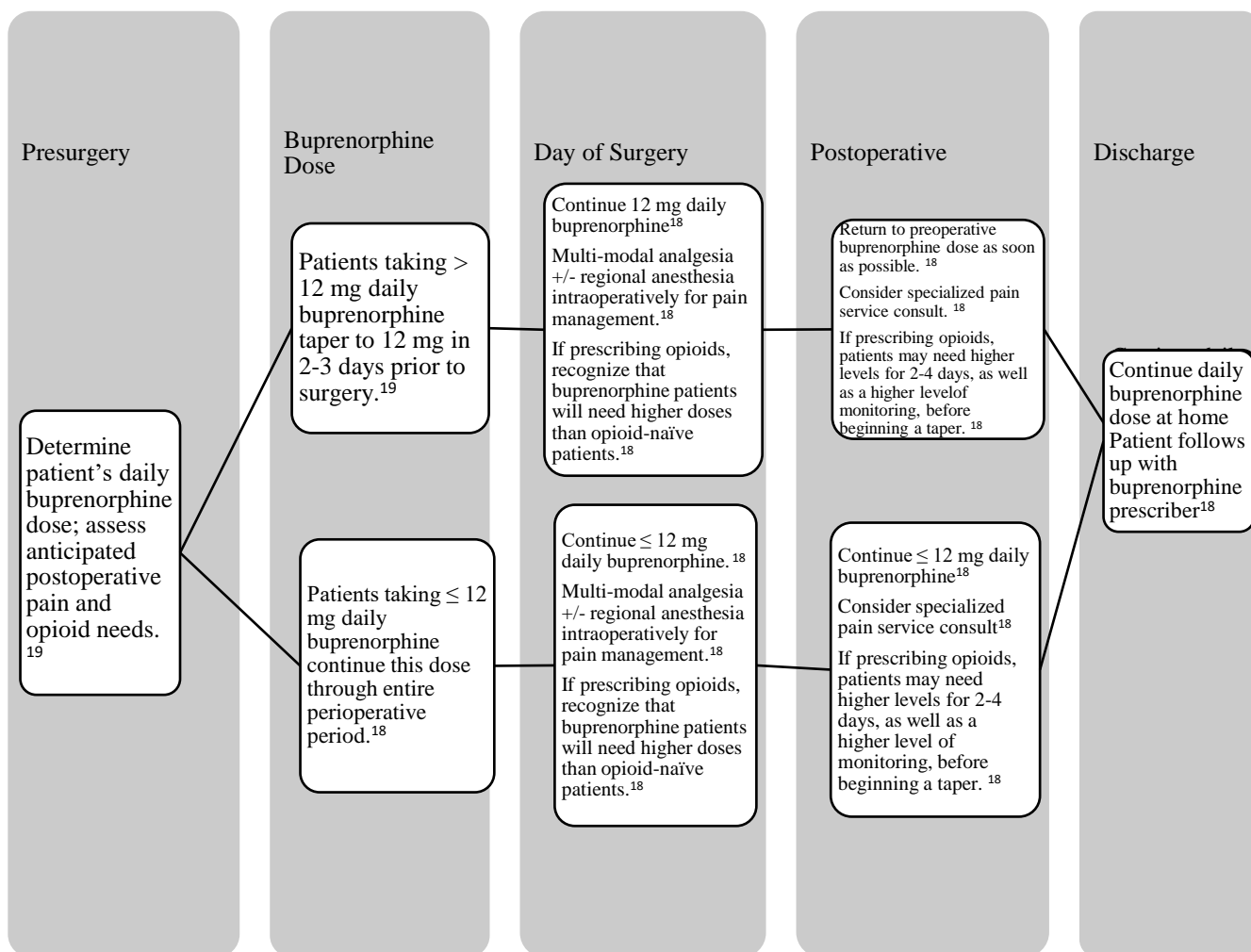
Goel et al conducted an expert consensus Delphi-based survey in 2019. The Delphi based survey technique included the following criteria: specifying the need for perioperative guidelines for patients on buprenorphine and offer a set of recommendations for the perioperative management of patients taking buprenorphine⁸. Goel et al developed a clinical practice advisory 22-step checklist recommended by the essential reporting items for practice guidelines in the healthcare (RIGHT) group.⁸ The practice advisory's principal recommendation is to continue buprenorphine therapy in the perioperative period. Rarely the dose of buprenorphine is reduced regardless of indication or formulation.⁸ If analgesia is inadequate after optimizing adjunct analgesic therapies, the article recommends initiating a full mu agonist while continuing the

same buprenorphine dose.⁸ A systematic review of preoperative buprenorphine management concluded that more evidence is required.⁸ There are multiple case reports and observational studies. However, there is a lack of high-quality evidence in buprenorphine-maintained patients using increased doses of opioids.

Lembke et al wrote an editorial in 2019 which looked at maintaining buprenorphine through the perioperative period in patients being treated for OUD. Maintain buprenorphine in patients with OUD avoids that risk of relapse and unwarranted burden on the health care system and promotes safety, adherence, and continuity of care. Lembke et al viewed discontinuing buprenorphine before surgery in patients with opioid use disorder introduces unnecessary risk for four reasons. One of the risks expressed that buprenorphine discontinuation introduces a surgical delay to allow adequate time to taper, require more clinic visits and care coordination between multiple providers, and burden patients with additional preoperative instructions and tasks.¹⁸ The second risk explained that after surgery, re-introduction of buprenorphine would be physically painful and medically destabilizing for patients because the patient then undergoes an active period of opioid withdrawal before buprenorphine can be restarted.¹⁸ The third risk described that re-starting buprenorphine, particularly in the outpatient setting, is logistically complicated. The patient is at risk for potentially discontinuing care, especially when multiple prescribers are involved.¹⁸ The last risk explained that patients on buprenorphine for OUD are at increased risk of relapse to opioid misuse and accidental overdose when buprenorphine is discontinued. The patient may experience an opioid deficit while simultaneously gaining access to a new supply of full-opioid agonists.¹⁸ Lembke et al suggest that patients taking 12mg or less of buprenorphine daily maintain this dose unchanged, and patients on higher daily doses of buprenorphine (more than 12 mg) taper to 12mg two to three days before surgery.¹⁸ The recommendation to taper

patients, when possible, down to 12mg buprenorphine is based on studies of receptor occupancy and clinical experience.¹⁸

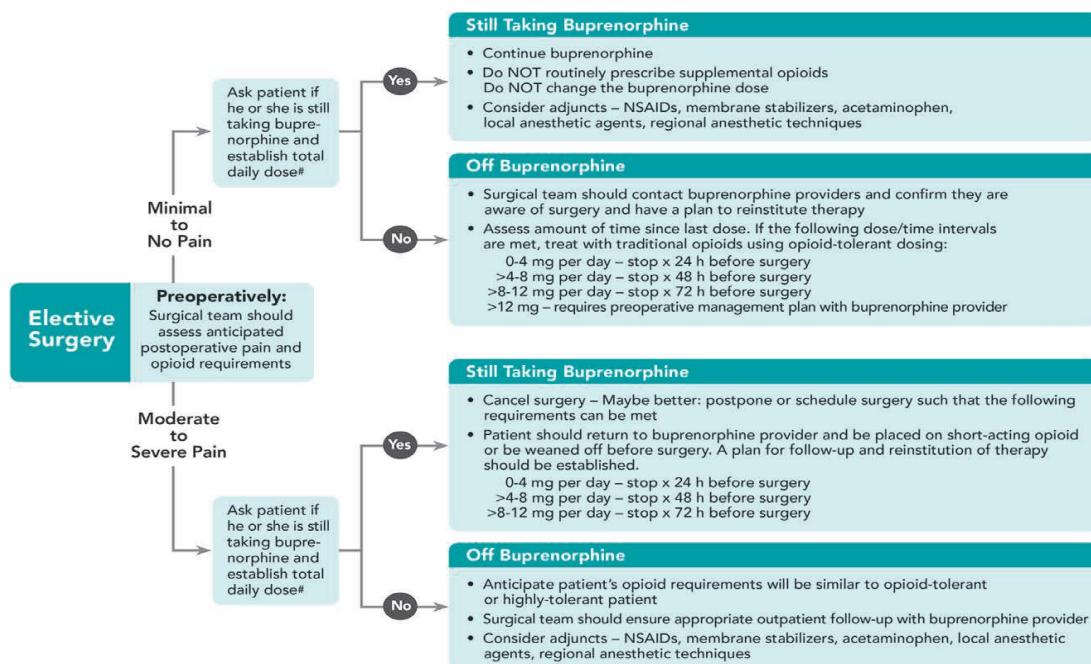
Figure 2. Lembke Guidelines for Surgical Patients Taking Buprenorphine.¹⁸



Anderson et al conducted an observational study that included a review of case reports.⁴ Perioperative guidelines for surgical patients taking buprenorphine were developed in the study. Anderson et al included the University of Michigan Health System protocol that is based on clinical experience, published reports, and pharmacology. The protocol is intended to give the patients, surgeons, nurses, and anesthetist guidance and expectations.⁴ Perioperatively, nonopioid

analgesic strategies should be maximized. Inadequate pain management in patients taking buprenorphine can lead to significant postoperative pain and prolong hospital stay. The authors concluded that buprenorphine could be continued perioperatively, and co-administered opioid agonists can efficiently treat acute pain.⁴ Below in figure 3 are the guidelines Anderson et al published.

