Utilization of opioids for acute pain control during surgical procedures is commonplace for anesthesia providers. Opioid use is associated with many undesirable side effects, including opioid use disorder. Opioid-free anesthesia for surgical procedures using a multimodal approach can reduce these side effects. This quality improvement project evaluated the implementation of an opioid-free anesthesia protocol for elective abdominal surgical procedures in a community hospital. The project had specific aims of detecting a reduction in opioid consumption in the operating room and the first 30 minutes in the post anesthesia recovery unit (PACU) while confirming pain relief comparable to that seen with opioid analgesia. Implementation of the quality improvement protocol resulted in a 79% reduction in the number of patients who received opioids during surgery and provided pain relief through the first 30 minutes in PACU comparable to anesthesia that included opioids. This project confirmed that an opioid-free anesthesia protocol could be successfully implemented within a community hospital for healthy adults undergoing elective abdominal surgery.

**Keywords:** Anesthesiology, implementation of an anesthesia protocol, multimodal analgesia, opioid-free anesthesia, opioid reduction.

Opioids provide effective pain relief and are commonly used in the operating room as an adjunct to general anesthesia, but also are highly addictive substances and are abused as illegal recreational drugs. There has been a rise in opioid use disorders and deaths related to opioid abuse in the last decade with the sharpest increase recorded in 2017. According to the Centers for Disease Control and Prevention (CDC) 67,367 people died as a result of opioid overdose in the United States in 2018, an average of 180 deaths daily. Deaths from synthetic opioids like fentanyl rose 10% in 2018. This national crisis is estimated to cost over $78 billion dollars per year. Fighting the opioid epidemic is one of the top priorities for the Centers for Medicare & Medicaid Services.

There has been an increasing trend in patients with substance use disorder in New Hampshire over the past decade. The number of people with opioid use disorder in New Hampshire is almost double the national average. Some patients in our community hospital are requesting reduction or elimination of opioid use during the perioperative period in efforts to reduce the undesirable side effects from opioids and to reduce their risk for developing opioid use disorder.

The use of fentanyl during surgery can increase postoperative requirements for opioids. Thus, it is counterproductive to expose patients to a regimen that might inadvertently increase their requirements for opioids. Reducing the use of opioids in the operating room reduces the total amount of opioids consumed by the patient postoperatively. Reserving the use of opioids for severe acute pain that cannot be relieved by other methods in the operating room leads to less opioid consumption during the entire peri-operative period.

The purpose of this project was to evaluate a quality improvement project involving a multimodal opioid-free anesthesia protocol for healthy patients during elective, general abdominal surgery cases. Implementation of a standardized protocol that provides guidance on dosing and timing of medications also has been proven to reduce adverse events from medications.

**Literature Review**

The priority strategy to reduce the economic and emotional costs of the opioid crisis is to prevent opioid use disorder. Opioids are commonly used for pain control as part of an anesthesia regimen during surgical procedures. However, it is believed that even small amounts of opioids received by patients for analgesia during surgery can lead to subsequent patient addiction and misuse. Additionally, known side effects for opioids include nausea, vomiting, constipation, dizziness, somnolence, respiratory depression, and increased length of stay in the post-anesthesia care unit (PACU). A realistic place
to avoid utilization of opioids for pain control is during anesthesia as surgery is a stimulus for chronic opioid use. Avoiding opioids during surgery can reduce the likelihood a patient will misuse opioids after surgery. Finding appropriate alternative analgesics to be used intraoperatively is complex. Effectiveness, availability, ease of use, and low risk of side effects are all important characteristics to consider. Opioid-free analgesics include acetaminophen, gabapentin, ketamine, dexmedetomidine and magnesium, and when given as a multimodal plan can be effective at controlling pain during surgery.

