Patient Controlled Analgesia (PCA) – Adult

**This medication guideline contains information specific to practice at Boston Medical Center (BMC), and is not intended for use as an inclusive drug information reference. For comprehensive drug information, please consult Micromedex®, a tertiary reference to which BMC subscribes.**

I. Definitions

PCA: A technique whereby patients self-administer opioid medications by using a pre-programmed syringe pump; the purpose of utilizing PCA is to provide a method of patient controlled delivery of an opioid which maintains optimal analgesia while minimizing sedation. Operation of PCA pumps by nursing staff or family members may cause excessive sedation of the patient by overriding the "patient controlled mechanism" therefore, these practices are prohibited.

Loading dose: The goal of a loading dose is to quickly bring the patient to a therapeutic analgesic blood concentration. Loading doses may be given:
1. As an initial dose
2. For persistent pain (i.e., during a break in PCA treatment)
3. Before a procedure
4. With an increase in opioid requirement

PCA bolus dose: Dose of opioid administered when patient activates pump during a “drug available” interval

Lockout interval: Period during which PCA cannot be activated; the number of minutes allowed between PCA doses: allows time for patient to realize full effect of the previous dose before receiving another dose, which is a minimum of six minutes for all agents available as PCA at BMC (e.g., morphine, hydromorphone, fentanyl and meperidine).

Continuous infusion rate (basal) dose: Low-dose continuous infusion of opioid used to maintain constant "background" level of analgesia. When prescribed, a continuous dose should be ordered with caution. Use of PCA with a continuous dose has been associated with a higher incidence of respiratory depression and excess sedation than PCA with no continuous dose. This is particularly important for opioid-naive patients.
1. In post-operative patients, continuous dosing is most effective for the first 0-48 hours
2. All patients may benefit from continuous dosing, especially those with higher opioid requirements (i.e., chronic pain conditions)

One hour limit: Pre-determined maximum drug amount that can be delivered during any one hour period (sum of continuous and PCA dose over one hour)
Patient-Controlled Analgesia (PCA) - Adult
BMC Medication Guideline

II. Patient Selection
The physician (or licensed prescriber) will select suitable patients; the following patient-specific factors should be present:
1. Requires post-operative or other acute pain
2. Mentally-alert and able to understand and comply with instructions/procedure
3. Able to push PCA button
4. Able to quantify pain
5. Understands the relationship between pushing the PCA button and medication delivery
6. Understands the safety mechanism of the machine
7. Able to report unsatisfactory pain relief
8. No history of allergy to selected opioid
9. Patients who are unable to meet the above criteria may be initiated on a PCA with an order for the Continuous dose ONLY. (In this scenario, PRN bolus doses must be ordered separately.)

III. Contraindications to use of PCA
1. Developmentally or cognitively inappropriate
2. Hypoxia not responsive to oxygen therapy except in end-of-life care
3. Hemodynamic instability

IV. Relative Contraindications
1. Previous issues with patient or family member tampering with PCA
2. Chronic use of sedatives except in end-of-life care

V. Criteria for discontinuation of PCA
1. Suspected or positive allergic reaction
2. Significant decrease in level of consciousness (i.e., difficult to arouse) except in end-of-life care
3. Infiltration of IV site (if the IV is not started within 30 minutes, the patient should receive another bolus dose)
4. Respiratory rate < 10 except in end-of-life care
5. Heart rate < 50 except in end-of-life care
6. Systolic BP 20-30 mmHg below baseline except in end-of-life care
7. Tampering of PCA pump by patient/family
8. Tolerating oral intake and pain can be managed with oral analgesia
9. Any evidence of hemodynamic instability except in end-of-life care
10. Inability to comply with monitoring requirements

VI. Ordering PCA
A. Drug selection

At Boston Medical Center, PCA for adult patients may be ordered for morphine, hydromorphone, fentanyl and meperidine.

PCA concentrations should be selected using the table below to minimize potential errors that may occur with frequent syringe changes. When a PCA is ordered, the pharmacist will be responsible for selecting the concentration.
Patient-Controlled Analgesia (PCA) - Adult
BMC Medication Guideline

Available PCA Concentrations:

<table>
<thead>
<tr>
<th>Opioid</th>
<th>Max 1 Hour Limit</th>
<th>Concentration to Select</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>&lt; 5mg/hr</td>
<td>1mg/ml (30mg/30ml)</td>
</tr>
<tr>
<td></td>
<td>&gt; 5 mg/hr but ≤ 25mg/hr</td>
<td>5mg/ml (150mg/30ml)</td>
</tr>
<tr>
<td></td>
<td>&gt; 25mg/hr</td>
<td>10mg/ml (300mg/30ml)</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>&lt; 1mg/hr</td>
<td>0.2mg/ml (6mg/30ml)</td>
</tr>
<tr>
<td></td>
<td>&gt; 1mg/hr but &lt; 5mg/hr</td>
<td>1mg/ml (30mg/30ml)</td>
</tr>
<tr>
<td></td>
<td>&gt; 5mg/hr</td>
<td>4mg/ml (120mg/30ml)</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>N/A; concentration standardized</td>
<td>50 mcg/ml (1500mcg/30ml)</td>
</tr>
<tr>
<td>Meperidine</td>
<td>N/A; concentration standardized</td>
<td>10mg/ml (300mg/30ml)</td>
</tr>
</tbody>
</table>