Figure 3. Anderson Guidelines for Managing Patients Taking buprenorphine.⁴



Scholzen et al outlined the options for perioperative management of patients taking buprenorphine with OUD in 2019.¹⁹ Scholzen et al concluded that patients undergoing surgical procedures expected to result in minimal postoperative pain are treated with the continuation of buprenorphine therapy.¹⁹ For elective surgical procedures expected to result in moderate to severe postoperative pain, the protocol suggests transitioning buprenorphine therapy to a short-acting full opioid agonist.¹⁹ When patients consuming buprenorphine present for emergent surgery, the buprenorphine should be discontinued after surgery, and a multimodal regimen should be implemented. Medication-assisted treatment (MAT) has emerged as an option to

decrease the incidence of OUD and relapse prevention.¹⁹ MAT includes the administration of medications such as buprenorphine. Scholzen developed a table that had the pharmacological approach to perioperative management of the patients with MAT for OUD who are taking buprenorphine.

Table 3. Scholzen Pharmacologic Management of Patients with OUD.¹⁹

Preoperative	Intraoperative	Postoperative
<ul style="list-style-type: none"> • Acetaminophen PO • NSAIDs PO • Gabapentinoids • Regional anesthesia 	<ul style="list-style-type: none"> • Acetaminophen IV • NSAIDs IV • Ketamine • Magnesium • Alpha-2 agonist • Lidocaine • Dexamethasone • Esmolol • Regional anesthesia • Opioids 	<ul style="list-style-type: none"> • Acetaminophen PO/IV • NSAIDs PO/IV • Gabapentinoids • Ketamine • Lidocaine • Alpha-2 agonist • Capsaicin • Opioids PO/IV/PCA

Meyer et al conducted a case study that included sixty-three women treated with buprenorphine for OUD.²⁰ The patients were followed during the intrapartum and postpartum period to determine pain differences in patients who do not take buprenorphine. Out of the sixty-three patients, 44 had a vaginal birth and 19 had a cesarean; the patients were matched to control women.²⁰ Analgesic medication and pain scores on a scale from 0 to 10 were extracted from the medical record.²⁰ Women maintained on buprenorphine during pregnancy required 50% more opioid analgesic medication following cesarean delivery compared to control women.²⁰ Opioid use following vaginal birth was modest in both groups. Pain scores were consistently higher for women maintained on buprenorphine following delivery from either route. During labor, women

who continued buprenorphine had significant pain relief following regional analgesia initiation.²⁰ Pain scores following vaginal birth were elevated in women maintained on buprenorphine, with no difference in the amount or frequency of opioid use, $P = 0.45$. Following cesarean delivery, women maintained on buprenorphine had higher postoperative pain scores and required a 47% increase in opioid utilization. There were no differences in intrapartum pain or analgesia. Following vaginal birth, buprenorphine maintained women had increased pain, $P = 0.006$, but no increase in opioid utilization $P = 0.10$.²⁰ Following cesarean delivery both pain, $P = 0.009$, and opioid utilization, $P = 0.004$, were increased.²⁰ Buprenorphine maintained women have similar intrapartum pain and analgesic needs during labor but experience more postpartum pain and require 47% more opioid analgesic following cesarean delivery.²⁰ The data suggest that patients can be maintained on buprenorphine throughout labor and delivery with a modest increase in opioid analgesics available if cesarean delivery is required.²⁰

DISCUSSION

Summary of Evidence

Three RCTs with a total of 153 patients, five case reports with a total of 104 patients, five observational studies with a total of 173 patients, a Delphi survey, an editorial, and a clinical outline were included in this quality improvement project. Several studies were excluded which had an inappropriate publication date, i.e., older than 2010, wrong population, e.g., non-ODU patients or non-surgical patients on buprenorphine, and wrong intervention, e.g., patient not on buprenorphine for OUD. Of the fourteen articles found, two were rated as high quality, and twelve were rated as a medium quality based on Johns Hopkins' appraisal scale. Due to larger sample sizes, well-defined methodology and inclusion criteria, as well as rigorous statistical methods, two of the articles met the criteria for high-quality level 1 evidence. Twelve articles

appraised by the Johns Hopkins' tool, as medium-quality level 1 evidence had small sample sizes or mediocre defined inclusion criteria and methodology.

Of the fourteen articles analyzed all recommended continuing buprenorphine throughout the perioperative period. The articles suggest that potential complications can arise when buprenorphine is discontinued for more than a few days, and patients are placed on full agonist opioids before surgery.¹⁷ According to Scholzen et al. it is important to recall that buprenorphine possesses significant agonist activity.¹⁹ Therefore, if the patients discontinue buprenorphine therapy preoperatively, patients have been found to suffer through increased pain and require significantly more opioids in the first 24 hours after surgery than those who are continued on their buprenorphine preoperatively.

In the five case reports, every patient whose buprenorphine was discontinued experienced poorly controlled pain was taking 16 mg SL daily or greater preoperatively. Pain was successfully controlled in all but one of the patients taking 16 mg buprenorphine SL daily or greater who continued buprenorphine. The articles reviewed suggest that the traditionally conservative approach of discontinuing and reducing opioids perioperatively may not be the most effective way to manage patients with OUD. Evidence suggests that the continuation of buprenorphine may offer the most effective analgesia while maintaining opioid-replacement therapy. Hansen et al. and Macintyre et al. directly address this theory with the cohort study performed. The evidence suggested that pain control was easier to achieve with greater functional recovery when buprenorphine was continued throughout the perioperative period.^{13,21}

Although there is no consensus in the literature about managing acute pain in patients taking buprenorphine, according to Chern et al there are three alternative options when regional anesthesia is contraindicated or not considered in this case. The first option is to continue

buprenorphine and supplement with additional buprenorphine if needed. Raising the dose of buprenorphine is an option, mainly when used in the treatment of OUD to avoid relapse of opioid use. The ceiling effect is a concern when increasing the dose of buprenorphine due to inadequate pain management; however, 1 case study reports adequate pain control. The next alternative is to proceed preoperatively with buprenorphine; however, conventional opioids can be substituted if there is insufficient pain relief by additional buprenorphine. The risk is that substantial doses will be necessary to counteract the high receptor affinity and the partial antagonist effects of buprenorphine. Sedation and respiratory depression can become significant concerns at those doses, and higher levels of monitoring postoperatively may be required. Finally, buprenorphine can be converted to a traditional opioid preoperatively with the continuation of buprenorphine following the acute perioperative period. While there is no antagonist effect to overcome, large doses of opioids may still be required as described in this case since these patients may have significant tolerance.

According to Goel et al, it is almost always appropriate to continue buprenorphine at the preoperative dose. Additionally, it is rarely appropriate to reduce the buprenorphine dose. Some of Goel's perioperative interventions included: initiate adjunct analgesics including NSAIDs, acetaminophen, ketamine, gabapentin/pregabalin, dexmedetomidine, and lidocaine in the perioperative period for analgesia; discharge the patient on same dose of buprenorphine; discharge the patient on some full mu agonist for analgesia, and initiate outpatient buprenorphine provider involvement in the perioperative period. A summary of significant existing perioperative recommendations of patients on buprenorphine are listed below:

Figure 4. Approaches to Manage Patients Perioperatively on Buprenorphine.¹⁹

Anderson et al

- Where moderate-to severe pain is expected, cancel surgery such that buprenorphine is weaned off before surgery and short-acting opioids are used to replace it.
- A plan for follow-up and reinstatement of therapy should be established.
- Anticipate patient's opioids requirements will be similar to an opioid-tolerant patient.
- Consider adjuncts NSAIDs, membrane stabilisers, acetaminophen, local anaesthetics, regional anaesthetic techniques.

Lembke et al

- Continue buprenorphine in the perioperative period for patients taking 12 mg SL or less.
- Taper buprenorphine to 12 mg SL 2-3 days before operation.
- Multimodal analgesia, regional techniques where possible.
- Higher than normal doses of opioids to treat pain for 2-4 days post-surgery.