Acetaminophen is a commonly used analgesic and anti-pyretic with mild anti-inflammatory effects. One dose of 1 gram is effective for acute pain with number needed to treat (NNT) reported at 3.6 (95% confidence interval (CI) 3.2-4.1). The mechanism of action is inhibition of prostaglandins. Acetaminophen has been shown to be an equally effective analgesic via the oral or intravenous route. Acetaminophen as a pre-operative analgesic is effective at reducing opioid use for adult patients undergoing laparoscopic hysterectomy. While nausea, rash, headache, hepatotoxicity are possible side effects, a total preoperative dose of 2 grams (g) has minimal incidence of side effects (number needed to harm [NNH] not applicable) while maintaining efficacy for pain relief.

Gabapentin is an oral agent structurally similar to gamma-Aminobutyric acid (GABA), an inhibitory neurotransmitter that reduces the excitability of neurons throughout the central and peripheral nervous systems. Gabapentin works at various binding sites of calcium channels in plasma membranes of presynaptic terminals of the dorsal root ganglion and dorsal horn neurons to inhibit transmission of nerve impulses to the brain. Another mechanism of action is the inhibition of glutamate, protein kinase-C and inflammatory cytokine release that contribute to pain. Gabapentin 1,200 milligrams (mg) by mouth pre-operatively for adults undergoing cardiac surgery reduces anxiety and attenuates blood pressure and heart rate. Doses as low as 600 mg given pre-operatively to adult women for abdominal hysterectomies can reduce opioid consumption, pain scores, nausea and vomiting. Dosages as low as 250 mg have been shown to be effective for acute pain (NNT 11, CI 95% 6.4-35) without serious side effects (NNH not applicable). Common side effects are dose related and include dizziness, somnolence, and confusion; headache, nausea, vomiting, and dry mouth.

Ketamine inhibits the N-methyl-D-aspartate (NMDA) receptor by blocking influx of glutamate and decreasing the excitability of neurons in the central nervous system. Intravenous (IV) ketamine is indicated by the Ketamine Guidelines Committee to reduce opioid consumption for patients undergoing lower abdominal surgery. Administration of 0.5 mg per kg before incision followed by 0.6 mg per kg per hour until emergence decreased opioid consumption up to 6 weeks postoperatively. Bolus doses delivered at the same total amount per hour as infusion rates were determined to be equally as effective. Dosage ranges are left to the discretion of the trained anesthesia provider. Ketamine is effective for acute pain with reported NNT of 3 at 5 minutes (95% CI 1.7-4.2) and 4 at 10 minutes (95% CI 2.0-6.2) (NNH=12, 95% CI 5.8-174.2). Schizophrenia is an absolute contraindication of ketamine. Ketamine can cause psychomimetic and dissociative side effects including hallucinations, delirium, and confusion. Other side effects include increased oral secretions, mild respiratory depression, and increased blood pressure and heart rate.

Dexmedetomidine is a selective alpha-2 adrenergic receptor agonist. Analgesic effects are caused by decreased central nervous system stimulation from decreased firing of nociceptive neurons. Dexmedetomidine also acts on the locus ceruleus in the brain which provides sedative effects without causing respiratory depression. Its use for anesthetized patients has shown additional benefits of cardiovascular stability, anxiolysis, and sympatholysis. Intraoperative IV dexmedetomidine is effective for acute pain (NNT=4) and has been shown to reduce opioid consumption and decrease pain scores postoperatively in adult patients undergoing laparoscopic cholecystectomies. The most common side effects of dexmedetomidine include initial hypertension followed by reflex bradycardia and hypotension, nausea and vomiting, and dry mouth. Dosages range widely and rely on judgment of the anesthesia provider. Recommended dosages include a loading dose of 0.89-2 µg per kg per hour, followed by an infusion of 0.2-0.7 µg per kg per hour.