The specific agent selected from the list will depend on patient history, comorbidities, condition being treated, organ function and patient allergies. (See section VI G for Drug Allergies to Opioids, and/or Pain Management (Adult) Medication Guideline for additional information).

1. When to use fentanyl PCA
   - In patients with an allergy to non-synthetic opioids (e.g., morphine, hydromorphone)
   - In patients with chronic pain that requires fentanyl who experience acute exacerbations of pain when admitted to the hospital
   - Fentanyl is a synthetic opioid and is a safer alternative than meperidine
   - Fentanyl is dosed in terms of **micrograms (mcg)** whereas the other agents are dosed in terms of **milligrams (mg)**. Remember 10mg of IV morphine = 100mcg of IV fentanyl (See section VI F for Equianalgesic Dose Conversions).

2. When to use meperidine PCA
   - In patients with a history of unmanageable adverse reactions to or unsuccessful pain management with other opioid agents
   - In research protocols where meperidine is specified
   - Avoid use of meperidine in patients with significant renal insufficiency (estimated creatinine clearance < 30mL/min)
   - **Meperidine is not a preferred agent and should only be used in situations described above**

B. Writing the order – See Section I for definitions

Enter inpatient PCA orders via “Patient Controlled Analgesia (Adult)” order set. In the ED, utilize the PCA orders under Common Order Panel.

Physician/NP order for PCA must include:

1. Select agent: Morphine, Hydromorphone, Fentanyl or Meperidine
2. Select Indication: Sickle cell crisis, Opioid Naïve, or Opioid Tolerant
3. **Loading dose and maximum loading dose (optional):** If necessary, dosed in milligrams (mg) for morphine, hydromorphone, and meperidine. Dosed in micrograms (mcg) for fentanyl.
4. **PCA bolus dose:** Dosed in milligrams (mg) for morphine, hydromorphone, and meperidine. Dosed in micrograms (mcg) for fentanyl.
5. **Lockout interval:** Ordered in minutes (minimum of 6 minutes)
6. **Continuous infusion rate (basal) dose (optional):** If necessary, dosed in milligrams/hr (mg/hr) for morphine, hydromorphone, and meperidine. Dosed in micrograms/hr (mcg/hr) for fentanyl. There are two continuous infusion dose fields, one for hours 0700 to 2300 and the second for hours 2300 to 0700 so the prescriber can choose different amounts to be delivered during the two time periods if desired/warranted. If not using continuous infusion rate (basal) dose, a zero must be placed in the dose field.
7. **One hour limit:** To be manually calculated based on basal dose, PCA dose and lockout interval. The prescriber can choose a lower hourly limit if the clinical situation warrants.
8. **Patient Care Interventions:** Pre-checked to be ordered within the PCA order set and includes Pain scale, vital signs (HR, RR, BP, O2 sat), and level of pain and sedation

9. **Naloxone prn:** Must be ordered (See Section VII for Side Effects Management)

10. **Keep Vein Open (KVO) Order:** Patients receiving PCA should have a KVO order with a compatible solution at a standard KVO rate (typically 10, 15 or 20ml/hr).

C. **Use of supplemental opioids or CNS depressants while on PCA**
   1. Before starting PCA, all previous opioid medications should be discontinued unless the patient is on chronic long-acting opioid therapy.
   2. Oral opioids should not be given as a supplement to PCA. If a patient is not receiving adequate pain control on PCA, the continuous rate should be increased.
   3. Upon conversion from PCA to an oral opioid regimen, there may be a short interval in which a patient may receive an oral opioid regimen and the PCA dose. (Note: the continuous dose is discontinued one hour after oral regimen is started while a longer period of overlap is necessary for patients receiving very high opioid doses).
   4. While on PCA, use caution with supplemental CNS depressants (e.g., diazepam, lorazepam)