Scholzen et al

- In all patients on buprenorphine, discontinuing buprenorphine led to at least a 50% relapse in opioid use.
- Continue buprenorphine in the perioperative period.
- Maximizing perioperative multimodal analgesia and regional anesthesia techniques may offer perioperative benefits.

Limitations of the Quality Improvement Project

The quality of evidence regarding perioperative management of patients on buprenorphine is weak. The number of studies is limited, and few directly evaluate the continuation versus discontinuation of buprenorphine. Of the observational studies, including matched cohort, prospective cohort, and retrospective cohort, that included patients on buprenorphine as part of the outcomes, four met the inclusion criteria. Many of the articles reported variables such as pain levels, buprenorphine dose, and perioperative buprenorphine continuation. Differentiation amongst different formulas of buprenorphine was not separated during case reports or RCTs. Only three studies, all case reports included relapse rates, with one extending beyond the three-week time point.

An evidence-based guideline for perioperative management for patients on chronic buprenorphine is needed.¹⁰ However, additional research needs to be conducted to determine the best perioperative regimen for acute pain management in patients with OUD. Regardless of choice, multimodal analgesia should be used when possible, and the anesthesiologist must anticipate the need for large doses of traditional opioids and detailed preoperative discussion with patients is needed.

The existing guidelines cited in the systematic review are mainly driven by expert opinion with little reference to peer-reviewed primary evidence.²² Potential weakness in the existing guidelines includes the recommendation to transition patients to short-acting opioids before surgery. Evidence to the contrary shows lower relapse rates in the OUD patient population that are maintained on buprenorphine. Other guidelines disagree with this practice and do not recommend replacing buprenorphine with full mu agonists in the perioperative period.

Overall, the current evidence for continuing or discontinuing buprenorphine perioperatively is limited.²² To better manage patients with OUD, providers caring for patients on buprenorphine in the perioperative setting need to incorporate harm reduction into goal setting and decisions. In every case, connecting with outpatient primary care physicians and addiction specialists during the preoperative period is advised to ensure proper follow-up for these patients. During the preoperative assessment, attention should be paid to each patient's buprenorphine dose, indication, and relapse risk.

Recommendations for Future Research

To help manage patients presenting to surgery with OUD taking buprenorphine, further research must focus on managing OUD patients during the perioperative period. Also, larger-scale RCTs with larger sample sizes in multi-centers to make the results more evident. Future

research on perioperative buprenorphine management should separate comparisons of pain scores according to transdermal or SL buprenorphine. Data suggested the discontinuation of transdermal buprenorphine is less critical to its continuation, so the analyses of the articles were focused on SL buprenorphine.¹¹

Future studies should recognize the importance of differentiating the designation of a history of OUD from current OUD.¹¹ As with any retrospective analysis, the studies had poor control over the exposure factor in terms of each patient's buprenorphine regimen. Of the fourteen articles, only three included long-term follow-up, relapse rates, or mortality. Further work includes performing a comprehensive retrospective cohort study on the buprenorphine patients who were managed after implementing a standardized checklist and extending into a longitudinal study to monitor for long-term rates of addiction relapse, including long-term morbidity and mortality. Future studies should require standardized reporting of median doses, details on the route of delivery, dosing schedules, any dosing changes, and addiction relapse rates for patients with OUD on buprenorphine. Future studies should be designed to study a single surgical type with a standardized anesthetic management protocol to control regional anesthesia's influence on PACU pain scores and opioid administration.¹⁵ Ultimately, the population of patients who use buprenorphine for OUD is heterogeneous and is not isolated to a particular surgical subtype. The finding of buprenorphine continuation is associated with adequate pain control across surgical types has true practice generalizability.¹⁵

Although some recommendations for treating acute pain in opioid-dependent patients have already been published, due to a lack of RCTs, most of the evidence has been collected in case reports, retrospective studies, and expert opinions. These emphasize the importance of

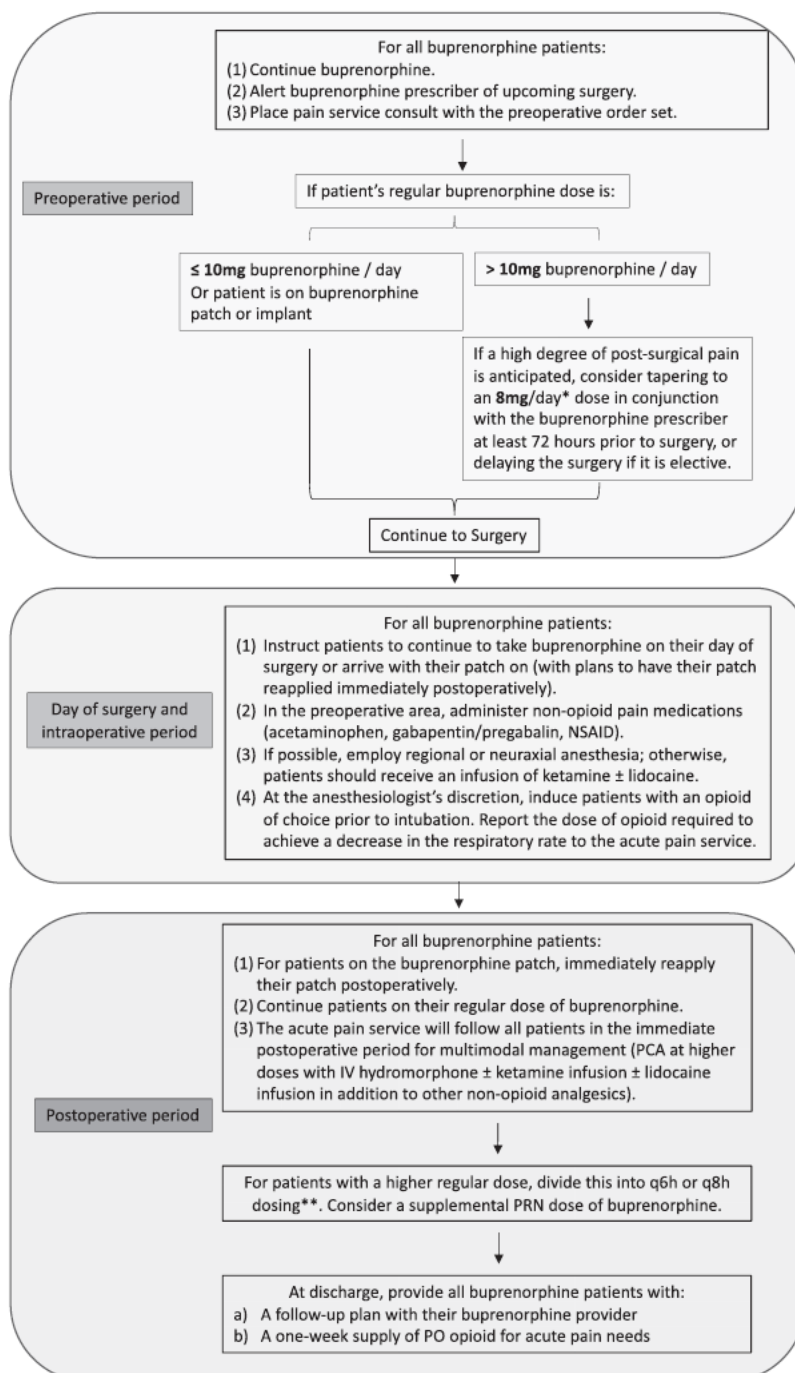
continuing buprenorphine maintenance therapy as a foundation. A prospective trial where patients are randomized to continue or stop buprenorphine should be conducted in the future.¹⁵

Recommendations for Practice Presented in an Algorithm

Preoperatively, the perioperative buprenorphine policy is dose-dependent for patients taking ≤ 10 mg versus > 10 mg of buprenorphine.¹¹ According to Li et al, patients on a baseline dose of ≤ 10 mg are required to meet the following three guidelines: buprenorphine should be continued, the buprenorphine prescriber should be made aware of the upcoming surgery, and a consult to the Pain Service should be placed via the preoperative order set. The above guidelines also apply to patients on a baseline dose of > 10 mg.¹¹ However, for scheduled procedures with an anticipated high degree of postsurgical pain, the guideline is to consider tapering to an 8mg dose in conjunction with the buprenorphine prescriber at least 72 hours before surgery or delaying the surgery if it is elective. Quaye et al suggested the 8mg threshold.¹¹

Regarding intraoperative considerations, all patients are instructed to take buprenorphine or arrive on the day of surgery with the patch on with plans to have the patch reapplied immediately postoperatively. Preoperatively, patients also receive nonopioid pain medications, specifically acetaminophen, gabapentin, and NSAIDs. Furthermore, regional or neuraxial anesthesia is employed if possible; otherwise, patients should receive an infusion of ketamine and lidocaine. Finally, at the anesthesia provider's discretion, patients should be induced with an opioid of the anesthesia provider's choice before intubation; meanwhile, the dose of opioid required to achieve a decrease in the respiratory rate is reported to the acute pain service.¹¹ Provided below in Figure 3 is an algorithm based on the evidence found in this systematic review, other current literature, and guidelines suggested for anesthesia providers' clinical practice.