Intravenous magnesium sulfate reduces central pain sensitization by antagonizing hippocampus NMDA calcium channel receptors responsible for aspartate and glutamate regulation. Magnesium sulfate IV 50 mg per kg has been shown to decrease opioid consumption in adult patients undergoing laparoscopic cholecystectomy. Reductions in opioid consumption for adult patients undergoing general, gynecologic and orthopedic surgeries have been seen at doses ranging between 1 to 23 grams total per patient via bolus, infusion, or a combination of both. Effectiveness for acute pain has been moderate (NNT=14). Side effects of magnesium sulfate include increased sedation, prolonged neuromuscular blockade, muscle weakness, electrocardiogram changes, and magnesium toxicity. Negative side effects can be reduced by discontinuation of infusion or reversed by 10% calcium gluconate IV.

There is synergy in combining these medications. For instance, a single oral dose each of acetaminophen and gabapentin have been found to reduce post-operative opioid consumption in adult women undergoing laparoscopic hysterectomies. Ketamine and magnesium administered intraoperatively for noncardiac surgery
Inclusion criteria for the dosage for each patient. In addition, ketamine and magnesium together provide pain control for adults undergoing surgical procedures as evident by reduced hemodynamic variability. A combination of ketamine, dexmedetomidine, and magnesium have been shown to be synergistic in opioid-free anesthesia protocols for adults in multiple types of surgical procedures including bariatric surgery, cardiac surgery, and laparoscopic hysterectomy.

Given the large body of strong evidence for the above agents, common practice is to combine the use of multiple agents to provide multimodal management of pain without the use of opioids during general and gynecologic abdominal surgeries. Key areas to be addressed during intraop management by the anesthesia provider are heart rate, non-invasive systolic and diastolic blood pressure, electrocardiogram, and respiratory rate if breathing spontaneously.

• **Aims.**

  1. Reduce the number of patients receiving opioids in the operating room and the first 30 minutes in the PACU by 75%, as compared to pre-implementation opioid-inclusive cases, for patients undergoing elective general and gynecologic abdominal surgery requiring general anesthesia.

  2. Provide comparable pain relief with opioid-free anesthesia as compared to similar surgical patients who received opioid anesthesia before implementing as seen in anesthesia chart reviews.

**Methods**

• **Setting.** This pre/post quality improvement project was conducted in the operating room suite at Concord Hospital, Concord, New Hampshire. Concord Hospital has 15 operating rooms and performs over 800 elective general abdominal procedures per year. Concord Hospital has an exclusive contract with a private anesthesia group. There are 19 Certified Registered Nurse Anesthetists and 19 physician anesthesiologists in the anesthesia group.

The quality improvement project was formally evaluated using a quality improvement checklist and determined not to be human subjects research by an internal review process at Duke University School of Nursing. IRB approval for the project was received from Concord Hospital.

• **Patient Population.** Inclusion criteria for the project included age 21 to 65, American Society of Anesthesiologist (ASA) I, II, or III, and scheduled for elective, general surgery abdominal cases requiring general anesthesia. Exclusion criteria included allergies to the medications in the protocol, body mass index (BMI) greater than 35, pregnancy, breastfeeding, elevated liver function tests (LFTs) or glomerular filtration rate (GFR) ≤60 milliliters per minute. Each anesthesia provider used their own clinical judgment for each case regarding the use of each medication and appropriate dosage for each patient.

Specific surgery types included laparoscopic cholecystectomy, laparoscopic appendectomy, laparoscopic hysterectomy, laparoscopic colectomy, laparoscopic umbilical hernia repair, operative laparoscopy, robotic-assisted hysterectomy, robotic-assisted laparoscopic pyeloplasty, robotic-assisted laparoscopic nephrectomy, robotic-assisted laparoscopic prostatectomy, robotic assisted laparoscopic ventral hernia repair, open inguinal hernia repair, open umbilical hernia repair, open hemicolecotomy, and open sigmoid resection. Case durations ranged from 79 to 368 minutes.

