Medication Use Evaluation
Patient Controlled Analgesia in Total Knee / Total Hip Replacement
[Hospital X]
(12/20XX – 6/20XX)

Patient Controlled Analgesia (PCA) is one way that post-operative pain secondary to a Total Knee or Total Hip Arthroplasty (TKA, THA) is managed in the hospital. The three agents that are used at [Hospital X] for this purpose include the opioid analgesics morphine, hydromorphone, and fentanyl. Side effects of opioid analgesics include respiratory depression, sedation, constipation, nausea, vomiting, and itching (pruritis). Since opioids provide pain relief but are not benign drugs, the goal of this MUE was to determine if PCA use after a TKA or THA at [Hospital X] results in more morbidity.

Methods:

This was a retrospective chart review. Ninety (90) TKA patients and 90 THA patient charts were analyzed. The patients were chosen so that 45 patients in each group (TKA, THA) received PCA and 45 did not.

Indicators used in this evaluation included the following:

- Patient age, sex, weight, and attending physician
- Medication used in PCA (morphine, hydromorphone, or fentanyl)
- Morphine equivalents received via PCA
- Other opioid analgesics received (non-PCA)
- Morphine equivalents of other opioids received
- Total morphine equivalents of all opioids received to manage post-operative pain
- Name of peri-operative pain medication received (bupivacaine or ropivicaine)
- Name of adjuvant pain medication to manage post-operative pain
- History of chronic pain
- History of narcotic pain use prior to admission
- Pain relief (percentage of time patient reported no pain, mild pain, moderate pain, or severe pain)
- Episodes of over-sedation (naloxone administration utilized as surrogate marker)
- Nausea / Vomiting (ondansetron or promethazine administration utilized as surrogate marker)
- Constipation (Fleets® enema or lactulose administration utilized as surrogate marker)
- Length of stay in hospital

Assumptions Made:

- It was assumed that the dose delivered in the PCA was 1mL each time the patient pushed the button. Therefore if a patient received a total of 10 doses, then it was assumed they received 10mL of the opioid. This assumption may not have always been true, as there were several instances where doses and volumes did not add up. For example, if it was documented a patient received a total of 24 doses but the total cumulative volume delivered was documented as 23.4, this would represent a 0.6mL discrepancy. This may have been due to wasting or flushing that occurred by nursing that was not clearly indicated in the patient's chart. This would have resulted in the patient receiving slightly less dose of the opioid. Since cumulative volumes were determined to be unreliable for additional reasons (did not always represent a 24hr time period due to inter-nurse variability with documentation), total doses received were collected for this MUE instead. Therefore, it is possible that the morphine equivalents calculated for PCA patients may be an overestimate of what they actually received.
- The concentrations of PCA medications used at Rex for PCA are listed below. These are standard PCA doses recommended by the manufacturer, as documented in Lexi-Comp.
    - Morphine: 1mg/mL
    - Hydromorphone: 0.2mg/mL
    - Fentanyl: 10mcg/mL (or 0.01mg/mL)
- Morphine equivalent conversions can sometimes vary between sources. Opioids were converted to mg IV morphine based on the following equi-analgesic doses:

Opioid	***PO (mg)***	***IV (mg)***	***Transdermal***
Morphine	30	10	---
Hydromorphone	7.5	1.5	---
Fentanyl	---	0.15	1mcg/hr of patch approx. = 2mg PO morphine/day

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- Administration of naloxone (Narcan®) was used as a surrogate marker for over-sedation. However, there were likely more patients who experienced over-sedation than only the ones who received Narcan® (which were very few).
- Administration of ondansetron or promethazine was used as a surrogate marker for nausea. Unfortunately, nausea and vomiting are most often treated as a composite in patient charts (not listed out separately). Therefore, they are treated as a composite in this analysis as well.
- Constipation was assumed only if the patient received lactulose or Fleets® enema because the order set for a TKA or THA had other common medications listed to be given as both scheduled AND PRN (bisacodyl, senna-docusate). There was no way to determine when bisacodyl or senna-docusate was given PRN (indicative of constipation) versus when it was given scheduled.