Figure 5. Quate and Lembke et al Algorithm for Perioperative Buprenorphine Management.¹¹



CONCLUSION

Buprenorphine is a semisynthetic opioid agonist-antagonist used primarily to treat OUD.¹⁰ Its pharmacokinetic and pharmacodynamic properties make it an attractive drug for this purpose. It has a high affinity for the mu and kappa receptors and very slow dissociation, giving it an extended duration of action and limiting the opioid "high" produced by a pure mu agonist methadone. There is a ceiling effect at higher doses, reducing the abuse potential and minimizing respiratory depression. It also attenuates other opioid agonists' effect, decreasing the euphoria and efficacy of concurrently administered opioids.

There is no consensus of the management of buprenorphine, however, the recommendation is to continue buprenorphine during the perioperative period. The patient's outpatient buprenorphine provider should be engaged before surgery and as soon as is feasible after discharge.⁸ The perioperative physicians should engage the patient early to outline strategies, manage expectations about the perioperative course, and explain the importance of treatment retention.⁸

IMPLEMENTATION

Setting and Participants

The setting will take place through an online survey and a PowerPoint educational module with the members of the Anesthesia Department from Anesco Anesthesia Services at Broward General Hospital. The preliminary study will include anesthesia providers such as Certified Registered Nurse Anesthetist (CRNAs) and Anesthesiologists. The participation will be based on individuals who were forwarded within the email list provided by Broward General Hospital and will be asked to provide feedback regarding the educational module's anesthesia providers' experience. The anticipated sample size will be between 15-20 participants.

Recruitment

The target population consisted of CRNAs and Anesthesiologists who have taken care of patients throughout the perioperative period on buprenorphine with OUD. Participants were identified through an email list provided by Broward General Hospital. The anesthesia providers within the email list were emailed an invitation to participate in the educational module.

Description of Approach and Project Procedures

The primary methodology of the proposed project is to administer an online Zoom educational module to providers that focuses on perioperative management of patients with OUD who take buprenorphine. The project will be implemented by conducting an online pre-assessment test that will assess the anesthesia providers knowledge about managing a patient with OUD on buprenorphine during the perioperative period. The existing knowledge and understanding of the anesthesia provider will be defined using a pre-evaluation tool that will influence the intervention's information and determine the content or subject matter of the intervention.

The second phase will include a Zoom educational PowerPoint. The primary means of learning will be through a voiceover PowerPoint presentation with information regarding the management of patients with OUD on buprenorphine in the perioperative period. Anesthesia providers' education is essential in bridging existing gaps in knowledge and supporting the need for additional tools to ensure patients on buprenorphine are provided evidence-based care during the perioperative period. Current education is limited in the perioperative patient taking buprenorphine for OUD.⁴ Anesthesia providers must have knowledge that will benefit patients with OUD on buprenorphine to ensure proper pain management postoperatively and relapse prevention. The delivery of the presentation will offer insight for providers regarding the

importance of continuing buprenorphine during the perioperative period in order to prevent relapse and control postoperative pain in patients with OUD. The empirical evidence supports an evidence-based project with comprehensive information regarding continuing buprenorphine throughout the perioperative period and its benefits for OUD patients. A checklist will be provided within the education module on how to manage patients with OUD taking buprenorphine during the perioperative period.

The third phase of the project will involve an online post-assessment test to identify the anesthesia providers learned knowledge and perception to the intervention and the contents that were delivered. This information will provide greater feedback regarding the impact of the educational intervention and will determine how to best move forward in expanding the use of a perioperative checklist for patients taking buprenorphine with OUD. The pre/post-testing will provide relevant information regarding the effectiveness of continuing buprenorphine during the perioperative period and improve patient satisfaction postoperatively. At the end of the educational tool, feedback will also demonstrate if the perioperative checklist will improve anesthesia providers' knowledge and if any changes are necessary for the future so that other anesthesia providers will benefit from the program in the future.

Protection of Human Subjects

Anesthesia providers participating in the survey remained anonymous, and the data was secured by using unique code identifiers. The digital data collected from the pre-test and post-test were protected by a laptop password and spyware. Using laptop passwords and spyware, this ensured the safety of the data. There are no perceived risks to the study as it only requires the time spent by each anesthesia provider in the educational module which took less than 20 minutes to complete.

Data collection and analysis

For the study, the primary instruments included preassessment and post-assessment testing applications to determine the effects of the educational module. Both tests will be conducted using surveys utilizing Qualtrics that will determine if participants have an understanding of managing surgical patients with OUD taking buprenorphine during the perioperative period. The survey consisted of 15 questions that focus on knowledge and practice. The pre-test survey will gauge baseline knowledge. In contrast, the post-test survey will determine the participants knowledge from the educational module and application of knowledge gained to professional practice. The data collected will be confidential, and no subject identifiers will be recorded during any component of the study.

Data Management and Measure

The investigator for the project will be the DNP student responsible for obtaining the members of the Anesthesia Department at Broward General Hospital via email list for administration of the pre and post survey and Zoom educational module. Each question will be measured, and the responses recorded to identify the knowledge base before and after the educational module. No personal identifiers will be recorded for each of the study participants so that confidentiality will be protected. The impact of the educational module will be based upon the results of the pre-and post-test survey instruments. Through the statistical analysis, the study results will likely identify patterns that will be used to determine the effectiveness of the educational module and if the module will improve anesthesia providers' knowledge. The co-investigator will store the data collected in a password-protected laptop computer.

IMPLEMENTATION RESULTS

Pre/Post-Test Demographics

The pre-test demographics are shown in Table 4., shown below.

Pre-Test Participants Demographics

Demographic	n (%)
Total Participants	5 (100%)
Gender	
Male	1 (25%)
Female	4 (75%)
Age	
25-35	3 (60%)
36-45	0 (0%)
46-55	0 (0%)
56-66	2 (40%)
Ethnicity	
Hispanic	1 (20%)
Caucasian	3 (60%)
African American	0 (0%)
Asian	0 (0%)
Other	1 (20%)
Position/Title	
CRNA	5 (100%)
MD/DO	0 (0%)
Years of Experience	
Less than 1 year	1 (20%)
1 to 5 years	2 (40%)
6 to 10 years	0 (0%)
More than 10 years	2 (40%)

There were 5 participants in the pre-test demographics. The majority of the participants were female (n=4, 75%) instead of male (n=1, 25%). There were also a range of ethnicities represented: Caucasian (n=3, 60%), Hispanic (n=1, 20%), and other (n=1, 20%). Information was obtained regarding the participant's role at the clinic. It was found that all participants were CRNAs. The participants were questioned about the length of time practicing, finding that the practice period ranged: less than one year (n=1, 20%), 1 to 5 years (n=2, 40%), and more than 10

years (n=2, 40%). The participants consisted of DNP-prepared CRNAs (n=3, 60%) and Master level prepared CRNAS (n=2, 40%).

Pre-Test Confidence in Management of Surgical Patients with Opioid Addiction on Buprenorphine

The pre-test contained information regarding the perioperative management of surgical patients with opioid addiction on buprenorphine. The majority of participants (n=3, 60%) did not feel confident managing surgical patients on buprenorphine with opioid use disorder. The survey concluded that most participants (n=4, 80%) did not have patients who took buprenorphine often. In the pre-test, the participants (n=4, 80%) reported that a checklist for surgical patients with opioid addiction taking buprenorphine would somewhat unlikely be implemented.

Pre-Test Identification of Current Knowledge about Perioperative Management of Surgical Patients with Opioid Addiction on Buprenorphine

The survey focuses on identifying the benefits of a perioperative checklist for patients with opioid addiction taking buprenorphine. The participants know the mechanism of action of buprenorphine; the question was correctly answered by four participants (n=4, 80%). When asked about the withdrawal effects of buprenorphine, all five participants answered the questions correctly (n=5, 100%). All participants (n=5, 100%) answered how buprenorphine is provided for addiction maintenance treatment. The participant's scores improved in the post-test when asked about questions pertaining to perioperative management of surgical patients taking buprenorphine (n=5, 100%). The participants were asked questions involving the pharmacokinetics and pharmacodynamics of buprenorphine, scores generally improved when comparing pre- and post- test. Table 4 shows the difference in responses from the pre- to post-test.