• **Implementation.** Implementation within the anesthesia department began with a brief presentation about the protocol at a routine departmental meeting. Supporting evidence for the protocol and the protocol itself were presented via a group email in which written copies of the protocol were provided. Staff and provider questions were answered by the project leader. Participation in the opioid-free protocol implementation was voluntary. It was made clear that at no time should opioid medications be withheld for the sake of the protocol. Project champions were identified as available via the operating room voice page system, text messaging, email, and face-to-face for questions and discussions regarding the protocol.

Written copies of the protocol were provided to the PACU staff, and questions were answered regarding the protocol and pain score evaluations required by the nurses in the PACU. Pre-implementation meetings were held with the pharmacy manager about potential shifts in medication utilization. An adequate supply of medications for the protocol was made available to the anesthesia providers and accommodations for charting of medications in the protocol were created within the electronic anesthesia records.

The medication regimen in the evidence-based protocol, as detailed in Figure 1, began with the option of preoperative medications of Tylenol 1000 mg PO and Gabapentin 300-900 mg PO. Intravenous ketamine at induction was suggested as a bolus of 0.5-1 mg per kg. The goal of intraoperative maintenance analgesia was to keep the patient's vital signs within 20% of baseline. Intraoperative medications included a dexmedetomidine infusion of 0.7-1.4 µg per kg per hour for the first hour of surgery. It was recommended to reduce this infusion to 0.2-0.7 µg per kg per hour during surgery, and then discontinue the dexmedetomidine infusion 30 minutes before emergence. Ketamine was included in the protocol as needed at 25-100 mg per hour via boluses or a continuous infusion. Magnesium 30-50 mg per kg infusion over 30 minutes was also included in the protocol at the discretion of the anesthesia providers.

No new equipment was required for implementation of this protocol. Medications included in the protocol were on formulary and were being utilized by the anesthesia providers.
• **Data Collection.** Data were obtained from the patients’ electronic health records (EHR); Cerner is the EHR used at Concord Hospital in the operating rooms and PACU. Anesthesia staff have access to both types of records under the privacy policy rules of Concord Hospital.

Each day the project leader checked the operating room schedule for the following day for patients who met the inclusion criteria. Anesthesia providers assigned to those patients were notified and providers were encouraged to utilize the protocol for those patients. Charts were reviewed to determine protocol use and whether or not opioids were received by the patients during surgery. Adverse events from the medication protocol were recorded.

Data retrieved from the anesthesia EHR included provider initials and assigned number, patient number, patient ASA score, patient age, patient gender, date of service, type of surgery, surgery case record number, surgeon, whether or not the protocol was followed, whether or not opioids were given, and the 30-minute PACU pain score at rest. Data were also retrieved from the anesthesia EHR from matching provider charts and similar cases 1-year prior. Data retrieved from these records included provider number, patient number, patient ASA score, patient age, patient gender, date of service, type of surgery, whether or not opioids were given during surgery, and the 30-minute PACU pain score at rest.

Providers who submitted case numbers to the project leader were considered participating providers. Pre-protocol cases were searched by matching similar cases of the provider from one year prior. The equivalent number of similar pre-protocol cases were obtained to match the number of cases within the protocol. For example, if an anesthesia provider performed five cases within the protocol project time, five separate similar cases from 1-year prior were used as pre-protocol data. No protected health information of the patient was included in the data or results.

• **Data Analysis.** A sample size estimate for a Fisher’s exact test was calculated using G*Power software. An a priori sample size estimate was conducted and determined that a sample size of 22 would be required for change in proportion from 85% to 15%, with power set to .90 and alphas set to .05. Statistical analysis was conducted using SPSS software version 26 (IBM Corp., Armonk, NY).

Data were entered into Microsoft Excel and imported into SPSS for statistical analysis and de-identified before entry. Descriptive statistics (Mean, SD or n, %) were presented for patient characteristics and outcome variables. ASA scores were collected for pre and post-implementation patients compared using a chi-square test to determine if patients were comparable regarding physical status. A Pearson Chi-Square test (asymptotic, 2-sided) was calculated to determine the difference between the pre-protocol and within-protocol case types. To determine whether opioid administration decreased with significance from pre to post, a Fisher’s exact test was conducted.