Analysis:

- Females are slightly more represented in this sample than males. However, slightly more males received PCA and slightly more females did not receive PCA.
- Median age for the entire sample was approximately 65yo; this was consistent between groups. However, there were some younger patients in the non-PCA group, which widened the range.
- Mean weight was slightly lower in the non-PCA group.
- [Physician M] was the attending physician with the most representation in this sample of patients, followed by [Physician E], [Physician N], and [Physician G].
    - [Physician A] did not utilize PCA in his patients at all
    - [Physician E] utilized PCA for most of his patients
    - [Physician N] utilized PCA exclusively
    - [Physician G] utilized PCA in only one (1) of his patients
- There was only one patient in this sample who carried a diagnosis of chronic pain; this patient was in the non-PCA group.
- Only a very small percentage of patients in this sample were on home narcotic pain medications prior to admission; most of these were in the PCA group.
- Of those that were on home narcotic pain medications prior to admission, the medication most frequently utilized was oxycodone. Patients receiving oxycodone prior to admission were approximately evenly distributed between PCA and non-PCA.
- Only about 30% of those who were on a home narcotic prior to admission had it continued during their stay to help manage their pain.
- The most common agent utilized when PCA was administered was morphine. Hydromorphone was only utilized approximately 20% of the time. Fentanyl was not used at all.
- With regard to opioid received via non-PCA route, the bulk of these patients were in the non-PCA group (as one might expect). Hydromorphone, followed by morphine, were the most common agents utilized.
- Morphine equivalents received via PCA averaged at approximately 30mg, with a range of 4-92mg.
- Morphine equivalents received via the non-PCA route were higher in the non-PCA group (again, as one might expect).
- Total morphine equivalents received via any route was higher in the PCA group, by approximately 24 mg.
- The majority of patients received a peri-operative analgesic, and most all patients who received one received bupivicaine. Nearly all patients in the non-PCA group received a perio-operative analgesic, but the same is not true for the PCA group. A higher percentage of patients in the non-PCA group received a peri-operative analgesic when compared with the PCA group. Only 2 patients received ropivicaine and both of these patients were in the PCA group.
- Most patients received an adjuvant pain medication. The most common adjuvant pain medication administered was celecoxib, followed by acetaminophen. Pregabalin and tramadol were also fairly common.
- Pain relief scores did not differ greatly amongst the PCA and non-PCA groups. Each group's average is fairly close to the total average. Patients in the non-PCA group may have had less time with zero pain and greater amount of time with mild or moderate pain, but may have actually had less time with severe pain compared to the PCA group.
- There were only two episodes of over-sedation according to our surrogate marker for naloxone use. The episodes were evenly divided amongst PCA and non-PCA groups (1 in each group).
- Nausea and vomiting appears to be similar between the two groups, as well as constipation. There are small differences; without running statistical tests it is hard to say whether or not the differences are significant or not.
- Length of stay in the hospital averaged approximately 70 hours for the entire sample. The mean was slightly less in the non-PCA group, but only by about 1.5 hours. This difference is probably not significant, but it is hard to say without running statistical tests.

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Indicator	**Entire Sample (%)** ***Percentages rounded to the nearest tenth***	**PCA Patients Only (%)** ***% in terms of total PCA patients (not entire sample, unless specified)*** ***Percentages rounded to the nearest tenth***	**Non-PCA Patients Only (%)** ***% in terms of total non-PCA patients (not entire sample, unless specified)*** ***Percentages rounded to the nearest tenth***
Total Number of Patients	181	91	90
Male	85 (47.0)	46 (50.5)	39 (43.3)
Female	96 (53.0)	45 (49.5)	51 (56.7)
THA	90 (49.8)	46 (50.5)	44 (48.9)
TKA	91 (50.3)	45 (49.5)	46 (51.1)
Age (years)	Mean: 64.8 Median: 65 Mode: 57 Range: 22-93	Mean: 64.4 Median: 65 Mode: 67 Range: 40-93	Mean: 65.2 Median: 65 Mode: 66 Range: 22-89
Weight (kg)	Mean: 92 Median: 90.9 Mode: 83.7 Range: 42-182	Mean: 97.6 Median: 94.9 Mode: 83.7 Range: 42-182	Mean: 86.8 Median: 86.8 Mode: 90.3 Range: 52-138
Attending Physician			
Physician A	3 (1.7)	1 (1.1)	2 (2.2)
Physician B	1 (0.6)	1 (1.1)	0
Physician C	2 (1.1)	2 (2.2)	0
Physician D	2 (1.1)	0	2 (2.2)
Physician E	52 (28.7)	40 (44.0)	12 (13.3)
Physician F	1 (0.6)	1 (1.1)	0
Physician G	18 (9.9)	1 (1.1)	17 (18.9)
Physician H	7 (3.4)	7 (8.0)	0
Physician I	1 (0.6)	1 (1.1)	0
Physician J	3 (1.7)	0	3 (3.3)
Physician K	1 (0.6)	1 (1.1)	0
Physician L	1 (0.6)	1 (1.1)	0
Physician M	54 (29.8)	0	54 (60.0)
Physician N	35 (19.3)	35 (38.5)	0
Percentage of Attending Physician's Total Patients			
Physician A	---	(33.3)	(66.7)
Physician B	---	(100)	(0)
Physician C	---	(100)	(0)
Physician D	---	(0)	(100)
Physician E	---	(76.9)	(23.1)
Physician F	---	(100)	(0)
Physician G	---	(5.6)	(94.4)
Physician H	---	(100)	(0)
Physician I	---	(100)	(0)
Physician J	---	(0)	(100)
Physician K	---	(100)	(0)
Physician L	---	(100)	(0)
Physician M	---	(0)	(100)
Physician N	---	(100)	(0)
History of chronic pain			
History of chronic pain	1 (0.6)	0	1 (1.1)
History of chronic pain – percentage of all those who had chronic pain	---	(0)	(100)
Any History of narcotic pain medication use prior to admission			