Table 5. Difference in Pre- and Post-Test Knowledge

Questions	Pre-test	Post-test	Difference
What is TRUE about opioid use disorder (OUD) and buprenorphine?	80%	100%	20%
What are the MAIN uses for buprenorphine?	80%	80%	0%
What is the method of action of buprenorphine?	80%	80%	0%
The affinity of buprenorphine results in?	80%	80%	0%
The goals of buprenorphine maintenance treatment include:	80%	80%	0%
Which statement is TRUE about withdrawal from buprenorphine?	100%	100%	0%
If the patient continued buprenorphine perioperatively, what are some of the unique considerations that apply to the patient?	40%	60%	20%
Compared with conventional opioids, the pharmacodynamics of buprenorphine ____.	40%	60%	20%
Which of the following is TRUE regarding tapering and discontinuing use of buprenorphine before surgery?	40%	100%	60%
If the patient DID NOT continue buprenorphine preoperatively, what are some of the unique considerations that apply to the patient?	40%	100%	60%
How does buprenorphine provide addiction maintenance treatment?	100%	100%	0%
What statement is TRUE about buprenorphine during the perioperative period?	100%	100%	0%

After the Zoom PowerPoint presentation, scores increased on the post-test from the baseline pre-test scores. The majority of participants improved knowledge about perioperative management of patients on buprenorphine (n=3, 60%). When asked questions about managing patients on buprenorphine perioperatively and unique considerations of buprenorphine, only one person (n=1, 20%) improved the post-test score. However, there was an (n=3, 60%) increase post-test in participants that were able to identify true statements about tapering and discontinuing use of buprenorphine before surgery. Lastly, all participants answered how buprenorphine provides addiction maintenance treatment (n=5, 100%).

Post-Test Confidence in Management of Surgical Patients with Opioid Addiction on Buprenorphine

Participants were very confident (n=3, 60%) or somewhat confident (n=2, 40%) in managing a patient on buprenorphine with OUD after completing the educational module. When asked how often the participant had a patient in the perioperative period who takes buprenorphine, the majority selected rarely (n=4, 80%) compared to sometimes (n=1, 20%).

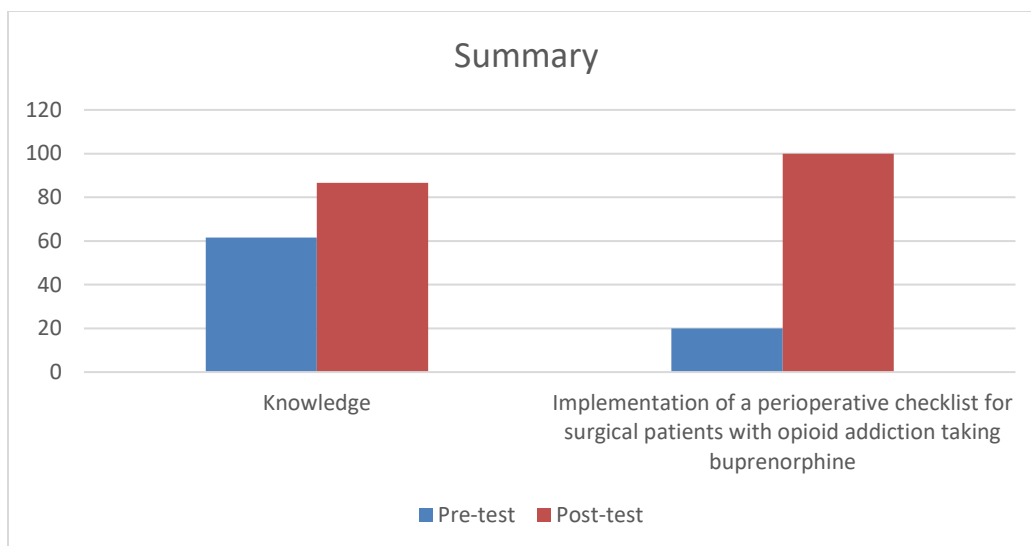
Table 6. Implementation of a perioperative checklist for surgical patients with opioid addiction taking buprenorphine

	Pre-test	Post-test	Difference
How likely are you to implement a perioperative checklist for surgical patients with opioid addiction taking buprenorphine?	20%	100%	80%

Table 5 shows the educational module changes in participants' perspectives on implementing a perioperative checklist when comparing the pre-test and post-test scores. The results suggest that the narrated PowerPoint presentation provided the necessary educational information, leading CRNAs to feel inclined to incorporate a perioperative checklist to manage surgical patients with OUD on buprenorphine.

Summary

Overall, the results reflected an improvement in knowledge based on the pre-test and post-test scores. Knowledge showed an average gain of (25%). In addition, the post-test demonstrated that participants are most likely (n=4, 80%) or somewhat likely (n=2, 20%) to implement a perioperative checklist for surgical patients with opioid addiction taking buprenorphine.



IMPLEMENTATION DISCUSSION

Limitations

Limitations of the study include a small sample size; the survey was emailed to the members of the Anesthesia Department at Broward General Hospital. There were 46 emails on the list; however, only five people completed the survey. A larger sample size is preferred to enhance the study's findings and offer a sample size that mirrors Broward Health Hospital's anesthesia practitioners. The survey link, which included a pre-test, a narrated PowerPoint presentation, and a post-test, was available online for two weeks; extending the time frame may have resulted in more replies. Finally, the project was completed entirely online, preventing it from being delivered through other means.

Future Implications for Anesthesia Practice

The literature demonstrated that a checklist for surgical patients taking buprenorphine will likely expand the knowledge base of the anesthesia providers and will demonstrate the importance of developing a meaningful strategy for improving the care for surgical patients taking buprenorphine. and in providing the best possible resources to treat patients effectively.

The anesthesia providers knowledge will improve, when an evidence-based checklist is provided. A perioperative checklist will improve the outcomes of surgical patients and ensure the best possible postoperative pain management will be provided to patients on buprenorphine. The quality improvement project showed that the intervention was effective in increasing healthcare providers knowledge and confidence on perioperative management of surgical patients with OUD taking buprenorphine.

During the perioperative period, there are no policies, or checklists for managing surgical patients on buprenorphine, which presents an opportunity to close the gap between recommendation of care and actual care delivery. Implementing the evidence-based checklist for the perioperative management of surgical patients with opioid addiction on buprenorphine will improve the quality and standard of care for OUD patients on buprenorphine. The implementation of a checklist is essential for anesthesia to help improve outcomes and relapse prevention for surgical patients with OUD on buprenorphine.

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Appendix A




Office of Research Integrity
Research Compliance, MARC 414

MEMORANDUM

To: Dr. Yasmine Campbell

CC: Mary Transleau

From: Elizabeth Juhasz, Ph.D., IRB Coordinator 

Date: April 7, 2021

Protocol Title: **"An Evidence-Based Quality Improvement Checklist for the Perioperative Management of Surgical Patients with Opioid Addiction on Buprenorphine"**

The Florida International University Office of Research Integrity has reviewed your research study for the use of human subjects and deemed it Exempt via the **Exempt Review** process.

IRB Protocol Exemption #: IRB-21-0141 **IRB Exemption Date:** 04/07/21
TOPAZ Reference #: 110220

As a requirement of IRB Exemption you are required to:

- 1) Submit an IRB Exempt Amendment Form for all proposed additions or changes in the procedures involving human subjects. All additions and changes must be reviewed and approved prior to implementation.
- 2) Promptly submit an IRB Exempt Event Report Form for every serious or unusual or unanticipated adverse event, problems with the rights or welfare of the human subjects, and/or deviations from the approved protocol.
- 3) Submit an IRB Exempt Project Completion Report Form when the study is finished or discontinued.

Special Conditions: N/A

For further information, you may visit the IRB website at <http://research.fiu.edu/irb>.



Institutional Review Board - Human Research Protections

Broward Health Medical Center
Broward Health Coral Springs
Broward Health Imperial Point
Broward Health North

Salah Foundation Children's Hospital
Broward Health Weston
Community Health Services
Broward Health Physician Group

DATE: 04/15/2021

TO: Mary Transleau, BSN, MSN

FROM: Broward Health Institutional Review Board

RECORD NUMBER: 2021-038

STUDY TITLE: An Evidence-Based Quality Improvement Checklist for the Perioperative Management of Surgical Patients with Opioid Addiction on Buprenorphine

RE: NOT HUMAN SUBJECT RESEARCH DETERMINATION

Dear Mary Transleau, BSN, MSN:

This is to advise you that your project, "An Evidence-Based Quality Improvement Checklist for the Perioperative Management of Surgical Patients with Opioid Addiction on Buprenorphine" was reviewed on behalf of the Broward Health Institutional Review Board and was declared "not research involving human subjects" based on the definitions provided in the U.S. Department of Health and Human Services Code of Federal Regulations found at 45 CFR 46.102.