Results

The project was implemented from early January through mid-March 2020. Limitations included a short period of collection, provider participation, and small sample size.

Provider participation in the protocol was just above 50% for approximately 20% of eligible patients during the implementation time period. There was an initial learning curve for medication dosages and timing resulting in undesirable somnolence in recovery. This side effect was quickly resolved for subsequent patients as providers learned to reduce dosages and discontinue infusions earlier in the surgery. Verbal feedback from participants was positive.

• **Regarding Aim One.** A total of 48 patient records were reviewed for pre- and post-implementation (24

<table>
<thead>
<tr>
<th>Medications</th>
<th>Acetaminophen</th>
<th>Gabapentin</th>
<th>Ketamine</th>
<th>Dexmedetomidine</th>
<th>Magnesium</th>
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<tbody>
<tr>
<td>Preoperative</td>
<td>1,000 mg PO</td>
<td>300-900 mg PO</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Induction</td>
<td></td>
<td>0.5-1 mg/kg IV bolus</td>
<td>0.7-1.4µg/kg/hr IV initial infusion for first hour of surgery</td>
<td>Reduced to 0.2-0.7 µg/kg/hr IV during remainder of surgery</td>
<td>30-50mg/kg (max 3,000 mg) IV infusion over 30 min</td>
</tr>
<tr>
<td>Intraoperative maintenance</td>
<td>0.1-0.6 mg/kg/hr IV by infusion or comparable intermittent boluses</td>
<td></td>
<td>Discontinue 30 min prior to emergence</td>
<td>Initiate as close to incision as possible</td>
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</table>

Figure 1. Protocol
records pre and post). Table 1 presents the participant characteristics. The ASA characteristic collected at both timepoints with calculated chi-square results show no difference between groups in ASA category ($P = .421$). A Pearson Chi-Square test revealed no significant difference ($P = .284$) between the pre-protocol and within-protocol case types. Case types consisted of GYN, GU and General Surgery procedures. A total of 10 CRNA providers submitted data for this project. One provider treated 11 (45.8%) of the 24 patients and another provider treated 3 (12.5%) patients. All other providers submitted protocol data for 1 or 2 patients.

Opioid consumption in the operating room and the first 30 minutes in the PACU was reduced as compared to pre-implementation opioid-inclusive cases. A Fisher’s exact test showed a statistically significant reduction in opioid use from pre (n=22, 91.7%) to post (n=3, 12.5%), $P < .001$; effect size phi=.792 (Figure 2). The 79% reduction of patients receiving opioid medications exceeded the aim. The total amount of opioids given in terms of morphine equivalent doses (MED) in the pre-implementation group was 119.55 mg and 6.85 mg in the post-implementation group. This represents a reduction in opioid consumption of 94.27% MED.

Regarding Aim Two. The protocol was utilized in a total of 32 cases; however, eight cases were excluded from the data analysis due to patient age >65. Initial at rest PACU pain scores as measured by the numerical rating scale (NRS) were low, with 75% of patients at a 30-minute pain score of 0 (Figure 3). Only 1 patient in the post-implementation group had a pain score greater than 5 within the first 30-minutes of the patient’s PACU stay (Table 2). The range of at rest PACU pain scores was 0 to 8 for both pre-implementation and post-implementation groups. The mean scores were compared using an independent samples t-test with a Satterthwaite approximation for degrees of freedom due to unequal group variances (Levene’s homogeneity of variance test $P <.001$). The results (Figure 4) showed a statistically significant reduction in mean NRS pain scores from a pre-mean of 2.67 (SD=2.93) to a post- mean of 0.79 (SD= 1.72) ($P =.01$). The mean difference was 1.88 (95% CI = .48 to 3.27).