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History of narcotic pain medication use prior to admission	16 (8.8)	11 (12.1) (68.8% of all those who recv'd narcotics prior to admission)	5 (5.6) (31.2% of all those who recv'd narcotics prior to admission)
Type of home narcotic used prior to admission			
None	165 (91.2)	80 (87.9)	85 (94.4)
Codeine	0	0	0
Fentanyl	1 (0.6)	1 (1.1)	0
Hydrocodone	1 (0.6)	1 (1.1)	0
Hydromorphone	3 (1.7)	3 (3.3)	0
Meperidine	0	0	0
Methadone	0	0	0
Morphine	2 (1.1)	1 (1.1)	1 (1.1)
Oxycodone	5 (2.8)	2 (2.2)	3 (3.3)
Oxycodone + APAP	5 (2.8)	3 (3.3)	2 (2.2)
Oxymorphone	0	0	0
Tapentadol	0	0	0
Tramadol	0	0	0
Buprenorphine	0	0	0
Butorphanol	0	0	0
Home narcotic continued on admission	5 (2.8) (31.3% of all those who were using a home narcotic at the time of admission)	4 (4.4) (80% of all those who were using a home narcotic at the time of admission)	1 (1.1) (20% of all those who were using a home narcotic at the time of admission)
Opioid used in PCA			
Fentanyl	---	0	n/a
Hydromorphone	---	18 (19.8)	n/a
Morphine	---	70 (76.9)	n/a
Morphine switched to hydromorphone	---	3 (3.3)	
Opioid used non-PCA			
Received an opioid via non-PCA	80 (44.2)	24 (26.4)	56 (62.2)
None	101 (55.8)	67 (73.6)	34 (37.8)
Fentanyl	2 (1.1)	2 (2.2)	0
Hydrocodone			
Hydrocodone-APAP	11 (6.1)	8 (8.8)	3 (3.3)
Hydromorphone	49 (27.1)	11 (12.1)	38 (42.2)
Morphine	27 (14.9)	4 (4.4)	23 (25.6)
Oxycodone	17 (9.4)	7 (7.7)	10 (11.1)
Oxycodone-APAP	3 (1.7)	0	3 (3.3)
Tapentadol	1 (0.6)	1 (1.1)	0
Morphine Equivalents			
Morphine Equivalents (PCA), mg	n/a	Mean: 30.0 Median: 22.4 Mode: 19 Range: 4-92	n/a
Morphine Equivalents (non-PCA), mg	Mean: 8.2 Range: 0-258.7	Mean: 5.8 Range: 0-153.3	Mean: 10.6 Range: 0-258.7
Total Morphine Equivalents (grand total, PCA + non-PCA), mg	Mean: 22.8 Median: 11.0 Range: 0-258.7	Mean: 34.8 Median: 22.7 Mode: 19 Range: 0-240.0	