Please note, this determination does not absolve the Principal Investigator from complying with other federal, state, or local laws or institutional policies and procedures that may be applicable in the conduct of this project. This determination applies to your project in the form and content as submitted to the IRB for review. Any variations or modifications to this project involving the participation of human subjects must be approved by the IRB prior to implementing such changes. Please maintain a copy of this determination for your records.

Thank you for submitting your project to the IRB for consideration.

The Broward Health Institutional Review Board – FWA00001248 operates in accordance with the Office of Human Research Protections and U.S. Food and Drug Administration (FDA) regulations. The Broward Health Institutional Review Board complies with the ICH guidelines on Good Clinical Practice (GCP) where they are compatible with the FDA and HHS regulations.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Broward Health IRB's records.

Appendix B: Matrix Table

Author (Year) & Level of Evidence	Indications for Buprenorphine use	Study type/ Sample size	Findings: Was buprenorphine continued perioperatively or discontinued	Independent Variables	Dependent Variables	Analgesia success	Success of deterrence against opioid abuse	Guidelines provided	Conclusion
Jonan <i>et al.</i> (2018) Level 4 Quality A	Chronic pain or OUD		Recommendations for preoperative management of buprenorphine was based on urgency and type of surgical procedure.			Poorly controlled pain	High risk of a relapse if buprenorphine is held for an extended period prior to the procedure.	Yes	
Chern <i>et al.</i> (2013) Level 5 Quality A	Chronic pain	Vaginal mesh removal and cystoscopy X2 Sample Size: 1	Both methods were conducted,	Independent variable: IV1: The patient withheld from taking buprenorphine for the first surgery. IV2: The patient continued buprenorphine throughout the perioperative period.	Dependent variable: DV1: The patient was in severe pain in the postoperative period when buprenorphine was continued during the perioperative period. DV2: When the patient withheld buprenorphine during the perioperative period, the patient reported adequate pain control in the postoperative period.	Buprenorphine was discontinued five days before surgery and the patient was switched to hydromorphone 4 mg PO q4-6 hours. The patient experience "unbearable" pain 8/10. Patient experience poorly controlled pain when buprenorphine was continued perioperatively.	Non-reported	Yes	Although there is no consensus in the literature as to how to best manage acute pain in these patients, there are three alternative options when regional anesthesia is contraindicated or not considered as in this case. The first option is to continue the baseline regimen and supplement with additional buprenorphine. The second option is to continue the buprenorphine preoperatively; however, if pain control is inadequate with additional buprenorphine, traditional opioids will need to be added. Lastly, the buprenorphine can be converted to a traditional opioid preoperatively with resumption of buprenorphine following the acute perioperative period.
Hansen <i>et al.</i> (2016) Level 3 Quality B	Study group (patients with a history of OUD) compared to a control group (patients without a history of OUD)	Total hip (n = 8) and knee (n = 9) arthroplasty, continuing Buprenorphine /naloxone	Buprenorphine/naloxone was continued in the patients with a history of OUD.	Independent Variables: IV1: Patients who take buprenorphine/naloxone compared to those who do not take buprenorphine/naloxone.	Dependent Variables: DV1: In the study group (those taking buprenorphine/naloxone) two patients developed deep infections. In the control group (those not taking buprenorphine/naloxone) one patient developed a deep infection. DV2: A change in morphine dosing at the	There was no significant difference in pain scores between groups studied	Relapse rate of heroin addiction has been shown up to 50%.	No	The patients took buprenorphine/naloxone preoperatively can achieve adequate pain control and successful clinical outcome after surgery. Similar experiences with controlled groups compared to the study group were identified. Equivalent pain control and successful clinical outcome at 1 year can be achieved in patients who use methadone or buprenorphine/naloxone preoperatively.

					time of discharge decreased in the study group (-203.5) and increased in the control group (84.3).				
Kornfeld <i>et al.</i> (2010) Level 5 Quality A	Chronic pain or OUD	Five patients who underwent seven major surgical procedures including colectomy, total knee replacement, small bowel resection and mastectomy.	There were no interruptions of daily buprenorphine therapy.	Independent Variable: IV1: Increased dose of buprenorphine for postoperatively surgery vs sample dose buprenorphine a preoperatively	Dependent Variable: DV1: For surgery 2 During the patient's hospital stay post-operatively buprenorphine was continued, and the patient was discharged on 16 mg of buprenorphine and on oral hydromorphone for breakthrough pain. DV2: For same patient (surgery 3) sublingual buprenorphine was not given during this brief hospitalization but was restarted without difficulty at discharge at the preoperative dose. Pain was well managed however, patient had multimodal pain management including an epidural.	All had successful analgesia reported.	Non-reported	No, however, emphasized the need for peri-operative guidelines.	Potential complications arise when buprenorphine is discontinued for more than a few days and patients are placed on full agonist opioids before surgery, making it difficult to reconvert to buprenorphine. The robust effectiveness of full agonist opioids in patients stabilized on buprenorphine undergoing major surgery supports the strategy of uninterrupted buprenorphine treatment in these patients.
Macintyr <i>et al.</i> (2013) Level 4 Quality B	OUD	22 patients, Any surgery, taking buprenorphine or methadone.	Partial: buprenorphine continued POD 0 in 14/22 patients (64%) and POD 1 in 11/22 patients (50%).	Independent variable: methadone opioid substitution therapy (MOST) versus buprenorphine opioid substitution therapy (BOST)	Dependent variable: DV1: PCA morphine, DV2: pain scores, DV3: cessation of buprenorphine, DV4: First 24-hour analgesic doses, efficacy and adverse effects	Well controlled pain, no significant differences between groups or between continuation without stopping.	Non-reported	No, suggested continuing buprenorphine perioperatively	In summary, the audit showed that the efficacy and safety of PCA opioids prescribed for the management of postoperative pain is similar for BOST and MOST patients. Importantly, PCA opioid requirements were less in patients in whom BOST was continued perioperatively compared with those patients whose regular BOST was ceased, and therefore BOST should not be withheld in patients undergoing surgery. That is, administration of

									buprenorphine in BOST patients does not adversely affect acute pain management using full agonist opioids after surgery.
Quaye et al. (2020) Level 2 Quality B	OU	55 patients, who had surgery from March-October 2018. Minor procedures such as colonoscopies and endoscopies were excluded.	Partial: 38 continued buprenorphine versus 17 held buprenorphine	Independent variable: Patients either abstaining from buprenorphine perioperatively of continuing.	Dependent variable: History of OU.	The number of opioid prescriptions dispensed was significantly higher with buprenorphine discontinuation. PACU pain scores were higher with buprenorphine discontinuation.	Non-reported	No, suggest continuing buprenorphine perioperatively	Patients who continued buprenorphine had a significant reduction in opioid prescriptions filled and PACU pain scores in patients than patients who held buprenorphine perioperatively. Evidence was provided to support that buprenorphine can be continued perioperatively, and that continuation is associated with decreased postoperative pain and decreased outpatient opioid dispensing. The results contribute to the existing literature supporting the perioperative continuation of buprenorphine.
Hassamal et al. (2017) Level 5 Quality A	OU	Tricuspid and Aortic valve repair Sample Size: 1	Discontinued and restarted postoperatively; timing of change was not reported.	Independent variables: OU patient took buprenorphine for chronic pain.	Dependent Variable: discontinue of buprenorphine before surgery and restarted after the procedure was completed	Well controlled pain	Six months after surgery refrained from opioids	No	In summary, initiating buprenorphine in the acute medical setting along with continued outpatient addiction treatment is an effective yet underutilized strategy. Initiating MAT in the hospital setting provides an opportunity to engage high-risk patients in substance abuse treatment, decrease recidivism, and subsequently improve patient outcomes and decrease health care costs. An inpatient setting offers the advantage of close monitoring and supervision during a critical period of change that may not be available in an outpatient setting. Therefore, practitioners should not be hesitant to start buprenorphine in acutely ill patients with an opioid use disorder.
Huang et al. (2014) Level 5 Quality B	Chronic pain	Clagett window closure Sample size: 1	Continued buprenorphine by 50% postoperatively, with subsequent tapering to 0 mg before discharge.	Independent variable: IV1 Continued regular dose of Suboxone 16 mg twice a day	Dependent variable: DV2 high postoperative pain scores.	Pain was poorly controlled; Improved after postoperative decrease	Abstained from opioids at three week follow-up	No	In a chronic pain patient continued on buprenorphine/naloxone perioperatively, significant improvement in postoperative pain control was observed following tapered doses. Eventually, the use of buprenorphine/naloxone was discontinued.