D. **Suggested guidelines for adult dosing:**

<table>
<thead>
<tr>
<th>Drug</th>
<th>PCA bolus dose</th>
<th>PCA dose range</th>
<th>Lockout interval (min)</th>
<th>Usual 1 hour limit</th>
<th>Suggested starting continuous infusion (basal) dose, if used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
<td>0.5-3mg</td>
<td>0.5-5mg</td>
<td>6-10</td>
<td>4-20mg</td>
<td>0-1mg/hr</td>
</tr>
<tr>
<td>Hydromorphone</td>
<td>0.1-0.5mg</td>
<td>0.1-0.3mg</td>
<td>6-10</td>
<td>1.2mg</td>
<td>0-0.2mg/hr</td>
</tr>
<tr>
<td>Fentanyl</td>
<td>10-30mcg</td>
<td>5-50mcg</td>
<td>6-10</td>
<td>50-200mcg</td>
<td>0-10mcg/hr</td>
</tr>
<tr>
<td>Meperidine</td>
<td>10-20mg</td>
<td>10-30mg</td>
<td>6-10</td>
<td>50-75mg</td>
<td>0-10mg/hr</td>
</tr>
</tbody>
</table>

*Some patients may have higher or lower requirements; if patient were previously on opioids, appropriate conversion(s) should be made (See section VI F for Equianalgesic Dose Conversions or the Pain Management – Adult Medication Guideline). In surgical patients, the need for a continuous infusion dose usually diminishes by 24-48 hours postoperatively. **PCA with a continuous infusion dose has been associated with a higher incidence of respiratory depression and excessive sedation, particularly in opiate-naive patients, compared to PCA with no continuous dose.**

E. **Suggested guideline for adult loading dose**
   1. A loading dose is not the same as the PCA bolus dose
   2. A loading dose is a separate order field as part of PCA order set and should be administered through the PCA pump
   3. A loading dose is optional (i.e., may not be necessary if a patient has received a dose of opioid shortly before starting PCA)

<table>
<thead>
<tr>
<th>Suggested Guideline for Adult Loading Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine</td>
</tr>
<tr>
<td>Hydromorphone</td>
</tr>
<tr>
<td>Fentanyl</td>
</tr>
<tr>
<td>Meperidine</td>
</tr>
</tbody>
</table>
Patient-Controlled Analgesia (PCA) - Adult  
BMC Medication Guideline

F. Equianalgesic Dose Conversions**

<table>
<thead>
<tr>
<th>Opioid Equianalgesic Dose Conversion Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opioid</td>
</tr>
<tr>
<td>-------------</td>
</tr>
<tr>
<td>Morphine</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Codeine</td>
</tr>
<tr>
<td>Hydromorphone</td>
</tr>
<tr>
<td>Meperidine*</td>
</tr>
<tr>
<td>Methadone</td>
</tr>
</tbody>
</table>

**For patients with Sickle Cell Disease, follow PCA dosing per Clinical Care Plan under FYI navigator if one has been developed for that patient

<table>
<thead>
<tr>
<th>Recommendations for Morphine to Fentanyl Patch Equivalency After Dose Reduction for Incomplete Cross Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morphine Dose (mg) 24-hr. PO dose</td>
</tr>
<tr>
<td>45</td>
</tr>
<tr>
<td>90</td>
</tr>
<tr>
<td>180</td>
</tr>
<tr>
<td>270</td>
</tr>
<tr>
<td>360</td>
</tr>
<tr>
<td>450</td>
</tr>
<tr>
<td>540</td>
</tr>
<tr>
<td>630</td>
</tr>
<tr>
<td>720</td>
</tr>
<tr>
<td>810</td>
</tr>
<tr>
<td>900</td>
</tr>
<tr>
<td>990</td>
</tr>
<tr>
<td>1080</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Opioid Sustained-Release Product Equivalencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxycodone CR 10 mg</td>
</tr>
</tbody>
</table>

G. Drug Allergies to Opioids

1. True allergies are rare.
2. Categories of Opioids: Each category is chemically distinct and therefore no cross-sensitivity exits between them. For example, if a patient has a true allergy and contraindication to oxycodone then the patient should not be prescribed any opioid in the morphine-like agonist class, but would be able to tolerate opioids in the meperidine and methadone-like agonist classes.

| Phenanthrenes: (Morphine-Like Agonists) | Morphine, codeine, hydrocodone, hydromorphone, levophanol, oxycodone |
| Phenylpiperidines: (Meperidine-Like Agonists) | Meperidine, fentanyl, alfentanil, sufentanil |
| Diphenylheptanes: (Methadone-Like Agonists) | Methadone, propoxyphene, diphenoxylate |
VII. Side Effect Management

A. Respiratory Depression
   1. In the event of severe somnolence, depressed or ineffective respiration, stimulate patient and administer oxygen, disconnect PCA pump and tubing and notify the primary service.
   2. If patient is apneic, unresponsive, or cyanotic, stimulate patient, assist ventilation as needed, disconnect pump and tubing, and FOLLOW CODE BLUE PROCEDURES. **Anticipate naloxone administration.**

**Naloxone Use in the Reversal of Opioids:** To be used for complete or partial reversal of opioids in suspected overdose or for diagnostic/therapeutic purposes.