Results exceeded Aim Two of comparable pain relief received with the opioid-free anesthesia protocol. Statistical analysis revealed a statistically significant reduction in

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Pre-implementation n (%)</th>
<th>Post-implementation n (%)</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 (4.2)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>ASA 2</td>
<td>18 (75)</td>
<td>21 (87.5)</td>
<td>.421</td>
</tr>
<tr>
<td>3</td>
<td>5 (20.8)</td>
<td>3 (12.5)</td>
<td></td>
</tr>
<tr>
<td>&lt;21</td>
<td>1 (4.2)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>Age 21-65</td>
<td>17 (70.8)</td>
<td>24 (100)</td>
<td>.017</td>
</tr>
<tr>
<td>&gt;65</td>
<td>6 (25.0)</td>
<td>0 (0)</td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>15 (62.5)</td>
<td>12 (50)</td>
<td>.561</td>
</tr>
<tr>
<td>F</td>
<td>9 (37.5)</td>
<td>12 (50)</td>
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</tr>
</tbody>
</table>

Table 1. Frequency Table: Patient Characteristics$^a$

$^aP$ calculated by Pearson Chi Square test, 2-sided asymptotic significance.

Figure 2. Percentage of Patients Receiving Opioids Pre- and Post- Implementation of Protocol

Figure 3. At Rest PACU Pain Scores First 30-Minutes of Arrival as Recorded in Patient Charts Pre- and Post-Implementation$^a$

$^aNumeric Rating Scale (NRS) 0 to 10: 0=no pain; 10=worst pain.
pain for patients in the opioid-free protocol group.

**Discussion**

The use of opioids for effective analgesia during surgical procedures is long-standing for anesthesia providers. However, opioids have significant undesirable side effects, contribute to adverse perioperative events, and trigger postoperative opioid use disorder. Though anesthesia is just one portion of the total perioperative experience, contribution to overall reduction in opioid use during surgery is significant. Adequate pain control remains imperative, as a lack of acute pain control can lead to chronic pain and associated opioid use.\(^{38}\) There is currently no evidence supporting an ideal alternative to opioids for analgesia during anesthesia.\(^{39}\) However, multimodal analgesia regimens which eliminate or reduce opioids have been shown to provide equivalent pain control as opioid-focused regimens. Decreasing opioid-related adverse events while providing appropriate analgesia is a concern for anesthesia providers across the country.\(^{38}\)

Behavior change in health care providers can be difficult to accomplish. Negative attitudes and a perception of a lack of importance of recommended changes are common elements that highlight resistance to change in health care providers. Anxiety regarding patient safety can also contribute to health care provider resistance to change.\(^{25}\) In this project, providers who were contacted and personally encouraged to utilize the protocol were more likely to use the protocol. Personal communication and encouragement achieved a change in care and the desired outcome of opioid reduction.

Within the scope of this study, it was determined that a multimodal analgesia protocol with limited opioid use could adequately control pain for patients during surgery. This quality improvement project was an appropriate starting point to decrease overall opioid use in the perioperative period. The implementation of this project prompted questions beyond the scope of this study regarding reduction of total perioperative opioids and pain scores beyond the initial 30 minutes in PACU. Successful implementation of an opioid-free anesthesia protocol during surgery without any apparent increase in discomfort for the patients was a first step toward reducing overall perioperative opioid use.