<p>Martine et al. (2019)</p> <p>Level 5 Quality A</p>	<p>OUD</p>	<p>Various surgeries and type of anesthesia included in the study.</p> <p>Sample size: 32</p>	<p>19 patients continued sublingual-buprenorphine, 13 discontinued sublingual-buprenorphine 1 to 30 days before surgery.</p>	<p>Independent Variable: IV1 Various types of anesthesia for patients taking sublingual-buprenorphine IV2 Continuing vs discontinuing sublingual-buprenorphine prior to surgery</p>	<p>Dependent Variable: Use of opioids increasing in PACU in patients with long-term treatment of sublingual-buprenorphine</p>	<p>Patients who received long-term treatment with sublingual-buprenorphine had high opioid requirements through POD1, regardless of type of anesthesia used or whether sublingual-buprenorphine was preoperatively continued or discontinued.</p>	<p>The use of opioids increased substantially after discharge from the PACU, and by 24 hours after PACU discharge, no differences in opioid requirements were noted between patients who underwent surgical procedures with general anesthesia only versus combined general/regional anesthesia.</p>	<p>No</p>	<p>Regardless of the type of anesthesia used, physicians treating patients with sublingual-buprenorphine must be prepared to administer large doses of opioids during the early postoperative period. No difference in opioid requirements was noted between patients who perioperatively stopped sublingual-buprenorphine versus those who sublingual-buprenorphine.</p>
<p>Goul et al. (2019)</p> <p>Level 4 Quality A</p>	<p>Chronic pain or OUD</p>		<p>Recommendations to continue buprenorphine in the peri-operative period.</p>	<p>Independent variable: Management of patients on buprenorphine.</p>	<p>Dependent variable: Developing guidelines and a set of recommendations for the perioperative management of patients taking buprenorphine</p>	<p>Non-reported</p>	<p>Non-reported</p>	<p>Yes, several guidelines from difference authors were included in the article.</p>	<p>Goel et al. identifies that long-term treatment retention, and morbidity are essential when deciding to stop or continue buprenorphine during the perioperative period.</p>
<p>Meyer et al. (2010)</p> <p>Level 2 Quality B</p>	<p>OUD</p>	<p>Vaginal (n = 44) and Cesarean (n = 19) delivery taking buprenorphine</p>	<p>Continued perioperatively</p>	<p>Independent variable: V1: Intrapartum and postpartum pain management for women on buprenorphine IV2: Pain management for patients with OUD taking buprenorphine compared to non-OUD patients</p>	<p>Dependent variable: DV1: c-section DV2: vaginal delivery DV3: continued buprenorphine preoperatively pre-operatively DV4: pain management techniques (epidural)</p>	<p>Pain was well controlled, Significantly higher pain scores in study group versus controls postpartum</p>	<p>Non-released</p>	<p>No</p>	<p>Buprenorphine maintained women have similar intrapartum pain and analgesic needs during labor but experience more postpartum pain and require 47% more opioid analgesic following cesarean delivery. The data suggest that patients can be maintained on buprenorphine throughout labor and delivery with a modest increase in opioid analgesics available if cesarean delivery is required.</p>

Appendix C

Proposed Method for Data Collection Pretest and Posttest Questionnaire



Pretest and Posttest Questionnaire:

A Quality Improvement Checklist for the Perioperative Management of Surgical Patients with Opioid Addiction on Buprenorphine

INTRODUCTION

The primary aim of this QI project is to improve the knowledge of anesthesia providers in order to improve perioperative management of patients taking buprenorphine for opioid addiction.

Please answer the question below to the best of your ability. The questions are either in multiple choice or select all that apply. These questions are meant to measure knowledge and perceptions on identification, management, and patient education on management of buprenorphine throughout the perioperative period.

PERSONAL INFORMATION

1. **Gender:** Male Female Other
2. **Age:** _____
3. **Ethnicity:**
Hispanic Caucasian African American Asian Other
4. **Number of years of experience:**
Less than 1 year 1-5 years 6-10 years more than 10 years
5. **Type of anesthesia provider:** _____
6. **Level of Education:** Associates Bachelors Masters DNP PhD M.D.

QUESTIONNAIRE

- 1) How confident do you feel managing a patient in the perioperative period on buprenorphine with opioid use disorder (OUD)?
 - a. Very confident
 - b. Somewhat confident
 - c. Somewhat unconfident
 - d. Very unconfident
- 2) How often do you have a patient in the perioperative period who takes buprenorphine?
 - a. Often
 - b. Sometimes
 - c. Rarely
 - d. Never
- 3) As the anesthesia provider, how likely are you to implement a perioperative checklist for surgical patients with opioid addiction taking buprenorphine?
 - a. Most likely
 - b. Somewhat likely
 - c. Somewhat unlikely
 - d. Most unlikely
- 4) What is TRUE about opioid use disorder (OUD) and buprenorphine?
 - a. Opioid Use Disorder is often treated with psychological interventions and medications such as buprenorphine.
 - b. Opioid use disorder patients are on drugs that make it challenging to manage pain in the perioperative period, including buprenorphine.
 - c. The structure of buprenorphine makes it an appealing selection for managing chronic pain and opioid use disorder.
 - d. All the above
- 5) What are the MAIN uses for buprenorphine?
 - a. Analgesia
 - b. Opioid withdrawal
 - c. Addiction maintenance treatment
 - d. All the above

CORRECT ANSWER: D.

- 6) What is the method of action of buprenorphine?
- a. Partial agonist at Mu-opioid receptors, antagonist at Kappa-opioid receptors
 - b. Agonist at Mu-opioid receptors, partial agonist at Kappa-opioid receptors
 - c. Partial antagonist at Mu-opioid receptors, antagonist at Kappa-opioid receptors
 - d. Partial antagonist at Mu-opioid receptors, agonist at Kappa-opioid receptors

CORRECT ANSWER: a.

- 7) The affinity of buprenorphine results in:
- a. A very strong bond to the opioid receptor.
 - b. Partial activation of mu receptor.
 - c. Can precipitate withdrawal if full agonist on board.
 - d. All the above

CORRECT ANSWER: d.

- 8) The goals of buprenorphine maintenance treatment include:
- A. Discontinue or markedly reduced use of other opioids
 - B. Persistent craving
 - C. Persistent withdrawal symptoms
 - D. The expectation of sedation

CORRECT ANSWER: a.

- 9) Which statement is TRUE about withdrawal from buprenorphine?
- a. There is no known withdrawal syndrome when stopping buprenorphine if it has been taken sublingually.
 - b. Withdrawal from buprenorphine maintenance is more severe than withdrawal from a full agonist like methadone.
 - c. The time before withdrawal sets in is longer with physical dependence on buprenorphine than with physical dependence on full opioid agonists.

CORRECT ANSWER: C. The time before withdrawal sets in is longer with physical dependence on buprenorphine than with physical dependence on full opioid agonists.

- 10) If the patient continued buprenorphine perioperatively, what are some of the unique considerations that apply to the patient?
- The surgeon should contact the physician prescribing buprenorphine and ensure that the patient is aware of the surgery
 - Continue the buprenorphine for postoperative pain
 - Do NOT routinely prescribe supplemental opioids
 - All the above

CORRECT ANSWER: D.

- 11) Compared with conventional opioids, the pharmacodynamics of buprenorphine ____.
- Dissociates more slowly from the μ -OR, resulting in prolonged pain relief and less potential for withdrawal
 - Blocks OR-like-1 receptors, slowing the development of tolerance to analgesic effects and reducing the potential for misuse
 - Blocks δ -OR and κ -OR, making it less likely to induce sedation, dysphoria, constipation, and hyperalgesia
 - All of the above

CORRECT ANSWER: D. all of the above

- 12) Which of the following is TRUE regarding tapering and discontinuing use of buprenorphine before surgery?
- It is generally easier to go from 12 mg to 10 mg of buprenorphine than from 2 mg to 0 mg.
 - Most patients are ready to start tapering off of buprenorphine after they complete a year of maintenance treatment.
 - If buprenorphine is discontinued, a taper over 48 hours is recommended
 - The risk of relapse is low if tapering off of buprenorphine is extended over a month.

CORRECT ANSWER: A. It is generally easier to go from 12 mg to 10 mg of buprenorphine than from 2 mg to 0 mg

- 13) Patient Alexa, age 36, is quitting her misuse of hydrocodone plus acetaminophen before surgery. She has had her first dose of generic, sublingual combination

buprenorphine/naloxone to start treatment for opioid use disorder. If she is typical of most patients, what target dose of buprenorphine will she most likely need?

- a. 6 mg to 10 mg
- b. 12 mg to 16 mg
- c. 18 mg to 22 mg
- d. 24 mg to 28 mg

CORRECT ANSWER: B. 12 mg to 16 mg

14) If the patient DID NOT continue buprenorphine preoperatively, what are some of the unique considerations that apply to the patient.

- a. If greater than five days off buprenorphine, treat with traditional opioids, may require tolerant or highly tolerant doses
- b. After postoperative pain normalizes, the patient may work with his or her physician to reinstitute buprenorphine therapy
- c. Assess the amount of time since the last dose of buprenorphine
- d. All the above

CORRECT ANSWER: D.