**Naloxone Dosing Guideline:**
- Initially administer 0.1-0.2 mg IV
- Repeat doses of 0.4 to 2 mg every 2-3 minutes to a total dose of 10mg
- May be administered IM, subcutaneously, or via endotracheal tube if IV administration is not possible. If administering via endotracheal tube, dosing is two times the IV dose
- To maintain reversal effects, repeat doses may be used, or a continuous infusion may be used starting at 2/3rd of dose required to reverse effects. For titration, please the poison control center at 617-232-2120.

**Naloxone Pharmacokinetics:**
- Onset of reversal: within 2 minutes if given IV, longer if given subcutaneously or IM
- Peak effect: 6-10 minutes
- Half-life: 30-80 minutes
- Duration of action: 30-120 minutes
- Metabolism: hepatic

Precautions:
- Administer cautiously to patients who may have physical dependence to opioids.
- Reversal will unmask pain symptoms and may precipitate an acute withdrawal syndrome.

B. Pruritus
   1. See separate medication guideline Naloxone Continuous Infusion for use with PCA in Sickle Cell Patients

VIII: Patient Assessment and Documentation:

A. Monitoring*
   1. Patients receiving PCA should be monitored and documentation made on the eMAR as follows, with exception of patients receiving PCA for end-of-life care:
      - Vital signs: HR, RR, and BP initially every 15 minutes x 2 and with any dose change
      - Oxygen saturation: initially every 15 minutes X 2 and with any dose change
      - Pain level** initially, Q 4hr, and with any dose change
      - Sedation level*** initially and Q 2hr
      - Record total dose given Q 8hr

*Patient condition or clinical setting may warrant more frequent monitoring
**Pain Scale: 0-10 where 0 is no pain and 10 is the most pain.**

***Sedation Scoring***
- S1 = not sedated
- S2 = calm and cooperative
- S3 = drowsy/responds to verbal stimuli
- S4 = sleeping, easy to arouse
- S5 = difficult to arouse
- S6 = unable to arouse

2. Patients on PCA must be accompanied by a healthcare worker during transport to clinical areas. Decision of who will accompany patient is determined by patient’s physiologic stability.
3. Oxygen and BVM must be readily available
4. Naloxone must be readily available in the clinical area.
5. Patients receiving PCA for end-of-life care should have a baseline assessment of vital signs including HR, RR, BP, O2 sat, pain and sedation level. If patient has pain, pain assessment should be completed Q 15 minutes with each dose titration, until pain control is satisfactory.
6. MD must be notified if:
   - Respiratory compromise
   - Hemodynamic instability
   - Unsatisfactory analgesia
   - Excessive sedation/change in mental status

B. PCA Administration
1. Nurses caring for patients receiving PCA must demonstrate initial competency in the use of a BMC-approved PCA pump.
2. Initiation of PCA requires that 2 RN’s independently check the label on the syringe of medication against the actual order and check the programming of the pump at the bedside. Documentation is to be made on the eMAR/ED flow sheet.
3. Any dose change requires 2 RN’s independently check the new order against the label on the syringe of medication and check the programming of the pump at the bedside. Documentation is to be made on the eMAR/ED flow sheet.
4. Any syringe change requires 2 RN’s independently check the label on the syringe of medication being delivered against the actual order and check the programming of the pump at the bedside. Documentation is to be made on the eMAR/ED flow sheet.
5. At the change of shift, two RN’s independently check the label on the syringe of medication being delivered against the actual order and check the programming of the pump at the bedside. Documentation is to be made on the eMAR/ED flow sheet.
6. Nurses must document the total medication (in mg for morphine, hydromorphone or meperidine or in mcg for fentanyl) received in an 8 hour shift on the eMAR/ED flow sheet.

C. Maintenance of Controlled Substance Security
1. IV PCA will be infused using a lockable programmable pump
2. PCA pump keys will be secured in the same manner as controlled substances. If PCA key is lost, the nurse will contact the nurse manager (or charge nurse if nurse manager is not available) who will file a STARS report of the loss and sign out a new key from the pharmacy department.

References:

Responsibility: Nurses, physicians, pharmacists
Patient Controlled Analgesia (PCA) - Adult
BMC Medication Guideline

Forms: N/A

Other Related Guidelines or Policies: Pain Management Medication Guideline,
BMC Pharmacy Adult Palliative Care Guideline, Pain Crisis Management, Migraine
Pharmacotherapy Guideline,

Section: Pharmacy

Title: Patient Controlled Analgesia (PCA) – Adult

Initiated by: Originated From: Pharmacy/Heather Sorrick, PharmD

Yearly Review: Lisa Modelevsky, PharmD, Gail Sanchez, PharmD, and Radhika Sane,
PharmD 6/2014
Radhika Sane, PharmD 5/2016
Thuy Luu, PharmD 2/2017

Contributing Departments: Pharmacy