A preoperative dose of gabapentin was one of the recommended medications in the protocol. After the completion of this project, a meta-analysis was published regarding the use of gabapentin for pain control during anesthesia. Results noted that gabapentin did not provide any significant improvement in acute postoperative pain as compared to placebo, with a small, although not statistically significant reduction in opioid use. Thus, the inclusion of gabapentin as part of an opioid-free anesthesia protocol may not provide additional benefit to patients.\(^{40}\)

For patients included in this project, we were able to reduce the number of patients who received opioids by 79.2%. Opioid medications received were reduced by 94.27% MED. Overall PACU pain scores were equivalent or

<table>
<thead>
<tr>
<th>Pain Score</th>
<th>Pre-implementation (N=24), n (%)</th>
<th>Post-implementation (N=24), n (%)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>12 (50)</td>
<td>18 (75)</td>
<td>0.044</td>
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<tr>
<td>1-4</td>
<td>4 (16.7)</td>
<td>4 (16.7)</td>
<td>1</td>
</tr>
<tr>
<td>5-8</td>
<td>8 (33.3)</td>
<td>2 (8.3)</td>
<td>0.033</td>
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**Table 2.** At Rest PACU Scores First 30 Minutes of Arrival\(^{8}\)

\(^{8}\)Numeric Rating Scale (NRS) 0 to 10: 0=no pain; 10= worst pain. P calculated by Pearson Chi Square test, 2-sided asymptotic significance.

**Figure 4.** Mean PACU Pain Scores at Rest for Pre- and Post-Implementation of Protocol\(^{8}\)

\(^{8}\)Numeric Rating Scale (NRS) 0 to 10: 0=no pain; 10= worst pain.
less for patients who received opioid-free anesthesia. Mean NRS PACU scores were reduced by 1.88 under the protocol.

The protocol was disseminated via email, as well as printed on cards providers could carry. The aim of reducing opioid utilization was stressed during discussions before and during implementation. Fidelity to the intervention was affected by a misunderstanding of what it meant to “adhere” to the protocol. Providers thought all medications had to be utilized in the recommended doses to participate in the protocol implementation, as opposed to individual provider clinical judgments for each patient. This highlights typical barriers to change seen in organizational health care culture. Providers who received personal communication and support were more likely to utilize the protocol.

Provider participation in this project was voluntary. Providers who were contacted by the project leader and encouraged to utilize the protocol for qualifying patients were more likely to utilize the protocol. In total, 10 of the 19 (~50%) CRNA providers utilized the protocol for approximately 20% of the patients who met the project criteria.

This project received strong support from Concord Hospital Medical Staff Affairs and the Concord Hospital Pharmacy staff. The anesthesia department was also encouraging. After several cases had been run utilizing the protocol, anesthesiologists and surgeons began requesting the opioid-free protocol.

PACU nurses commented on the noticeable reduction in the incidence of post-operative nausea in patients that received the opioid-free protocol. PACU nurses also commented that patients who received the protocol seemed to have a longer time to first arousal, but once awake, they stayed awake. This was compared to non-protocol patients who tended to wake up and go back to sleep multiple times before waking up satisfactorily for discharge. With exception of the first patients at the beginning of the protocol, the perception from PACU nurses and discharging physicians was that there was no difference in length of stay in PACU for pre-protocol versus within-protocol patients. Length of stay in the PACU was beyond the scope of this study.

The primary complication from the protocol was patient somnolence in PACU. This occurred early in implementation. After discussions with PACU nurses, anesthesiologists, and nurse anesthetists, it was determined that the somnolence was likely due to dexmedetomidine infusion dosages that were too high or discontinued too close to the end of the case. Providers were again reminded to use the protocol as a guide. Providers were reminded to use clinical judgment for dosing and timing of medications to provide pain relief without unintended post-op somnolence. Providers quickly learned to adjust dosages and timing of medications by communicating with the project leader and each other regarding dosages utilized. The side effect of post-op somnolence was quickly resolved.

**Conclusion**

This project demonstrated successful implementation of an opioid-free anesthesia protocol in a community hospital. The number of patients who received opioid medications in the operating room and the first 30 minutes of PACU were reduced by more than 75%. Opioid consumption was reduced by more than 94%. The protocol provided improved pain relief as compared to similar patients who received opioid anesthesia before implementing the protocol. The protocol was easy to develop within the existing formulary of the hospital and easy for anesthesia providers to follow.

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