15) How does buprenorphine provide addiction maintenance treatment?

- a. It displaces some of the full agonists at mu receptors and provides a very limited opioid effect. The patient DOES NOT experience opioid withdrawal symptoms but is not receiving full agonist effect.
- b. The patient DOES experience opioid withdrawal symptoms and is receiving full agonist effect.
- c. Buprenorphine does not provide addiction maintenance treatment
- d. none of the above

CORRECT ANSWER: a.

16) What statement is TRUE about buprenorphine during the perioperative period?

- a. In all patients on buprenorphine, discontinuing buprenorphine during the perioperative period leads to at least a 50% relapse in opioid use.

- b. In all patients on buprenorphine, continuing buprenorphine during the perioperative period leads to at least a 50% relapse in opioid use.
- c. The patient does not need to plan for a follow-up regarding buprenorphine management postoperatively.

CORRECT ANSWER: a.

Appendix D

1 ☆ 00:14

2 ☆ 00:28

3 ☆ 00:46

4 ☆ 01:05

5 ☆ 01:08

6 ☆ 01:06

7 ☆ 01:13

8 ☆ 00:42

9 ☆ 00:34

10 ☆ 00:33

11 ☆ 00:31

12 ☆ 00:15

13 ☆ 00:47

14 ☆ 00:02



A Quality Improvement Checklist for the Perioperative Management of Surgical Patients with Opioid Addiction on Buprenorphine

Mary Transleau MSN, RN, SRNA; Ann B. Miller, DNP, APRN; Patrick Jordan M.D.



Introduction

Buprenorphine is a semisynthetic opioid agonist-antagonist that displays antagonism at kappa receptors and partial agonist at mu receptors.¹ The peak-and-valley plasma effects seen with shorter-acting opioids are minimized for patients on buprenorphine because of its long half-life.^{2,3} Additionally, the kappa antagonism of buprenorphine minimizes the euphoric and psychotomimetic effects associated with opioid use.³ Buprenorphine has the unfortunate effect of interfering with the actions of opioids administered for medical indications.⁴ When patients on buprenorphine that present for surgery or procedures requiring anesthesia, it can become a substantial challenge.⁴

Problem

Patients on buprenorphine are often mismanaged in the operating room. There are no perioperative guidelines or checklists provided to the anesthetist to manage the OUD patient population. If patients with OUD are mismanaged, it can pose a significant risk to long-term health, including the risk of relapsing.⁷ Patients that have a history of OUD or chronic pain frequently have other comorbidities that lead to surgery.⁷ Often, anesthesia providers are unaware of the special considerations necessary when a patient is on buprenorphine; this creates uncertainty in managing the patient's pain intraoperatively.⁷

Clinical Significance

- ✓ Formulation of a checklist will guide the anesthetist to provide adequate analgesia and anesthesia to patients on buprenorphine.⁷
- ✓ The pharmacokinetic and pharmacodynamic properties of buprenorphine allow it to be a feasible option for substitution therapy in the treatment of opioid dependence.
- ✓ Buprenorphine provides addition maintenance treatment by displacing some of the full agonists at mu receptors and provides a very limited opioid effect.
- ✓ Discontinues more slowly from the mu-receptor, resulting in prolonged pain relief.
- ✓ Blocks OR-like-1 receptors, slowing the development of tolerance to analgesic effects and reducing the potential for misuse.
- ✓ Block's kappa receptors, making it less likely to induce sedation, dysphoria, constipation, hyperalgesia, and a difficult anesthetic.

Methods

- ✓ Articles were obtained by utilizing the following databases: Pubmed, CINAHL, Google Scholar, and Medline.
- ✓ Search Terminology: (buprenorphine or naloxone or buprenorphine/naloxone), (drug use or opioid use disorder or opioid abuse) (relapse), (opioid replacement therapy).
- ✓ The study included RCT, Observational Studies, and Case Reports.
- ✓ The primary methodology of the proposed project was to administer an online PowerPoint educational module to providers that focuses on perioperative management of patients with OUD who take buprenorphine.
- ✓ The Educational Module included a pre- and post-test.

PICO Question

(P) For adult surgical patients on buprenorphine (I) does the use of an evidence based preoperative checklist (C) compared to no checklist (O) increase the CRNA's knowledge and confidence in understanding the challenges, pharmacokinetics and pharmacodynamics of managing a patient on buprenorphine?

Literature Review

Anderson et al

- Where moderate to severe pain is expected, cancel surgery until that buprenorphine is tapered off before surgery and then using opioids are used to replace it.
- A plan for follow-up and resumption of therapy should be established.
- Anesthetist patient's opioid requirements will be similar to an opioid-tolerant patient.
- Consider adjuncts NSAIDs, membrane stabilizers, entonox, local anesthetics, regional anesthetic techniques.

Lembke et al

- Continue buprenorphine in the perioperative period for patients taking 12 mg/d or less.
- Taper buprenorphine to 2 mg, 2-3 days before surgery.
- Multidisciplinary, regional techniques where possible.
- Higher than normal doses of opioids to treat pain for 2-4 days post-surgery.

Scholzen et al

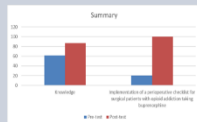
- In all patients on buprenorphine, discontinuing buprenorphine led to less a 50% worse in opioid use.
- Continue buprenorphine in the perioperative period.
- Minimize perioperative multimodal analgesic and regional anesthetic techniques after perioperative benefits.

Sen et al

- Utilize non-opioid adjuncts, regional anesthesia, and local anesthetic, anticholinergics to surgical when possible.
- Where low post-operative pain is expected, continue buprenorphine perioperatively without taper.
- Where intermediate pain is expected, discontinue buprenorphine 5 days prior to procedure, consider high dose PCA, and consider CI, anticholinergics for respiratory monitoring.
- Where high pain is expected, discontinue buprenorphine 3-5 days prior to procedure, consider pre- and post-operative to manage withdrawal, and consider CI for respiratory monitoring.

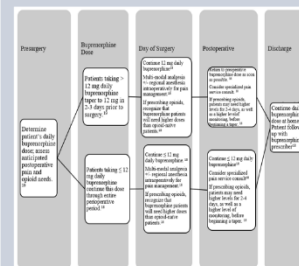
Results

- ✓ Continue buprenorphine in patients with OUD avoids that risk of relapse and unwarranted burden on the health care system and promotes safety, adherence, and continuity of care.
- ✓ Discontinuing buprenorphine before surgery in patients with opioid use disorder introduces unnecessary risk for four reasons:
 - ✓ Buprenorphine discontinuation introduces a surgical delay to allow adequate time to taper.
 - ✓ After surgery, re-introduction of buprenorphine would be physically painful and medically destabilizing for patients because the patient then undergoes an active period of opioid withdrawal.¹⁸
 - ✓ Re-starting buprenorphine puts the patient at risk for potentially discontinuance case.¹⁸
- ✓ Patients on buprenorphine for OUD are at increased risk of relapse to opioid misuse and accidental overdose when buprenorphine is discontinued.
- ✓ Lembke et al suggest that patients taking 12mg or less of buprenorphine daily maintain this dose unchanged, and patients on higher daily doses of buprenorphine (more than 12 mg) taper to 12mg two to three days before surgery. It is generally easier to go from 12 mg to 10 mg of buprenorphine than from 2 mg to 0 mg.



Overall, the results reflected an improvement in knowledge based on the pre- and post-test scores. Knowledge showed an average gain of (25%). In addition, the post-test demonstrated that participants are most likely (n=60%) or somewhat likely (n=20%) to implement a preoperative checklist for surgical patients with opioid addiction taking buprenorphine.

Recommendations for Practice Change



Conclusion

- ✓ Buprenorphine is a semisynthetic opioid agonist-antagonist used primarily to treat OUD.¹¹ Its pharmacokinetic and pharmacodynamic properties make it an attractive drug for this purpose.
 - ✓ high affinity for the mu and kappa receptors and very slow dissociation, giving it an extended duration of action and limiting the opioid "high" produced by a pure mu agonist methadone.
 - ✓ Ceiling effect at higher doses, reducing the abuse potential and minimizing respiratory depression.
 - ✓ Attenuates other opioid agonist effect, decreasing the euphoric and efficacy of concurrently administered opioids.
- ✓ There is no consensus of the management of buprenorphine, however, the recommendation is to continue buprenorphine during the perioperative period.
- ✓ The patient's outpatient buprenorphine provider should be engaged before surgery and as soon as is possible after discharge.⁹
- ✓ The perioperative physicians should engage the patient early to outline strategies, manage expectations about the perioperative course, and explain the importance of treatment retention.⁹

References

References available upon request:
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