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Indicator	Entire Sample (%) *Percentages rounded to the nearest tenth*	PCA Patients Only (%) *% in terms of total PCA patients (not entire sample, unless specified)* *Percentages rounded to the nearest tenth*	Non-PCA Patients Only (%) *% in terms of total non-PCA patients (not entire sample, unless specified)* *Percentages rounded to the nearest tenth*
Percent of total morphine equivalents received via PCA, %	Mean: 45.5 Range: 0-100	Mean: 90.5 Range: 0-100	n/a
Percent of total morphine equivalents received via non-PCA, %	Mean: 30.2 Range: 0-100	Mean: 6.2	(100)
Peri-operative pain medication received			
Received a peri-operative pain medication	153 (84.5)	66 (72.5)	87 (96.7)
None	28 (15.5)	25 (27.4)	3 (3.3)
Bupivicaine	151 (83.4)	64 (70.3)	87 (96.7)
Ropivicaine	2 (1.1)	2 (2.2)	0
Adjuvant pain medications received in hospital			
None	18 (9.9)	9 (9.9)	9 (10)
All patients who received at least one adjuvant	163 (90.1)	82 (90.1)	81 (90)
Acetaminophen (APAP)	91 (50.3) (55.8% of all those who recv'd adjuvants)		
Gabapentin	17 (9.4) (10.4% of all those who recv'd adjuvants)		
Pregabalin	45 (24.9) (27.6% of all those who recv'd adjuvants)		
Celecoxib	113 (62.4) (69.3% of all those who recv'd adjuvants)		
Ketorolac	5 (2.8) (3.1% of all those who recv'd adjuvants)		
Tramadol	43 (23.8) (26.3% of all those who recv'd adjuvants)		
TCA	0		
Pain Relief			
% of time patients had zero pain	Mean: 11.7	Mean: 12.8	Mean: 10.7
% of time patients had mild pain	Mean: 47.1	Mean: 46.1	Mean: 48.1
% of time patients had moderate	Mean: 24.4	Mean: 23.4	Mean: 25.4
% of time patients had severe pain	Mean: 16.8	Mean: 17.9	Mean: 15.8
Other Clinical Indicators			
Episodes of over-sedation	2 (1.1)	1 (1.1)	1 (1.1)
Nausea / Vomiting	75 (41.4)	37 (40.7)	38 (42.2)
Constipation	27 (15.0)	12 (13.2)	15 (16.7)
Length of Stay in Hospital, hours	Mean: 69.3 Median: 74.8 Mode: 54 Range: 31-144	Mean: 70.2 Median: 75 Mode: 78 Range: 31-144	Mean: 68.5 Median: 73.7 Mode: 55 Range: 32-123

THA, total hip arthroplasty; TKA, total knee arthroplasty

Problem areas, potential problem areas, or opportunities to improve patient care identified:

- Overall, indicators for morbidity (pain relief, over-sedation, constipation, and length of stay) were numerically comparable between the PCA and non-PCA groups. Several other factors, such as time to mobility, could not be addressed due to limitations in how data was recorded pre-EPIC. Episodes of constipation are most likely underestimated due to incomplete documentation.

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- Only approximately 30% of patients who were on home narcotic pain medications prior to admission had their medications continued. It may be useful to look into why this is the case. Continuing these pain medications may help with continuity of care and better management of pain overall in these patients.

Conclusions and Recommendations:

- One hundred eighty-one (N = 181) patients were analyzed in this retrospective chart review, equally divided amongst those who received PCA and those who did not receive PCA s/p THA or TKA.
- Looking more closely in Cerner for missing and incomplete information may make this analysis more complete.
- Since clinical indicators were numerically comparable between the two groups, no recommendations can be made at this time.

Limitations of this chart review:

The data obtained for this chart review occurred during a transition from Cerner to EPIC. As a result, documentation was not always clear or consistent; best guesses were made as needed, which may limit the reliability of this analysis. Preparers of this MUE only had access to EPIC and information pulled into a spreadsheet from Cerner, but did not have direct access to Cerner to verify questions as they arose. Due to these barriers, there were various limitations:

- Medications prior to admission (adjuvants used PTA) could not be obtained.
- Doses of hydrocodone-APAP, oxycodone, oxycodone-APAP, and tapentadol received via non-PCA in hospital to help manage post-operative pain could not be obtained. Due to this, morphine equivalents calculated for opioids received via non-PCA will be an underestimate because these medications could not be converted without doses received. Total morphine equivalents calculated will also be an underestimate.
- Epidural use for post-operative pain could not be obtained.
- Route of non-PCA meds administered were not always indicated. For example, hydromorphone was sometimes listed as 2mg dose, but it was unclear whether this was given PO or IV – it comes as both; this will affect morphine equivalents calculated.
- Time to mobility was not clear from EPIC nursing notes. Morse Fall Risk notes were analyzed for this information but were often not consistent so this practice was abandoned. Length of stay was chosen as the alternative marker because it was readily obtainable and reliable.
- Incidence of constipation was likely higher than what the surrogate marker indicated (surrogate marker was use of lactulose or Fleets® enema). Nursing notes in EPIC were not clear and MAR in EPIC did not indicate when medications were given as scheduled (according to order set) or as PRN.
- Vomiting was not clearly documented in nursing notes and often combined together with nausea so there was no way to separate it out as an independent indicator of morbidity.
- Because these patients are individuals who are undergoing a knee or hip replacement, it is likely that many more of them were dealing with chronic pain than was indicated in the patient chart as a chronic pain diagnosis.
- Time limitations prevented full analysis of adjuvant pain medication use in the PCA and non-PCA groups. The data has been collected, but the numbers were not calculated as of yet. No comparison could be made as a result.

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